ABSTRACTS

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Plenary Sessions (Abstracts 1 to 22)

001	Plenary Session 1 – Factors determining the success/failure of an implant-based rehabilitation

Host related factors: Bone healing

John Davies
University of Toronto, Toronto, Ontario, Canada

Peri-implant bone healing recapitulates fracture healing with the interface created between bone and the implant surface occupied by a collagen-free cement line. This interfacial matrix has been conserved throughout evolution and provides a stable interfacial bond. While many implant surfaces are osteoconductive, only the so-called ''bioactive'' materials are bone-bonding. These two phenomena have been shown to be predominantly effected through substrate surface topography. Examples will be provided of materials which are of the requisite topography but outside the range of traditional bioactive materials surfaces.

002	Plenary Session 1 – Factors determining the success/failure of an implant-based rehabilitation

Pathogenesis of peri-implantitis. Influence of susceptibility to periodontitis and implant surface roughness

Tord Berglundh
Göteburg University, Göteborg, Sweden

Biological complications at implants refer to processes that compromise hard and soft tissue integration to implants during function. Continuous loss of supporting bone around implants in radiographs and findings on clinical signs of inflammation, i.e. bleeding on probing and/or suppuration in the soft tissues surrounding implants, are not acceptable. Peri-implantitis is a diagnosis, which is associated with tissue destruction and corresponds to periodontitis at teeth. In the presentation new data from clinical and experimental studies will be presented. Detailed characteristics of peri-implantitis lesions will be demonstrated and factors related to the risk for peri-implantitis, such as implant surface modifications and periodontitis susceptibility within the subject, will be outlined.

003	Plenary Session 1 – Factors determining the success/failure of an implant-based rehabilitation

Implant related factors: surfaces and design

Steven Eckert
Mayo Clinic, Rochester, USA

When osseointegration was initially described the implants that were used were made of commercially pure titanium and were machined into the shape of a threaded screw. The machining process left a surface with small irregularities. With time a number of modifications have been made to the implant surfaces. Today the vast majority of implants have micro textured surfaces. The new surfaces are said to recruit bone forming cells earlier and in a more robust manner. The implications of this biologic response towards the long-term performance of implants are rarely discussed. This presentation will discuss the clinical performance of implants with different surface characteristics.

004	Plenary Session 1 – Factors determining the success/failure of an implant-based rehabilitation

Clinician related factors: the human risk factor

Ross Bryant
University of British Columbia, Vancouver, Canada

The human risk factor as it pertains to oral implant outcomes has been described variously as the 'training', 'skill' or 'experience' of clinician, provider, or operator, or as the so-called 'learning curve' effect. A substantial period of risk for implant failure occurs during the healing phase, and so may relate to aspects of surgical decision-making and operator skill during the placement and healing of oral implants. Similarly, prosthetic loading is noted to be of substantial importance to outcomes, although the proportion of osseointegration failures prior to prosthetic loading has tended to predominate over failures after loading, even when many years of follow up have been reported. From the outset of the recent scientific era of osseointegration, studies have reported an improved implant survival from early or developmental periods through experienced or routine periods. Improved experience may include various aspects, for example, improved patient selection, and implant placement with less surgical trauma or with better axial inclination relative to anticipated loading. More recent proposals suggest that implant therapy should optimally be possible for operators with a range of skills and experience. However, published evidence suggests predominantly that oral implant survival does vary with operator experience, particularly surgical experience, although the reasons for such variation are not clear.

005	Plenary Session 2- Implant supported prostheses: new challenges

Abutment characteristics influencing the result of the rehabilitation

Irena Sailer
Zürich, Switzerland

Nowadays, several kinds of implant abutments are offered by the implant manufacturers. On the one hand, a choice has to be made

between standardized and customized abutments. On the other hand, different abutment materials like titanium or various high strength ceramics (alumina, zirconia) are available. Clinical studies reporting on single-implant crowns on ceramic abutments are showing comparable clinical results like the ones achieved with titanium abutments, even when they are applied in molar regions.

Encouraged by the good clinical results of ceramic abutments, modern trends even go farther with the development of one-piece zirconia implants. From a biological standpoint this ceramic may be a valid alternative to titanium. Studies of the orthopedic use proved zirconia to be a material with good biocompatibility. Still, the prosthodontic part of the reconstruction of one-piece implants remains critical, since these implants have to be ground in the patient's mouth. This may cause surface roughness and subsequently reduce the stability of the ceramic by inducing microcracks. Furthermore, the reaction of the soft-tissue seal to polished or ground zirconia still remains to be examined. Therefore, more studies of zirconia for this indication are necessary in future.

006	Plenary Session 2- Implant supported prostheses: new challenges

Is the occlusion a determining factor for the implant success?

Ignace Naert
University of Leuven, Leuven, Belgium

Unlike natural teeth, implants react biomechanically different to occlusal forces, due to the absence of a periodontal ligament. It is therefore not unlogical to believe that implants may be prone to occlusal overloading and eventually leading to marginal bone loss and/or implant failure. Large cantilevers, parofunctions, improper occlusal design, etc. may provoke such an overloading and forces acting onto implants may surpass the physiological limits. The purposes of this contribution are to discuss the influence of occlusal factors on the implant longevity and to set clinical guidelines of an implant-based occlusion. Today, there is no evidence-based literature for one implant-specific concept of occlusion whatsoever.

007	Plenary Session 2- Implant supported prostheses: new challenges

The outcome of fixed prostheses on implant versus teeth: A systemic review

Giovanni Salvi
University of Berne, Berne, Switzerland

In partially edentulous subjects, teeth may be treated and used as abutments for fixed dental prostheses (FDPs). Alternatively, such patients may be rehabilitated by means of fixed implant- or tooth/implant-supported reconstructions including single-unit crowns.

Outcomes from systematic reviews have provided evidence on the long-term survival and success rates of tooth-supported FDPs with or without the use of cantilever units. Results from a recent systematic review have shown that FDPs incorporated on severely periodontally compromised abutment teeth compared favourably with those of FDPs incorporated in subjects without severely periodontally compromised dentitions. In comparison, other systematic reviews have reported on survival rates as well as on long-term biological and technical complications of implant- or tooth/implant-supported FDPs including implant-supported single-unit crowns.

The aim of this presentation is to provide a comparative analysis of survival rates and of biological and technical risks versus benefits in the treatment planning of partially edentulous subjects by means of fixed prostheses on implants or natural abutment teeth.

008	Plenary Session 2- Implant supported prostheses: new challenges

Cadcam: is this a challenge for the future prosthodontist or for the patient?

Lyndon Cooper
University of North Carolina, Schl of Dentistry, Chapel Hill, USA

The ultimate promise of new imaging and manufacturing technology in dentistry is improved patient care. Perhaps the greatest improvement offered by CAD CAM technology is the resultant merging of treatment planning and therapy. Imaging systems permit dentistry to move planning into the computer environment. Therapy using computer-based rapid prototyping methods for computer guided surgery or prosthesis design and manufacture can be linked to these planning images. This enforced merging of treatment planning and prosthesis manufacture further enforces the communication of the entire clinical team. Digital platforms allow this communication to occur in a common language and in a virtual environment that is visually accessible to the therapy team as well as the patient. Despite the enormous promise of CAD/CAM, this technology will not directly alter patient demographics, the underlying diseases we encounter or the clinical scenarios that we address. This presentation will investigate how a digital dentistry future may alter the therapeutic approaches of the prosthodontist and the expectations of the patient.

009	Plenary Session 3 – Adjunctive surgical techniques

Surgical techniques in compromised bone quality

Carl-Johan Ivanoff
SU/Mölndal Hospital, Mölndal, Sweden

Dental implant treatment is a clinical established treatment modality with very good prognosis. However, advanced jaw resorption (type D or E) as well as poor bone quality (type 4) has been associated with implant failures. There is, however also evidence available that acceptable levels of implant success can be achieved in such conditions. Host and implant characteristics together with surgical technique properties are three parameters that can mainly influence the clinical results when using osseointegrated implants for prosthetic reconstruction of edentulism. Implant and surgical

considerations will be discussed in the treatment of compromised bone sites.

010	Plenary Session 3 – Adjunctive surgical techniques

Reconstructive surgery as a rescue procedure in implant rehabilitations

Stefan Lundgren
Avd för Käkkirurgi, Umeå, Sweden

Maxillofacial reconstruction with iliac crest bone grafts in the atrophic maxilla and reconstruction with intraoral bone grafts in the partially dentate patients prior to implant treatment will be reviewed. Bone reformation with vertical distraction osteogenesis in the posttraumatic patient and in combination with onlay bone grafting in the atrophic edentulous situation will be presented. The clinical as well as experimental results from a new surgical technique for rehabilitation of the posterior maxilla with reformation of bone with sinus membrane elevation without the use of any graft material will be presented.

011	Plenary Session 3 – Adjunctive surgical techniques

The correction and avoidance of esthetic disfigurements on implants resulting from trauma, dental disease or previous implant therapy

Burton Langer
New York, USA

There has been a steady progression of surgical and restorative modifications, which have improved the final cosmetic results for patients seeking implant therapy. These changes are a combination of improvements that have developed from the soft tissue treatment of teeth with esthetic defects to the enhancement of techniques of bone regeneration.

The presentation will illustrate the array of soft and hard tissue surgical procedures which may avoid the esthetic disfigurements, which often arise from dental disease and trauma. The essential treatment sequence will be presented which is often crucial to the final outcome. Unfortunately, many of the cases, which have had implants placed, result in esthetic nightmares. Reversal of these unsightly results to a favorable outcome will be highlighted.

In concert with these regenerative techniques, there are many interceptive steps that can be undertaken by the restorative and surgical colleagues that may preclude the need for these surgical procedures and thereby simplify the treatment for the patient.

012	Plenary Session 3 – Adjunctive surgical techniques

Systematic review of preprosthetic surgery: grafting vs osteotomy?

Emeka Nkenke
Klinik Und Poliklinik Für Mkg-Chirurgie, Erlangen, Germany

Loss of teeth leads to atrophy of the alveolar ridges. Sometimes the relation between maxilla and mandible is compromised. The anterior aspect of the maxilla moves more and more posteriorly, while the anterior aspect of the mandible seems to come in an even more pronounced anterior position. In order to achieve a correct occlusion between mandible and maxilla either augmentation procedures have to be carried out or the maxilla has to be advanced after a LeFort I osteotomy or the mandible has to be set back after a bilateral sagital split osteotomy.

Today, most of the cases can be solved by augmentation procedures that allow to overcome the discrepancies in position of maxilla and mandible. However, in cases of severe discrepancies osteotomies for advancement of the maxilla or setback of the mandible cannot be avoided. This kind of surgery will always be accompanied by conventional augmentation procedures because of the advanced state of atrophy.

013	Plenary Session 5 – Interdisciplinary management of implants in the aesthetic zone: data on strategy, systematic, outcome and complications

Laura Frost, Tidu Mankoo
Dorset House, Windsor, United Kingdom

This presentation will outline the contemporary surgical and prosthetic concepts in management of implants in the aesthetic zone with a view to achieving optimum long term aesthetics and stability. The emphasis will be on the clinical management and an understanding and application of the biological factors that influence our treatment outcomes. Management of bone, soft tissue and prosthetics contours all play a key part in the aesthetic outcome and long term stability of soft tissue aesthetics. An interdisciplinary approach is the key to optimal case management and this will be demonstrated by cases ranging single tooth management to complex full mouth restoration.

014	Plenary Session 5 – Interdisciplinary management of implants in the aesthetic zone: data on strategy, systematic, outcome and complications

Jens Fischer, Ronald Jung
University of Zürich, Zürich, Switzerland

A successful and predicable implant therapy starts with a locally and systemically related risk assessment. Based on risk assessments regarding surgical and prosthetic aspects individual treatment strategies and an appropriate material selection are defined.

Titanium implants are clinically successful and well documented. The increasing demand of metal-free therapeutic solutions advance the development of all-ceramic implants. The material performance and the clinical success of zirconia implants will be discussed.

Experimental and clinical data have shown similar implant survival rates and marginal bone levels for implants placed either transmucosally or submucosally. However, in aesthetic situations additional factors, i.e. soft tissue conditions, have to be taken into consideration.

The decision of using either metal or all-ceramic abutments is based on criteria including material science, clinical performance and aesthetics. It has been shown in a serious of experimental and clinical studies that the use of all-ceramic abutments might be beneficial over the use of titanium abutments when the soft tissue thickness labial to the implant is equal or less than 2 mm.

The cementation primarily has to provide a secure fixation of the reconstruction on the abutment. An additional function of the cement is the sealing of the marginal gap. Today, the reconstruction material defines the type of cement and the procedure of cementation.

015	Master Clinic - Factors influencing the result in the aesthetic zone

Strategies in restoring the esthetic zone

Avishai Sadan
Case Western Reserve University, Cleveland, OH, USA

The evolution of restorative materials and dental implants enables the restorative/surgical team to achieve pleasing esthetic results that they can accomplish using simplified approaches in most clinical situations. However, some demanding situations still require the use of a combination of restorative materials or modified prosthesis design. The presentation will review common and unique clinical challenges, including the provision of a predictable function in esthetically demanding situations, the comfortable management of prosthesis delivery, the achievement of optimal optical properties and the provision of a durable marginal seal .

016	Master Clinic - Factors influencing the result in the aesthetic zone

Can adhesive techniques vary the indication for implants?

Didier Dietschi
Genève, Switzerland

The use of implants in narrow spaces or in young patients constitutes a surgical, restorative and aesthetic challenge which can not yet be addressed in a fully satisfactory manner. As well, long term stability of tissues in these cases is difficult to control. Adhesive restorations offer conservative and reliable alternatives to implants. In addition, composite resins can be used to correct or enhance soft tissue contours and tooth form to improve aesthetic integration of implant supported restorations. This lecture will overview rationale, indications and use of adhesives techniques as addition or substitutes to implant therapy.

017	Master Clinic - Factors influencing the result in the aesthetic zone

The dilemma of the optimal number of implants in the aesthetic zone (aesthetic and biomechanical considerations)

Jaime Lozada
Loma Linda University, School of Dentistry, Loma Linda, USA

Immediate implant restoration has gained popularity in recent years due in part to technological advancements that use computed tomographic images to simulate the actual clinical situation. This computer-assisted simulation enables clinicians to develop a comprehensive treatment plan that can be precisely executed in a timely manner. In the aesthetic zone, however, a successful outcome requires more than merely accurate implant placement. This presentation discusses the significance of site development for aesthetic implant restoration and describes a computer-guided immediate provisionalization procedure and its surgical and prosthodontic rationale.

018	Master Clinic - Factors influencing the result in the aesthetic zone

The role of the dental technician in establishing optimal aesthetics

Jean-Marc Etienne
CERALOR Oral Design, Essey-Les-Nancy, France

CAD CAM technologies go on expanding in dental practice. The range of prosthetic solutions has recently being improved in an aesthetic and innovative way, particularly for cemented and trans screwed zirconia bridges.

Designing and manufacturing complex dental restorations combining biocompatible materials, new and digital techniques has become the daily way of working of dental technicians.

Today more than ever, real team working methods adopted by the implantologist, the prosthodontist together with their dental technician will lead the great prosthetic satisfactions.

019	Clinical Advances - Immediate loading 5 years after the Barcelona Consensus Conference: Where do we stand today?

Fully edentulous maxillae and mandibles: clinical techniques and scientific background

Abe Ingber
Bethesda, USA

For more than 35 years. P.I. Branemark and the dental community have been documenting the phenomenon that he called Osseointegration. The success of his original two-stage surgery with delayed loading of the healed implants yielded a high success rate for implant dentistry. The current emphasis on immediate and early loading places an additional burden on the clinician. This presenta-

tion will demonstrate the various clinical procedures used to restore the fully edentulous patient with dental implants utilizing the most current clinical and scientific studies for immediate implant placement and early loading.

020	Clinical Advances - Immediate loading 5 years after the Barcelona Consensus Conference: Where do we stand today?

Immediate loading on implants placed on post extraction sockets: Single and multiple tooth gaps, procedures and predictability

Devorah Schwarz-Arad
Tel Aviv University, Ramat Hasharon, Israel

Immediate functional loading is a rather new surgical-prosthetic technique that can be used in implant dentistry. One critical goal in implant placement is the achievement of optimal soft and hard tissue integration. Immediate functional and non-functional loading seems to be a technique that gives satisfactory results in selected cases.

The main rationale and one of the most important reasons for immediate implantation is the preservation of alveolar bone dimensions which has been documented in previous studies. Moreover, when bone shape and quality are compromised, immediate implantation becomes a major contributing success factor. This presentation will discuss the rational for immediate implantation accompanied with immediate loading of dental implants. The pros and cones as well as indications, contra-indications, case selection and complications will be referred and cases of immediate implantation accompanied with immediate loading will be presented.

021	Clinical Advances - Immediate loading 5 years after the Barcelona Consensus Conference: Where do we stand today?

Implants in the aesthetic zone: does immediate loading allow for optimal outcomes regarding function and aesthetics?

Massimo Del Fabbro
Istituto Ortopedico Galeazzi, Milano, Italy

The evaluation of implant success and survival is relatively simple to be objectively determined. Conversely, no conventionally accepted criteria exist to evaluate aesthetics which is often assessed in a subjective way. The aim of this lecture is to evaluate the outcome of immediate implant loading in the aesthetic zone in terms of functionality and aesthetics by using an evidence-based approach. Many different factors can affect the outcome of immediate loading procedure, such as bone quality and quantity, insertion torque value, implant characteristics. It is important to standardize the criteria for evaluating treatment success, possibly shifting from implant-based to patient-centred outcomes. The adoption of aesthetic scores and of questionnaires based on VAS should help clinicians to evaluate aesthetic component more objectively, taking also patient's judgment into consideration.

022	Clinical Advances - Immediate loading 5 years after the Barcelona Consensus Conference: Where do we stand today?

Treatment and management benefits resulting from immediate loading

Matteo Chiapasco
University of Milano, Milano, Italy

Immediate loading has become common practice in the last decade. However, this procedure should be carefully weighed and not applied to all situations without well defined protocols. The aim of the presentation is to show surgical and prosthetic protocols for the rehabilitation with immediately loaded implant-supported prostheses of partially and totally edentulous patients. A review of the literature and personal experience concerning immediate loading of both partial (single units and multiple implants) and total edentulism will be presented, underlining both potential benefits and risks of immediate loading protocols.

Research Competition (Oral presentations – Abstracts 23 to 40)

023 | Basic Research Competition

Early integration outcomes following immediate provisionalization of atrophic maxillae

Toljanic J[1], Thor A[2], Baer R[1], Ekstrand K[3]

[1]*The University of Chicago, IL, USA,* [2]*University of Uppsala, Sweden,* [3]*Oslo University, Norway*

Objectives of Investigation: While evidence is growing to support provisional implant restoration immediately following surgical placement, little data are available regarding outcomes following immediate provisional restoration in the edentulous maxilla which frequently presents with alveolar bone atrophy. A long-term multicenter clinical trial was initiated to assess integration outcomes for the atrophic edentulous maxilla without pre-implantation bone augmentation using threaded, fluoride modified (Astra Tech, OsseoSpeed) implants combined with immediate provisional fixed restoration. This presentation reviews early integration and restorative outcomes.

Experimental methods: 50 subjects with atrophic (Lekholm and Zarb classification) edentulous maxillae were enrolled and received a total of 300 implants (six implants per subject) followed by restoration with screw-retained fixed prostheses within 24 h of implant placement. Subjects returned at post-operative weeks 2, 4, and 12 after which time the provisional restorations were removed and implant integration evaluated by clinical examination, periapical x-rays, and application of torque pressure.

Results: 288 of 300 implants placed were clinically judged to be integrated after the 12 week follow-up interval and ready for definitive prosthetic treatment. 47 subjects successfully wore their provisional restorations throughout the 12 week interval. This represents an implant integration success rate of 96% and a prosthetic success rate of 94%.

Conclusions: These early qualitative results suggest that implant integration can be predictably achieved in the atrophic edentulous maxilla without bone augmentation using a rehabilitation strategy that includes immediate provisional restoration.

This research is supported by a grant from Astra Tech.

024 | Basic Research Competition

Fracture resistance of alumina toughened zirconia implants after chewing simulation

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[1]*Department of Prosthodontics, School of Dentistry, University Hospital Freiburg, Freiburg, Germany*

The aim of the present study was to evaluate the fracture strength of alumina toughened zirconia (ATZ) implants, imitating anterior tooth replacement.

A total of 48 ATZ ceramic implants were used for the experiment. These one-piece implants were divided into six groups: three groups remained as machined (noprep) and in the other three groups the implant heads/abutments were prepared with a 0.5 mm chamfer imitating upper central tooth preparation (prep). One subgroup of the noprep and prep groups each was submitted to the following treatment: no chewing simulator, 1.2, or 5 million thermomechanical loading cycles in a chewing simulator. Then, all test specimens were loaded until fracture in a universal testing machine. All implants survived the exposure to the chewing simulator. The mean fracture strength values of the as machined subgroups were: no chewing simulator: 1734.3 N, 1.2 million cycles: 1489.2 N, 5 million cycles: 1358.2 N. The respective values for the prepared subgroups were: 1220.5 N for no exposure to the chewing simulator, 1064.3 N for 1.2 million cycles, and 1089.4 N for 5 million cycles. There was a significant drop of fracture strength in the prepared groups. The results of the present study showed that the preparation of the implant heads had a negative influence on the fracture strength of the implants. However, all mean values obtained in the present investigation were within the limits of clinical acceptance meaning that all implants may withstand average occlusal forces over a clinical serving period of 5 to 20 years.

The implants for this investigation were kindly provided by Metoxit, Thayngen, Switzerland.

025 | Basic Research Competition

Prevention of gingival invagination by a new biodegradable hydrogel membrane

Thoma DS[1], Jung RE[1], Hälg GA[1], Dard M[2], Seibl R[2], Hämmerle CHF[1]

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Aim: The aim of this study was to test whether a synthetic, biodegradable hydrogel membrane made of polyethyleneglycol (PEG) can prevent soft tissue invagination into alveolar defects.

Methods: Initially, the three mandibular premolars were bilaterally extracted in 16 minipigs. Three months later, acute standardized defects (diameter 8 mm, depth 8 mm) were prepared. Four treatment modalities were randomly allocated to the defects (PEG membrane plus collagen sponge, polylactide [PLA] membrane plus collagen sponge, collagen sponge alone, and untreated defect). The animals were sacrificed after 10 days ($n = 5$), 21 days ($n = 5$), or 2 months ($n = 6$). The following parameters were analyzed: the ratio between the surface of the soft tissue and the initial bone defect surface, and the newly formed bone. The signed rank-test was applied for comparison between the groups.

Results: Regarding the ratio of the soft tissue area ingrowth into the original defect area, the PEG membrane group showed the lowest values at 10 days ($-0.3 \pm 0.1\%$, PLA membrane $1.2 \pm 1.9\%$, collagen sponge $12.4 \pm 15.7\%$, untreated defects $13.0 \pm 16.3\%$), and at 21 days ($6.5 \pm 4.9\%$, PLA membrane $13.8 \pm 15.2\%$, collagen sponge $21.4 \pm 6.0\%$, untreated defects $9.7 \pm 8.1\%$). At 21 days, the highest percentage of newly formed bone was found in defects covered with the PEG membrane ($29.2 \pm 13.3\%$, PLA membrane $23.5 \pm 11.6\%$, collagen sponge $17.9 \pm 3.0\%$, untreated defects $18.3 \pm 4.8\%$). No statistically significant differences were found between the tested membrane groups (PEG/PLA).

Conclusion: Although the PEG membrane group was more effective with respect to prevention of soft tissue invagination and bone formation, no statistically significant differences were found between the two membrane groups (PEG/PLA).

026 | Basic Research Competition

Healing following tooth extraction and immediate implant installation with flapless surgery

Cardaropoli G[1], Monticelli F[2], Osorio R[2], Toledano M[2], Pisani Proenca T[2], Thomsen P[3], Tarnow D[1]

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Experimental and clinical studies showed that marked hard tissue alterations occurred following tooth extraction and implant installation in the socket (Botticelli et al. 2004, Araújo et al. 2005). However, in these experiments open flap approach was performed for implants placements. Several studies suggested that flap elevation might result in alveolar ridge resorption (Wood et al. 1972, Nobuto et al. 2005).

The objectives of the investigation: Was to study the healing folowing tooth extraction and immediate implant installation using flapless technique.

Experimental methods used: In the current experiment 8 beagle dogs were used. The mandibular premolars were extracted. In one side of the mandible an immediate implant installation ($n = 16$) (3.3×10 mm Osseospeed ® Astra, Astra-Tech, Mölndal, Sweden) was performed without opening the flap (test) while in the contralateral side the implants ($n = 16$) were inserted following flap opening (control). After 3 months of healing the animals were sacrificed and the mandible were processed for ground section in buccal lingual direction. Histometric measurements of bone loss and bone implant contact were performed by a blind investigator.

Results: A buccal bone loss of 0.6 mm was recorded at the test implants while the bone loss at the control implants was 2.11 mm. Significant differences were recorded between the experimental groups ($P < 0.05$). The bone implant contact was of same magnitude in both the experimental groups.

Conclusions: The results of the present study revealed a minimal buccal bone loss when the flap was not open.

The insertion of fluoride-modified surface implants did not prevent buccal bone loss.

027 | Basic Research Competition

Surface properties of dental implants using high-resolution transmission electron microscopy

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Objectives: The purpose of the present study was to analyze the chemistry and morphology of the surface layer – interacting with biological components – of five clinically used oral implants using a hitherto unexplored method for producing ultra-thin sections of implant surfaces.

Experimental methods: The as-purchased implants were imaged with scanning electron microscopy (SEM) and electron-transparent samples of the surface layer in cross-section were produced by focused ion beam microscopy (FIB) allowing high resolution transmission electron microscopy (TEM) analyses.

Results: The implants had titanium-compounds or hydroxyapatite at the outermost surface, however the thickness, morphology and chemistry varied among the different implants. The Brånemark Integration Original Fixture, had a 10nm thick rutile layer while the Nobel Biocare anodically oxidized TiUnite® had a 2 μm thick mixture of anatase and amorphous titanium-oxide containing phosphorus. The AstraTech Osseospeed™ possessed a surface structure of elevated islands, rutile and anatase of 0.5–μm thickness, with 10nm thick amorphous titanium oxide in between. The Nobel Biocare Steri-Oss hydroxyapatite-coated implant had an outermost surface consisting of amorphous calcium phosphate and a sub-surface of crystalline hydroxyapatite. The Straumann SLA® Fixture had a surface with a micro as well as a macro roughness. The outermost layer was composed of a titanium containing compound recently identified as titanium hydride.

Conclusions: FIB provides a new means of obtaining ultra-thin sections of implant surfaces for high-resolution TEM analysis. The implants on the market have large variations in surface morphology and chemistry.

Support: The Swedish Research Council and the Institute for Biomaterials and Cell Therapy, Göteborg, Sweden.

028 | Basic Research Competition

Consolidation of Bio-Oss®, Osteoinductal®, and Ostim® in a porcine model of ectopic guided bone regeneration

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Aim of the study was to compare the consolidation of three approved bone substitutes in a porcine guided bone regeneration model. The calvarial bone of ten minipigs was exposed and circular grooves were prepared with a trephine drill. After perforation of the cortical layer, titanium hemispheres were filled with either of the three bone substitutes, Bio-Oss®, Osteoinductal®, and Ostim® and secured by friction. Six and 12 weeks after surgery, animals were euthanized and necropsies containing the hemispheres were processed for histomorphometry. Statistical analysis was performed by multiple range test. We report that six weeks post-operation, bone volume per tissue volume [BV/TV] was 29.1 ± 4.9% in the hemispheres containing Bio-Oss, 0.05 ± 0.02% with Osteoinductal, and 19.8 ± 14.4% with Ostim. At 12 weeks, BV/TV increased to 38.4 ± 13.3% in the Bio-Oss group, to 0.07 ± 0.2% with Osteoinductal, and to 23.3 ± 18.3% with Ostim. Determination of the residual bone substitutes inside the hemispheres revealed 26.3 ± 6.1% Bio-Oss, 44.9 ± 20.4% Osteoinductal, and 30.8 ± 25.1% Ostim at six weeks post-operation. Six weeks later, 22.8 ± 6.1% Bio-Oss, 55.5 ± 16.8% Osteoinductal, and 28.5 ± 27.7% Ostim were observed in that region. Statistical analysis showed that, independent of the time point, BV/TV was higher in the presence of Bio-Oss when compared to the Ostim group. No changes between Bio-Oss and Ostim were observed with regard to the residual volume of bone substitutes. Osteoinductal caused significant differences in all investigated parameters when compared to Bio-Oss and Ostim. The data suggest that Bio-Oss causes a higher extend of bone formation with less variability than Ostim in the porcine model of guided bone regeneration. Osteoinductal failed to support bone formation.

029 | Basic Research Competition

Hydroxyapatite fiber material for bone tissue engineering

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We had developed fibrous material (HF) consisting of 100% hydroxyapatite fibers of 5–15 micron meter in diameter. The purpose of the present study was to examine whether HF supports proliferation and differentiation of osteogenic cells as scaffold and whether it is effective as bone substitute.

Firstly, rat bone marrow cells were prepared and cultured. The cell suspension was dropped to the HF and cultured in osteogenic medium. After 7, 10 and 14 days of culture, DNA content, alkalinephosphatase (ALP) activity and gene expression of osteogenic genes (osteocalcin and type I collagen) were examined. Secondary, the bone defects of 3 mm in diameter were prepared in tibias of nine Japanese rabbits. The defects of the right tibias were filled with HF while the defects of the other side were untreated.

The animals were sacrificed at 4, 8 and 12 weeks. The defects were analyzed with soft X-ray and micro CT. In the culture experiment increase in DNA content and ALP activity and osteogenic gene expression were evident suggesting that bone marrow cells can grow and differentiate to osteoblastic cells in HF.

In the animal experiment, at 4 weeks HF was observed as radiopaque in the defects. At 8 weeks complete closure of the cortical bone occurred in the experimental group whereas the defect still existed in the control group. At 12 weeks HF completely disappeared from the marrow cavity.

These results indicate that HF could be favorable scaffold for bone regeneration and effective as resorbable bone substitute.

030 | Basic Research Competition

Bone apposition around two different types of SLA titanium implant surfaces

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Aim of the study: To evaluate bone apposition to a modified SLA implant surface (modSLA) in the canine mandible as compared to the standard SLA surface.

Materials and methods: In this experimental study, all mandibular premolars and first molars were extracted bilaterally in five foxhounds. After a healing period of six months, each side of the mandible received six randomly assigned dental implants alternating between the standard and modSLA surface. The dogs were sacrificed at two ($n = 2$) or four weeks ($n = 3$) after implant placement. Histologic and histomorphometric analyses were then performed for each implant.

Results: The microscopic healing patterns at weeks 2 and 4 for the two implant types with the standard and modified sandblasted and acid-etched surfaces showed similar qualitative findings. New bone tissue had already established direct contact with implant surfaces after two weeks of healing. The mean percentage of newly formed bone in contact with the implant (BIC) was significantly greater for modSLA (28.2% ± 7.9) than for SLA (22.2% ± 7.3) ($P < 0.05$). This difference was no longer evident after four weeks. An increase in BIC for both implant surface types occurred from week 2 to 4. This increase was statistically significant when compared to SLA at two weeks ($P < 0.05$), but not when compared to modSLA at two weeks.

Conclusion: The data from the present study demonstrate significantly more bone apposition for the modSLA surface than the standard SLA surface after 2 weeks of healing. This increased bone apposition may allow a further reduction of the healing period following implant placement for patients undergoing early loading procedures.

031 | Basic Research Competition

Titanium foam for the healing of bone defects. A controlled histologic and histometric study in the dog

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Titanium (Ti) is widely proved to enhance bone contact and growth on its surface. It is expected that bone defects could benefit from Ti to promote healing and to increase strength of the implanted area.

The present study aimed at comparing the potential of porous Ti sponge rods (Deakin University, Dept. Engineering and Technology) with synthetic hydroxyapatite (HA) for the healing of bone defects in a canine model. Six Mongrel dogs were submitted to 3 trephined perforations of 6.0 × 4.0 mm in one humerus and 3 perforations in the contralateral humerus 2 months later. A total of 36 defects were randomly filled either with Ti foam, particulate HA or coagulum (control). The six animals were killed 4 months after the first surgery for histologic and histometric analysis.

The Ti foam surface was always found in intimate contact with new bone especially at the defect walls. Control sites showed higher amounts of newly formed bone at 2 months – Ti ($P = 0.000$) and HA ($P = 0.009$) – and 4 months when compared with Ti ($P = 0.001$). Differently from HA, the Ti foam was densely distributed across the defect area which rendered less space for bone growth in the latter's sites. The use of Ti foam or HA resulted in similar amounts of bone formation in both time intervals. Nevertheless, the presence of a Ti foam rod tended to preserve defect's marginal bone height as compared with HA and control groups.

The Ti foam exhibited remarkable biocompatibility and its application resulted in improved maintenance of bone height.

032 | Basic Research Competition

Ectopic bone formation following subcutaneous implantation of a nanocrystallyne hydroxyapatite

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Objectives: In this study the authors tested the osteoinductive potential of a sol-gel derived hydroxyapatite (HA)-matrix

Methods: The biomaterial employed in this study was a HA-matrix produced in a sol-gel process at a temperature of < 700°C. Evaporation led to the formation of micropores. The crystallites are loosely packed and held together by SiO_2 connecting the HA crystals and leading to nanopores. The proportional porosity of the granules amounts to 61%. The osteoinductive properties of the HA-matrix were examined in adult Goettingen minipigs. In 12 animals 0.1 ml of the biomaterial were applied into the subcutaneous fatty tissue and adjacent musculature in the neck region. Tissue samples were excised after 2.5, 4 and 8 months and examined macroscopically, radiologically and microscopically.

Results: After 10 weeks in all animals ($n = 3$) small foci of ossification were found by histological examination.

The new bone formation after 4 months were larger and also visible macroscopically in all animals ($n = 3$).

After 8 months ($n = 6$) in three animals multiple macroscopically visible bone formation with a diameter of 2.5–6 mm were found. The largest was 3.5 mm wide and 12.5 mm long. In two animals only smaller foci of ossification were found histologically and in one animal no extraskeletal bone formation was verified after 8 months. Only in 2 animals an intramuscular formation of bone was found.

Conclusion: A differentiation of adult mesenchymal stem cells (especially adipocytes) into osteoblasts can be induced in vivo by biomaterials with an adequate structure without application of osteoinductive substances.

033 | Clinical Research Competition

Radiographic evaluation of marginal bone level around implants with different neck designs: 3-year results

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Purpose: To evaluate the influence of macro- and microstructure of the implant surface at the marginal bone level after functional loading.

Materials and methods: Sixty-eight patients were randomly assigned to 1 of 3 groups. The first group received 35 implants with a machined neck (Ankylos); the second group, 34 implants with a rough-surfaced neck (Stage-1); and the third, 38 implants with a rough-surfaced neck with microthreads (Oneplant). Clinical and radiographic examinations were conducted at baseline (implant loading) and 3, 6, 12, 24, and 36 months postloading. Two-way repeated measure ANOVA was used to test the significance of marginal bone change of tested groups at each follw-up. 1-way ANOVA was also used to compare the bone loss of each time interval within the same implant group ($P < .05$).

Results:

System	3	6	12	24	36 months
Ankylos	0.98 ± 0.32	1.24 ± 0.23	1.32 ± 0.27	1.35 ± 0.18	1.39 ± 0.21
Stage-1	0.58 ± 0.13	0.70 ± 0.18	0.76 ± 0.21	0.79 ± 0.15	0.80 ± 0.17
Oneplant	0.15 ± 0.05	0.18 ± 0.07	0.18 ± 0.16	0.17 ± 0.18	0.18 ± 0.14

In every interval, significant differences were noted in the amount of alveolar bone loss recorded for the 3 groups ($P < .05$). The first group had a mean crestal bone loss of 1.39 ± 0.21 mm; the second group, 0.80 ± 0.17 mm; and the third group, 0.18 ± 0.14 mm. In the rough-surfaced group and the rough-surfaced microthreaded group, no statistically significant changes were observed after 3 months, whereas the machined-surface group showed significant bone loss after 3, 6, and 12 months ($P < .05$).

Conclusion: A rough surface and microthreads at the implant neck not only reduce crestal bone loss but also help with early biomechanical adaptation against loading in comparison to the machined neck design.

034 | Clinical Research Competition

A multicenter clinical study of immediate load of the completely edentulous jaws by axially positioned and tilted implants

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Purpose: To assess the treatment outcome of immediately loaded full-arch screw-retained prostheses with distal extensions supported by both upright and tilted implants for the rehabilitation of edentulous jaws, and to compare the outcome of axial versus tilted implants.

Materials and methods: At 4 study centers, 472 Osseotite NT (3i, West Palm Beach, USA) implants were consecutively placed in 92 patients (160 were placed in the mandible and 312 in the maxilla). In the mandible 4 implants were placed between the mental foramina, with the distal implants tilted by 25–35 degrees. In the maxilla 6 implants were placed and the distal implants were tilted by 30–35 degrees. Immediate prosthetic load occurred within 48 h of surgery with short-span restorations made of a titanium framework and acrylic resin teeth.

Results: Four implants failed within 12 months and another 2 at 18 months of loading in the maxilla. The implant cumulative survival rate for the maxilla was 97.62% for up to 38 months of follow-up. No implant failure was recorded for the mandible. The prosthetic success rate was 100%. Marginal bone loss around upright and tilted implants was similar.

Conclusion: The preliminary results of this study suggest that rehabilitation of the edentulous maxilla and mandible by an immediately loaded hybrid prosthesis supported by 6 and 4 implants respectively may represent a viable alternative treatment respect to more demanding surgical procedures.

035 | Clinical Research Competition

Validity and reproducibility of the implant crown aesthetic index

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Objectives: Predictable osseointegration has taken the role of implant dentistry beyond the mere restoration of function for the compromised edentulous case to aesthetic single implant restorations in the anterior region. To be preferred as the treatment of choice, implant-supported restorations should be aesthetically equal or even surpass conventional fixed prostheses. While criteria for assessing implant function, i.e. fixture stability, bone quantity and bone loss, are widely accepted in the attempt to determine implant success, the benefit of scores for evaluating implant aesthetics have still to be determined. The aim of this study was to validate an index for rating aesthetics of implant-supported single crowns and adjacent soft tissues in private practice.

Material and methods: Nine parameters were selected, which have an influence on the final aesthetic result (anatomic form, colour, surface characteristics of crown and peri-implant soft tissues). Two general dentists, two prosthodontists, two oral surgeons, two orthodontists and two dental technicians rated 21 implant-supported single-tooth restorations and adjacent soft tissues on a form with the nine parameters of the Implant Crown Aesthetic Index (ICA Index) (Meijer HJA et al., 2005). The rating was carried out twice at intervals of 4 weeks by the same examiner. Weighted Cohen's kappa was calculated to express the intra- and interobserver agreement.

Results: Intraobserver results indicated that the agreement between the first and second rating within each group of interviewees was highly significant ($P < 0.001$) with a Kappa value of 0.49, which can be interpreted as moderate agreement. The best interobserver agreement was found between the oral surgeons (0.62 = substantial); the lowest was found between the orthodontists (0.24 = sufficient).

Conclusions: The application of the ICAI-Index showed a moderate to low agreement in this particular trial. Its validity and reproducibility as an objective tool in rating aesthetics of single-implant crowns and adjacent soft tissues is therefore questionable.

036 | Clinical Research Competition

Platform switching and immediately loaded post-extractive implants. Multicenter double-blind RCTs

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This study aimed to evaluate soft- and hard- tissues response to immediately loaded post-extractive implants using platform switching concept.

In 18 patients, selected for single-tooth replacement in anterior maxillae, 20 implants (Global®, Sweden & Martina, Italy), 5.5 mm platform diameter, were placed immediately after extraction. Jumping distance was filled using Bio-Oss Collagen® (Geistlich, Switzerland). Immediately after insertion, each implant was randomly assigned to test and control treatments: 10 implants were connected with 3.8 mm diameter abutments (test group) and 10 with 5.5 mm diameter abutments (control group). A provisional was adapted for non-functional immediate positioning. Two months after, definitive rehabilitation was performed. Radiographic assessments, periodontal indices, facial marginal mucosal level (REC) and papilla height (PH) were measured by an independent observer when implant was placed (baseline), definitive prosthesis inserted and every six months thereafter. REC, PH and radiographic bone loss at mesial and distal aspects of the implants were evaluated using an image analysis software.

Mean follow-up was 20 months. All 20 implants were clinically osseointegrated. In the test group, x-R analysis showed a bone resorption of 0.33 mm (SD = 0.19 mm). The mean values were statically significant ($P \leq 0.005$) compared to control group mean values (1.32 mm, SD = 0.30 mm).

The test group showed a +0.18 mm REC gain. PH gain was +0.25 mm. The mean values were statically significant ($P \leq 0.005$) compared to control group (PH = −0.32 mm; REC = −0.54 mm).

No difference between two groups in periodontal indices was found.

This study suggests that immediately loading with subsequent platform switching can provide peri-implant hard tissue stability, with a corresponding soft tissue preservation.

037 | Clinical Research Competition

Complications following computer assisted treatment planning and immediate function

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The objective of the present investigation was to evaluate the occurrence of surgical and technical complications following computer assisted virtual treatment planning, combined with flapless surgery for fixture installation in immediately loaded edentulous jaws.

Since September 2003, 29 edentulous patients, 9 women and 20 men with a mean age of 71.5 years (range 42–90), have been treated using the Nobel Guide™ and Teeth-in-an-Hour™ protocol for surgical planning, fixture installation and immediate functioning of a prefabricated prosthetic superstructure. During this period 176 fixtures were installed to support 21 maxillary and 10 mandibular reconstructions.

Surgical or technical complications occurred in 13 of the treated patients (45%).

Misfit of abutment-bridge appeared in 5 patients resulting in disconnection of bridge in 2 patients where fixtures were left for unloaded healing. During a follow up period of up to >3 years, 19 fixtures were lost. Fixture losses resulted in removal of prosthetic superstructure in 3 patients (10%), with return to a removable denture before reinstallation of complementary fixtures. Extensive adjustment of occlusion was made in 10% (3/31) of the immediately connected bridges. Radiographic bone defects after drilling developed in 3 patients. This appeared in 2 cases after anchor-pin drilling in the maxilla and in another severely resorbed mandible.

Patient experience in successfully treated cases was very positive. However, compared to conventional treatment protocols the occurrence of surgical and technical complications were higher. Although promising, the method of computer assisted treatment planning and immediate loading must still be regarded to be in an exploratory phase.

038 | Clinical Research Competition

Long-term follow-up on soft tissue and bone levels following GBR treatment

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In the present 5-Year follow-up study, The GBR technique in combination with bovine hydroxyapatite (BHA) (BioOss®) was evaluated with regard to soft and hard tissue stability. Implant survival, radiological bone level and clinical parameters were observed. Twenty patients received a total of 41 implants (Brånemark System) in conjunction with GBR treatment. The cumulative survival rate (CSR) was 97.5% corresponding to 1 implant failure. The radiological evaluation of the marginal bone level (MBL) demonstrated a stable marginal bone level above the level of the fixture head. The bone height decreased from −3.51 mm to −2.38 mm ($P < 0.001$). The marginal soft tissue level (MSTL) was −1.52 mm at baseline and −1.15 mm at the 5 year follow-up ($P < 0.04$) demonstrating a stable sub mucosal crown margin throughout the study period. In conclusion, GBR treatment in combination with a slow resorbing filling material (BHA) seems to be a viable treatment option in order to maintain stable hard and soft tissue levels long-term in conjunction with augmentative procedures related to oral implant treatment.

039 | Clinical Research Competition

Implant survival in sinus lift augmentation with bovine hydroxyapatite alone

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Objectives: This retrospective study was performed to evaluate the complications of sinus grafting and the survival rate of implant placement in the posterior maxilla after a lateral wall sinus floor elevation with bovine hydroxyapatite (two-stage approach).

Material and methods: Eighty five patients (41 males and 44 females, mean age 61 years) were treated with a sinus lift procedure to increase vertical bone height prior to implant placement between 2000 and 2006. Inclusion criteria were partial (unilateral or bilateral) or complete edentulous maxillary jaws involving the premolar/molar area. Bovine hydroxyapatite (Bio-Oss®) was the only bone graft substitute material used for the sinus procedure. A total of 110 sinuses (53 right and 57 left) were treated with on average 2.5 g (range from 1.0 to 5.5 g) of Bio-Oss®. After a mean healing period of 7.2 months, 281 implants (Nobel Biocare®) were inserted using one-step surgical technique in 72.2% of patients and two-step surgical technique in 27.8%.

Results: There was no implant loss and all implants placed were stable after a mean follow up period of 18.5 months (range from 3 to 71 months). Radiographic examination showed dense bone at all sites. Overall, 241 and 243 implants had no exposed threads at their mesial and distal aspects, respectively. Only 1 patient had infection after sinus grafting that required biomaterial removal.

Conclusion: This study showed that the use of bovine hydroxyapatite alone in lateral wall sinus lift augmentation is a predictable clinical procedure to increase vertical bone height in posterior maxilla, with an implant survival rate comparable to that of native bone. These results need to be confirmed in large controlled prospective and long term trials.

040 | Clinical Research Competition

Short implants versus augmentation to treat the extremely resorbed mandible

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Objective: To compare and analyse the treatment outcome of two strategies to treat the extremely resorbed mandible with implants and an overdenture. The first strategy was to insert four short implants in the interforaminal area of the mandible. The second strategy was to augment the mandible using an interpositional bonegraft of the crista iliaca and to insert after three months four implants. The clinical and radiographic results after five years will be presented.

Material and methods: In a randomized clinical trial design 20 patients in each group were included. The mandibular height of the patients included was between 6 and 12 mm, the mean age was 59.4 years and they were 29 years edentulous. The short implants were inserted under local anaesthesia, the augmentation was carried out under general anaesthesia, and three months later the implants were inserted under local anaesthesia. Implant survival, retreatment, peri-implant tissues were evaluated yearly.

Results: The mean mandibular median height was 9.7 mm. There was a significant difference in implant survival (80% in the augmentation group, 98% in the short implants group), the retreatment percentages were not significantly different. The condition of the peri-implant tissues was good and stable during the evaluation period; there were no significant differences between the two groups.

Conclusions: Because of its relative simplicity the insertion of (four) short implants is the treatment of choice to treat the extremely resorbed mandible with implants and an overdenture.

Short Oral Communications (Oral presentations – Abstracts 41 to 61)

041 | Short Oral Communications

Alteration of vertical dimension with implant-supported fixed restorations opposed by restored natural teeth or implant-supported fixed restorations

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Alteration of the OVD by increasing the inter-arch distance is a frequent procedure in oral rehabilitation. Little is known about the ability of patients to adopt new VDO with implant-supported restorations. PDL deficiency may reduce a patient's ability to accommodate these changes.

The aim: Of this study was to evaluate the outcome of increasing VDO in patients restored with implant-supported fixed restorations opposed by restored natural teeth or implant-supported restorations.

Materials and methods: In all study candidates ($n = 30$), VDO was increased by a range of 3–5 mm. Group A (control) consisted of 10 patients with fixed restorations on natural dentition that opposed natural dentition in a new VDO relationship. The test groups were 10 patients who were restored with implant-supported (Tapered Screw-Vent, Zimmer Dental, Carlsbad, CA) fixed restorations opposing restored natural dentition (group B), and 10 patients restored with implant-supported fixed restorations opposing implant-supported fixed restorations (group C). The average follow-up period was 66 months. Bone changes were calculated utilizing periapical radiographs. Prosthetic maintenance data were collected from patients' files. The results were analyzed using one-way analysis of variance.

Results: Two patients in group B and four in group C reported tooth clenching or grinding ($P < .05$). More bone loss and tooth failures were observed in group A and more mechanical complications were observed in group C ($P < .05$).

Conclusion: Within the limitations of this study, it was concluded that alteration of OVD is an acceptable procedure in implant-supported fixed restorations, but precautions should be taken to reduce mechanical problems.

042 | Short Oral Communications

Osteoblast adhesion, proliferation and differentiation induced by bone graft materials

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Objectives: The purpose of this study was to investigate in vitro the biological activity of eight bone graft materials.

Methods: The materials were categorized by derivation in: **Synthetic Origin:** SintBone, Fisiograft and Ostim; **Animal Origin**: BioGen, Bio-Oss and Osteograf/N; **Mixed Origin:** Biostite and Pepgen P-15. A morphological (SEM) and a composition (EDX) analyses were performed in order to describe better the material properties for the osteoblast proliferation and further new bone formation. Type SaOs2 osteoblast cells from a human osteogenic sarcoma were used. Each specimen was observed at 6, 24 and 72 h of cell growth. Given the different morphological-dimensional characteristics emerging from the preceding analyses, evaluation of the Alkaline Phosphatase (ALP) and of the Mitochondrial Dehydrogenase (MTT) enzyme activity following exposure of the cells to extracts from the samples, rather than to the samples themselves, have been done, at three and five days, in order to determine quantitatively the cell differentiation and proliferation. Data were statistically analyzed.

Results: The mean values of ALP and of MTT were different between tested materials. At 5 days, Osteograf/N, Bio-Oss and Pepgen p-15 had similar ALP values. At 5 days, all materials (with exception of Biostite) showed similar levels of MTT enzyme activity. Synthetic and animal origin materials showed the best values (statistically different) of both parameters ($P < 0.05$) considering proliferation and differentiation compared with mixed origin materials.

Conclusions: It may be concluded that the tested bone graft materials induced different amounts of cell proliferation and differentiation and the synthetic as well as animal based materials may proliferate and differentiate better the osteoblasts.

043 | Short Oral Communications

The influence of a novel zirconia surface on osteoblastic behavior

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Titanium (Ti) is the material of choice for oral implants. However, the gray color of the material may be esthetically compromising. Zirconia (ZrO_2) as Ti substitute could help to overcome these problems. The aim of the investigation was to evaluate in a pilot project the influence of a novel ZrO_2 surface on the behavior of osteoblastic cells. Four different materials (discs: Ø 5 mm, height: 1.5 mm) were used for the investigation: 1. machined Ti, 2. TiUnite® (Nobel Biocare, Gothenburg, Sweden), 3. machined ZrO_2, and 4. ZiUnite® (Nobel Biocare). The surfaces of the materials were evaluated with the atomic force (AFM) and scanning electron microscope (SEM). Subsequently, osteoblastic CAL72 cells (1×10^5 cells/ml) were cultivated for 14 days on the different

materials. Cells on the well plates (Ra = 0.008 μm, Rp-v = 0.19 μm, Rq = 0.012 μm) served as controls. Cell proliferation using optical density (OD) was investigated with a non-radioactive cell proliferation test (EZ4U, Biomedica, Wien; Austria). In addition, the bone specific marker protein Osteocalcin was assessed with RT-PCR. The statistical analysis was performed using the Kruskal-Wallis test (level of significance: $P < 0.05$). All materials showed a dense layer with CAL72 cells after 14 days. The values of proliferation using OD were similar for all investigated surfaces ($P > 0.05$). However, the expression of Osteocalcin was highest with the cells that were cultivated on ZiUnite®. Within the limits of our investigation it can be stated that the biocompatibility of the utilized ZrO_2 material is comparable to Ti. Furthermore, it seems that the ZiUnite® has a positive effect on Osteocalcin production.

The materials were kindly provided by NobelBiocare, Gothenburg, Sweden.

044 | Short Oral Communications

Nanotite surface vs. Osseotite: a prospective randomized double blind histomorphometric study in humans

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Introduction: Modification of turned or machined surface titanium implants via treatment with acids to create microtopography has been shown to affect the manner in which titanium implants heal in bone. Recognizing that surface modifications can affect the rate and extent of new adherent bone formation, additional investigations have led to new surface developments.

Purpose: The aim of the present study was to evaluate, in humans, the extent of Bone Implant Contact (BIC) with small Site Evaluation Implants (SEIs) that featured either a Double Acid Etched (DAE) surface or a DAE surface further modified with the addition of nanometer-scale hydroxyapathe (CaP) crystals.

Method and materials: 18 SEIs were custom manufactured for this study and prepared with DAE system (Osseotite and Nanotite surface). The protocol for this study involved unloaded healing for all of the implants. Either 4 or 8 weeks after implant placement, the SEIs were retrieved by trephine drills for histomorphometric analysis.

Results: The BIC values of the 18 specimens, 9 for the Nanotite and 9 for the Osseotite SEIs were 45.0% and 17.2%, respectively ($P < .01$).

Conclusion: In this study, the addition of nanometer-scale CaP crystals to the DAE surface of the implants appeared to have a significant effect on the development of new bone at 4 and 8 weeks after implant placement. This may have significant clinical implications in terms of implant placement, with accelerated healing in areas of poor quality bone.

045 | Short Oral Communications

Flapless surgery and immediate loading versus the classical surgical protocol

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Objectives: The aim of this study is to compare the outcome of implants placed using a flapless protocol and immediate loading with a conventional protocol and loading after 6 weeks.

Materials and methods: 14 patients with bilateral maxillary edentulous areas were treated using Straumann SLA-implants. Implants were placed in one side with a stereolithographic surgical guide for flapless surgery and immediately loaded on temporary abutments. In the other side, implants were conventionally placed and loaded after 6 weeks. Opinions were evaluated using a Visual Analogue Scale (0–10 cm) at different time points.

Results: A total of 73 implants were placed (36 flapless, 37 conventionally). One implant (flapless) was lost after 3 months, resulting in a survival rate of 97.3% for the flapless implants and 100% for the flap implants. One week after surgery, statistically significant differences were found between the 2 sides for opinion about speech, function, aesthetics, self-confidence and overall appreciation. There was no statistically significant difference for pain and comfort at any time-point. Mean treatment satisfaction was 6.62 (± 3.045); 8.085 (± 1.125); 8.067 (± 1.485) for the flap side versus 8.262 (± 0.891); 8.208 (± 0.992); 7.608 (± 2.053) at 1 week, 6 weeks and 3 months post-operative. There were no statistically significant differences between those scores.

Conclusion: Implants can successfully integrate in the posterior maxilla using a flapless approach with immediate loading. From a patient's point of view, this protocol is more accepted immediately after implant surgery. However no difference in pain and discomfort was observed between the 2 protocols.

046 | Short Oral Communications

Clinical performance of non-reinforced acrylic provisional restorations in immediate loading

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Immediate loading protocols have been extensively documented. A provisional restoration allows the immediate reposition of functional teeth, protecting at the same time implants from deleterious excessive micro-movements. Multiple techniques have been described on the elaboration of temporary prostheses. However, there is a lack of quantitative data regarding their clinical performance during the healing period.

Objective: Evaluate the short-term clinical performance of non-reinforced provisional implant restorations.

Material and methods: One hundred and sixty-four consecutive patients who received 209 immediate acrylic screw-retained non-reinforced restorations (2–4 h after implant surgery) were selected retrospectively (1–12/2006). 76 were full-arch restorations, 102 were partial restorations and 31 single-unit teeth. 47 prostheses included a cantilever. The surgery, the provisional restoration and the 2-month follow-up were carried out at a periodontal specialized clinic. After that period, patients were referred for final restoration. Fractures on prosthesis were repaired within the same say.

Results: Fractures on provisional prostheses were present in 11 cases (5.26%), clustered in 7 patients (4.27%). 2 patients (1.22%) fractured the prostheses twice, 1 patient (0.61%) three times and 4 patients (2.44%) once. Fractures were repaired without complications. Two implant failures were observed in one patient (0.6%). No prostheses fractures were experienced in the 157 patients left (95.7%, 95%cr: 91–99%) during the healing period.

4 fractures were observed in the prosthesis cantilevers (8.5%). Males presented a higher amount of fractures (4.76% vs 3.96%).

Conclusions: Immediate tooth replacement by means of an acrylic screw-retained non-reinforced provisional restoration seems to be a reliable procedure for a 2-month healing period.

047 | Short Oral Communications

Prospective evaluation of soft tissue around immediate implant restorations

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The objectives of the investigation: Immediate implantation enables preservation of soft tissue leading to natural appearance of implant restoration (Block et al. 2004). The aim of the present investigation was to prospectively compare the Pink Esthetic Score (PES) of the tooth which will be removed to the score evaluated after implantation and immediate restoration. PES evaluation was repeated six month later.

Experimental methods used: Clinical evaluation of soft tissue of 30 immediate implants was assessed on the days -1, 0 and $+180$ using the parameters of the PES: mesial and distal papilla, level and contour of soft tissue margin, alveolar process, colour and texture of soft tissue.

Essential results: The preoperative PES was 12.3 ± 1.7 and did not change after immediate implant restoration (12.1 ± 0.86) or within six month (12.2 ± 1.1). Compromised preoperative scoring for mesial and distal papilla (1.46 ± 0.74, 1.61 ± 48, respectively) nearly stayed the same values (1.46 ± 0.63, 1.66 ± 0.48, respectively). Soft tissue level showed minimal changes over time (1.69 ± 0.46, 1.57 ± 0.35, respectively).

Conclusions: Immediate implantation and restoration seem to preserve preoperative soft tissue conditions. Preoperative PES represents a basic value and this can be a valid tool for decision-making: If the initial PES is acceptable immediate implantation and restoration can be performed. If initial PES is poor alternative treatment methods have to be considered.

048 | Short Oral Communications

Hard tissue alterations after different socket preservation techniques – a histological evaluation

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Objectives: The aim of the following experimental study was to assess bone changes in the horizontal and vertical dimension when using different socket preservation procedures.

Material and methods: Three extraction sites in the beagle dog were randomly assigned to one of the following treatments: Tx1: BioOss Collagen®; Tx2: BioOss Collagen® and a free soft tissue graft from the palate; Tx3: blood clot. After four months histologic analysis was conducted. The vertical and horizontal dimension of the extraction socket was evaluated.

Results: The mean vertical height of the buccal bone plate was -3.2 ± 0.2 mm for Tx1; -2.8 ± 0.2 mm for Tx2 and -3.1 ± 0.3 mm for Tx3. The horizontal dimension of the alveolar process was 4.3 ± 0.3 mm for Tx1, 4.8 ± 0.2 mm for Tx2 and 3.7 ± 0.3 mm for Tx3.

When the results from the horizontal dimension were tested with the analysis of variance (ANOVA), a clear significance could be found between the test groups Tx1 and Tx2 and the control group (Tx 3) ($P < 0.001$).

Conclusion: Incorporation of BioOss Collagen® into the extraction socket seems to have no influence on the resorption process of the buccal bone plate. The loss of the buccal bone plate seems to be replaced by a certain amount by newly generated bone guided by the BioOss Collagen® scaffold.

The study was supported by Geistlich Biomaterials.

049 | Short Oral Communications

Stem and osteoblast cells response to surface modified titanium implant

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Aim: Evaluation of cellular interaction to surface topography and chemistry on different surface treated titanium.

Materials and methods: Three different treated titanium implant materials were used: anodic spark deposition (ASD); chemically etched (BioRough™, BR), and sol-gel (SG) coating. The non-treated surface, which served as a control, was commercially-pure titanium (cpTi). Samples were cut into discs and sterilised by gamma-irradiation. All samples were imaged using scanning electron microscopy (SEM) and atomic force microscopy (AFM) for both qualitative and quantitative surface analysis. Surface chemical composition was analysed using energy dispersive x-ray spectroscopy (EDX). The *In vitro* cellular response was determined using adult human mesenchymal stem and established human osteoblast cells. Cells

were seeded directly onto the test discs, as well as Thermanox® and polyvinylchloride (PVC) as controls. Cell proliferation was observed using the alamarBlue™ assay. Cell morphology and cytoskeleton organisation were observed by SEM and immunolabelling.

Results: Surface characterisation by SEM showed different surface textures. AFM images illustrated a 3-dimensional topography and quantitatively analyse surface roughness as follow; SG > BR > ASD > cpTi, respectively. A favourable proliferation was obtained on all surfaces compared to the controls. Cells exhibited normal cellular metabolic activity, and able to recognise the surface features and respond to them, as indicated by the actin filament in filopodia, and the formation of focal contacts.

Conclusion: The treated surfaces tested have surface topography and chemistry, favouring cell proliferation and attachment which may enhance osseointegration. Effect of different treated surfaces on cell differentiation and mineralisation is currently under investigation.

050 | Short Oral Communications

Evaluation of the indirect sinus elevation technique using a sinus endoscope on fresh cadavers

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Introduction: The osteotome sinus elevation technique is a widely utilized method of gaining additional bone height in the posterior maxilla. Indications for this technique are limited to those situations in which there is enough residual alveolar bone height to provide implant stability. As reported in the literature, the technique can accomplish 3.5 to 5 mm of elevation and is ideal for 5 mm or more residual ridge.

The purpose of this cadaveric study was to evaluate the sinus membrane endoscopically during the elevation process and quantify the amount of elevation without rupture. Additionally, the bone height as measured on a calibrated dental panorex was correlated with the actual measured bone height. The relationship between residual bone height and the amount of elevation was also analyzed.

Materials and methods: A total of 10 fresh cadaver heads were obtained, and the osteotome sinus lift technique performed once on each side under endoscopic control. A calibrated panoramic radiograph was compared to the actual clinical bone height using a regression analysis.

Results: The mean radiographic height was 7.1 ± 4.2 mm, and the mean clinical bone height was 6.0 ± 3.4 mm. We were able to predict the clinical height from the panorex as shown by the regression analysis ($R^2 = 0.54$). The mean sinus floor elevation for the sample was 8.5 ± 3.5 mm ($N = 19$). The regression analysis demonstrated no relation between the height of the residual bone and the amount of sinus floor elevation ($R^2 = 0.0041$).

Conclusions: The results suggest that the amount of elevation from the osteotome technique may be greater than previously thought. In 14 of the 19 (74%) sinus elevations performed, the elevation was enough to accommodate a 13 mm implant. Further clinical trials would be necessary to better define the limits of the osteotome technique.

051 | Short Oral Communications

Impact of glycemic control on implant integration in diabetes patients

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Diabetes mellitus is considered a relative contraindication to implant therapy dependent on levels of glycemic control. Consistent with this, hyperglycemic animal models have shown diminished integration following placement. The primary objective of this clinical study was to evaluate the impact of glycemic control on implant integration. This prospective study evaluated 42 implants placed in 32 patients, 10 control patients (HbA1c < 6%) and 22 type 2 diabetes patients (HbA1c: 6.1–13.8%). Glycated hemoglobin (HbA1c) levels were assessed at 0, 2, and 4 months. Diabetic patients were stratified based on HbA1c levels (6–8%, 8.1–10%, and > 10%). Implant stability was assessed using resonance frequency analysis. Measurements were collected at 0, 2, 4, 6, 8, 12, and 16 weeks, with restoration after the 4-month evaluation. All 42 implants placed were successfully integrated and restored with no clinical complications. For all groups, there were no significant differences in implant stability at placement ($P = 0.573$), and stability decreased following placement with the greatest decreases occurring after 2 to 4 weeks. The decreases in implant stability for the less controlled groups (HbA1c: 8.1–10% and ≥ 10.1%) were significantly greater ($P = 0.0014$, ANOVA) than those of the non-diabetic and well controlled groups (HbA1c: < 6% and 6.0–8%). Furthermore, the return in implant stability to baseline levels was delayed for the less controlled groups, significantly so ($P = 0.0248$) for the poorly controlled (A1c ≥ 10.1%) patients. This study demonstrates compromised implant stabilization consistent with compromised bone formation in patients with type 2 diabetes mellitus in direct relation to glycemic control. (NIDCR, ITI Foundation supported)

052 | Short Oral Communications

Biomimetic coating Incorporated BMP-2 on Polymers: A New bone-induction system

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Objective: The aim of this study was to prepare and evaluate a novel "calcium-phosphate-coated polymer" bone-induction system.

Materials and methods: Four clinically used materials were tested: Collagen, Polyactive®, Ethicon® and PLGA. These

materials were coated with two-layer coating: first amorphous calcium phosphate (ACP) (seeding layer), and crystalline one (protein-carrying layer). The morphological features of the coating were evaluated by scanning electron microscopy (SEM) and its composition by X-ray diffraction (XRD), energy-dispersive x-ray analysis (EDAX) and Fourier-transform infrared spectroscopy (FTIR). Fluorescence was used to inspect the relationship of the two-layer coating and the BSA release profile. The osteoinductivities were evaluated after implantation within the subcutaneous space of rats.

Results: SEM showed the size of the second layer crystalline diminished on substrate on larger surface area and increased with enhancing coating solution volume. XRD spectra and EDAX (Ca/P: 1.37–1.42) indicated the coating component: the first layer ACP and the second layer calcium-deficient hydroxyapatite (CDHA). Peak changes in FTIR suggest the incorporation of BSA in CDHA layer. BSA two-stage release profile was detected: initial rapid burst within 3–5 days and slower release over 5 weeks. The initial release ratio was relative to the microstructure of polymers. *In vivo*, bone formation was detected at 5 weeks in both BMP-2 incorporation groups and BMP-2 adsorption group but bone volume of the formers were significantly higher ($P < 0.05$). Bone volume was also found relative to the substrate microstructure instead of only the amount of BMP-2.

Conclusion: The inorganic/organic BMP-2-incorporating-coated-polymer composite is a promising alternative for bony regeneration.

053 | Short Oral Communications

BoneCeramic as alternative for BioOss in the treatment of bony dehiscencies along implants

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Due to the unpreventable alveolar resorption, a bone substitute is often needed to cover dehiscencies after implant insertion. In a randomised, controlled, split-mouth, prospective clinical trial, the efficacy of bone formation of 2 bone substitutes are compared. BioOss® (BO, Geistlich Biomaterials) is an established deproteinized bovine bone mineral and Straumann® BoneCeramic (BC, Institut Straumann AG) is a newly available, synthetic biphasic calcium phosphate. Six patients, with a very narrow upper jaw, received 4 to 6 implants (Straumann® SLActive, Institut Straumann AG) to support an overdenture. Two comparable dehiscence defects, at least 4 mm in height, were first covered with a layer of autogenous bone, followed by a layer of one of the bone substitutes. Finally a resorbable collagen membrane (BioGide®, Geistlich Biomaterials) sealed the augmented area. A submerged healing of 6 months was initiated. A Cone Beam CT (Accuitomo FPD®) was taken after implant placement and before second stage surgery. At abutment connection a vestibular flap was reflected to inspect the healing of both sites. Clinical and radiological parameters were compared at both time points. Both substitutes resulted in an optimal defect fill (initial defect height: BO: 6.2 mm, range 4.0–9.0 mm; BC: 6.6 mm, range 4.0–12.0 mm; at reentry: BO: 1.1 mm, range: 0–2.0 mm; BC: 1.5 mm, range: 0–2.5 mm). The radiographic analysis revealed no differences between the two treatment modalities. BoneCeramic® is considered to be a valuable alternative to BioOss® in the above mentioned treatment concept.

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054 | Short Oral Communications

Bone-anabolic treatment enhances implantion: shifting critical strains to bone-implant interface

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Intermittently administered human parathyroid hormone 1–34 (PTH) is the leading bone anabolic therapy. We have recently demonstrated that PTH is a potent stimulator of implant anchorage, especially in low-density trabecular bone, which represent a high failure rate in dental implantology. Here we explored the structural determinants involved in implant anchorage and how they are affected by systemic changes in trabecular bone architecture. Titanium implants were inserted horizontally into the proximal tibial metaphysis of adult rats, 6 weeks postorchiectomy (ORX) or sham-ORX. Daily systemic administration of PTH commenced immediately thereafter for 6 weeks. Implant anchorage was analyzed using stepwise microdisplacement pullout testing in combination with time-lapsed microcomputed tomography, which allows direct 3D visualization and quantification of failure initiation and progression at the microscopic level. Reactive forces in the cortex were negligible. Failure of implant anchorage occurred either at the thinnest segment of individual trabeculae, 0.5–1.0 mm away from the implant surface, or at the bone-implant interface (BI). ORX induced trabecular bone loss, showing the poorest biomechanical properties and the thinnest trabeculae. It presented the highest intratrabecular and lowest BI relative failure rates. PTH treatment induced supranormal increases in bone density and biomechanical parameters. The increases in trabecular thickness and BI in these animals were of a similar magnitude and were associated with a remarkable shifting of failure to the BI. These findings highlight the critical importance of the peri-implant trabecular bone properties and offer new therapeutic strategies that use bone anabolic modalities for the enhancement of endosseous implant anchorage.

055 | Short Oral Communications

Age and bone regeneration. An experimental study in rats

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Objective: To evaluate the effect of age on bone formation by guided tissue regeneration (GTR).

Material & methods: 40 Wistar rats were divided into 2 equal-sized groups: in the first group the animals were operated when they were 3 months old, while in the other group the animals were not operated until they became 2 years old. Following muscle-periosteal flap elevation, a rigid hemispheric Teflon capsule was placed with its open part facing the bone of the lateral surface of the mandibular ramus and fixed by means of silk sutures. Histological specimens including the capsules and surrounding tissues were obtained 2 and 4 months after surgery. The amount of newly formed bone inside the capsules was evaluated by means of a point-counting method and expressed as percentage of the capsule space.

Results: In the *old* group, 6 animals were lost before surgery. After 2 months of healing, similar amounts ($P = 0.47$) of new bone had formed inside the capsules in both the *young* and *old* group (25.5% vs. 19.0%, respectively). The new bone had a trabecular appearance with large marrow spaces filled with hematopoietic and fatty marrow. Similar observations regarding tissue characteristics inside the capsules were made after 4 months of healing, with the exception that statistically significant larger amounts ($P = 0.02$) of newly formed bone were found in the animals of the *young* group as compared with those of the *old* group (46.3% vs. 22.9%, respectively).

Conclusion: Bone formation by GTR seems reduced by old age.

056 | Short Oral Communications

Immunocytochemical evaluation of differentiation markers after sinus grafting

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Newly formed bone after performance of a sinus augmentation technique is an essential parameter to be considered in the early interaction between the implant and the receptor site. However, non-mineralized tissue could have a great importance in the maturation of grafting materials placed into sinus cavities. It is the aim of this study to analyze the expression of differentiation and inflammatory markers in cells present in non-mineralized tissue obtained from human augmented maxillary sinuses.

Material and methods: Five patients, who underwent a sinus grafting technique for delayed implant placement were selected. Cortical autogenous bone and xenogeneic bone (Bio-Oss®) were applied, using 50% of each material. Bone core biopsy samples were taken 6 months later, at the time of implant placement. Histological (Hematoxilin-eosin, PAS, Masson's trichromic), histomorphometric analysis, as well as an immunohistochemical assay (CD56, CD42b, CD38, fascin, vimentin, COX-2) were done, in order to assess both graft composition and marker expression in cells present in non-mineralized tissue.

Results: It was observed normal vital bone and remaining bovine bone particles infiltrated in a matrix of non-mineralized tissue, in absence of inflammation. After histomorphometric analysis, mean value for the presence of non-mineralized tissue was around 50%. Expression of CD56, CD38, COX-2, fascin and vimentin was positive in cells belonging to this tissue, which implies bone remodeling phenomena.

Conclusion: Marker expression patterns in mesenchymal non-mineralized tissue suggests that these cells may play an important role in bone maturation, presenting an interesting osteogenic potential, which may promote an increase in vital bone overtime.

057 | Short Oral Communications

Bilateral sinus graft with either bovine hydroxyapatite or beta tricalcium phosphate

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Background: Various techniques and bone graft substitute materials are used in maxillary sinus floor augmentation. Although autograft is considered as the gold standard, bone substitutes have been used with high successful rates and less morbidity compared with intraoral or extraoral autogenous bone.

Objectives: To compare two different graft materials, bovine hydroxyapatite (BH) (BioOss®) and pure phase Beta tricalcium (TCP) (Cerasorb®) in patients referred for bilateral sinus augmentation.

Materials and methods: Five patients (one female and four males, mean age 61.5 years) were selected for bilateral sinus augmentation. For each patient, the procedure was performed with BH on one side and TCP on the other side. Biopsies and implant placement were done 6.2 months later (range from 4 to 8 months).

Results: Wound healing was uneventful and all implants were clinically successful at 2.7 years (range from 1.5 to 5 years). Both BH and TCP led to a satisfactory increase in bone height. Histomorphometric analysis revealed differences in bone contact (43.1% vs. 26.8% for BH and TCP, respectively), bone

density (14.3% vs. 15.1%) and fibrous density (35.1% vs. 21.1%). Bone tissue biopsy showed a primary structure exclusively with BH and a mixture of lamellar and primary structures in sinuses grafted with TCP.

Conclusion: At 6 months, BH resulted in a slightly higher percentage of bone density compared to TCP, whereas TCP induced lamellar bone formation earlier than BH. These observations confirm the interest of these bone substitutes in sinus bone augmentation, and deserve further evaluation in larger controlled studies with long term histomorphometric studies.

058 | Short Oral Communications

Marginal accuracy of tooth-implant-supported FPDs after in-vitro stress simulation

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Objectives: Caries, periodontal disease, and peri-implant inflammation caused by deficient marginal fit are all reasons for clinical failure of combined tooth-implant supported fixed partial dentures (TISFPD). This in-vitro study examined the marginal accuracy in TISFPD after stress simulation in the artificial mouth.

Methods: Twelve 3-unit TISFPDs were produced with a high-noble-alloy on specially designed models containing human premolars with an artificial periodontium and implants with abutments for cementation (Straumann). Four 3-unit tooth-supported-bridges (TSFPD) represented the control group. The TISFPDs were cemented with 3 different cements: Group 1 – zinc-phosphate; Group 2 – glass-ionomer; Group 3 – self-adhesive-resin (TSFPD – zinc-phosphate). The specimens were mechanically loaded (1.2 million cycles/50 N) and thermally cycled (8,000 cycles with 5°C/55°C). The vertical marginal gap (VMG) was measured before and after cementation, after chewing simulation and after thermocycling by light-microscopy. The results were subjected to statistical analysis (*t*-test/ANOVA/Bonferroni).

Results: Significant increase ($P \leq 0.05$) of the VMG was found after cementation within all TISFPDs (implants: 11.7–18.7 µm; teeth: 13.4–24.2 µm) and TSFPDs (28.5 µm). Comparison of groups 1 and 2 revealed significant differences for the teeth while comparison of the implants showed significant differences between all groups. Chewing simulation and thermal cycling caused statistically insignificant changes in the VMGs of the TISFPDs and TSFPDs.

Conclusion: The cementation of the TISFPDs with different luting materials caused a specific enlargement of the VMG in teeth and implants. After long-term stress simulation in the artificial mouth no significant changes of the marginal accuracy could be found.

059 | Short Oral Communications

Assessment of peri-implant health by detecting peri-implant crevicular fluid prostaglandin E2 and matrix metalloproteinase-8 levels

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Objectives: Analyses of the constituents of peri-implant crevicular fluid (PICF) may provide crucial information about the pathologic processes around dental implants. Detection of prostaglandin E_2 (PGE_2) and matrix metalloproteinase-8 (MMP-8) levels in PICF have been tested as diagnostic markers of tissue destruction. The aim of this study was to determine whether a correlation existed between PICF PGE_2 and MMP-8 levels and clinical parameters, and also to assess whether the detection of these mediators in PICF might be useful in diagnosing early tissue breakdown.

Methods: 40 dental implants with peri-implant mucositis and 40 healthy implants consisted the study groups. Plaque index, gingival index and probing depths were recorded. PICF was collected onto filter strips. PICF PGE_2 and MMP-8 levels were evaluated using enzyme immunoassay method. The inter-group differences were evaluated using independent t-test and the relationship between clinical and biochemical parameters were tested using Pearson Correlation Analysis.

Results: All clinical and biochemical parameters were found to be statistically significantly higher in the test group ($P < 0.001$). PICF PGE_2 and MMP-8 levels correlated significantly with each other ($P < 0.001$). PGE_2 and MMP-8 demonstrated a positive correlation with all clinical parameters ($P < 0.001$, $P < 0.05$).

Conclusions: It may be concluded that detections of PGE_2 and MMP-8 in PICF serve as useful biochemical methods for monitoring the course of peri-implant disease. In the future, more cases with deeper peri-implant probing depths must be evaluated in longitudinal studies in order to confirm the diagnostic benefit of PGE_2 and MMP-8.

060 | Short Oral Communications

Diabetes effect on alveolar ridge augmentation combined with implant placement

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Objectives: To histologically evaluate the effect of experimental diabetes and metabolic control on the potential for neo-osteogenesis following Guided Bone Regeneration in combination with placement of titanium implants.

Methods: Thirty Wistar rats were allocated in three experimental groups: 1) uncontrolled, streptozotocin induced experimental diabetes; 2) insulin controlled experimental diabetes; 3) healthy controls. A standardised titanium microimplant was placed into the inferior border of the mandible. On the test side, the microimplant was covered with a non-resorbable, titanium

reinforced ePTFE membrane (Gore-Tex) securely fixed in the mandible. The contralateral side served as sham operated control. Following 90 days of healing, ground sections were prepared and planimetric measurements were performed.

Results: Significant *de novo* bone formation was observed in the space beneath the membrane in the GBR treated sides, but not in the sham operated controls. The diabetic state correlated with suppressed potential for new bone formation beyond the skeletal envelope, as well as with reduced bone to implant contact. The amount of newly formed bone and the bone to implant contact were similar for the insulin controlled and healthy groups.

Conclusions: Neo-osteogenesis is predictably achieved via Guided Bone Regeneration combined with placement of titanium implants. Experimental diabetes may compromise the potential for new extraskeletal bone formation, whereas insulin mediated metabolic control may reverse these adverse effects.

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061	Short Oral Communications

Vertical bone regeneration (rh-PDGF-BB & Xenograft): Back scattered electron microscope element analysis

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Vertical augmentation of the severely atrophic alveolar ridge continues to be a significant surgical challenge for the profession. This study analysed specimens where bone was augmented in standardized canine models in a vertical dimension using a xenograft scaffold, rh-PDGF-BB recombinant human platelet growth factor with or without a resorbable collagen membrane. The aim was to compare percentage weight and volume calcium/phosphorus ratio values between regenerated bone and native bone and the contact with two different implant surfaces.

The results of this preclinical canine study provide proof-of-principle that rhPDGF-BB, in combination with a deproteinized bovine block, without placement of a barrier membrane, has the potential to regenerate significant amounts of new bone in severe mandibular ridge defects. In addition, the results seem to point to the importance of the periosteum as a source of osteoprogenitor cells in growth factor mediated regenerative procedures.

In addition, the examination of the nature of the mineralized tissues by back scattered electron microscopy (BSE-SEM) provides an understanding of the composition and element ratio of bone regenerated from non-autogenous grafts. The data collected demonstrated no statistical significance between regenerated bone and native bone in the two tested groups. Our observations suggest that eventhough bone was regenerated via non autogenous grafts, its composition, structure and physical properties are very similar to the native bone. Similarly, no significant differences were observed between bone regenerated close to oxidized and machined implants.

Posters
(Abstracts 62 to 363)

062 | Topic Implant Aesthetics

Achieving nature in mandibular anterior edentulous area

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Implant dentistry in esthetically demanding anterior area is a challenge to clinicians, particularly in mandibular anterior area. Because a conventional implant needs minimum 7 mm space, it is difficult to use it to replace a missing mandibular incisor, which has an average 5.5 mm mesio-distal crown diameter. Periodontal recession compromises emergence profile of implant in anterior mandible because of narrower root diameter. The mini-implants with a small diameter can provide benefits of dental implant and esthetics to patients who lost a mandibular incisor.

Recent literature reported that bone-to-implant contact of mini-implants for transitional purpose is similar to that of conventional implants. Thus it is possible to use mini-implants for long-term in limited space where conventional implants cannot be placed. Unfortunately, most mini-implants do not have abutment system because their narrow diameter does not allow an abutment screw inside. It limits prosthetic options for esthetically demanding anterior area.

We have developed a mini-implant system that uses friction for abutment connection. No cement is needed to use various abutments which provide proper emergence profile and meet different prosthetic needs.

Twenty mini-implants were placed for a single missing mandibular incisor with 5 to 6 mm width on twenty patients. In two patients, four mini-implants were placed for missing two adjacent mandibular incisors that had mesio-distal space less than 12 mm. All implants were provisionalized immediately after placement. All of them have functioned for 6 to 18 months and have shown natural harmony with adjacent teeth, even in periodontally receded cases.

063 | Topic Implant Aesthetics

Sloped topped dental implants – aesthetic soft tissue benefits

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Objective: Implant systems commonly in use today were originally intended for the fully edentulous patient while the bony topography for the partially edentulous patient has been overlooked in implant design. The study objective was to contour the coronal aspect of dental implants to follow the prevailing bony anatomy typical to this patient population and evaluate the results.

Methodology: Astra implant blanks were contoured to the desired sloping coronal configuration. The fixtures were then surface treated utilizing a commercially proven RBM process.

Results: Clinicians advocate placing the implant platform 3.0 mm apical to the desired facial soft tissue level. This often requires burying the lingual aspect of the fixture below available bone height resulting in the loss of hard tissue. Sloped topped fixtures placed following these accepted clinical guidelines avoided this complication and restored cases exhibited more natural soft tissue contours. However, it was noted that the soft tissue tunnels presented an unusual characteristic. The prototype implants resulted in symmetric tissue tunnels that were deeper on the facial than the lingual aspect.

Conclusion: The ability to design dental implant fixtures to follow healing bony topography was shown to be practical and beneficial. The facial side of the soft tissue tunnels appears to be supported by the lingual height of bone preserved in a manner similar to connective tissue grafts placed for root coverage being dependent on proximal bone levels. The higher tissue level on the facial aspect allows for more predictable and aesthetic soft tissue manipulation enhancing the final restorative solution.

064 | Topic Implant Aesthetics

Peri-implant tissue around the immediately-restored single tooth implant: a retrospective analysis in a period of 12 to 72 months

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Implant aesthetics has been the subject of much discussion for the last decade and one vital question has been what effect an immediate restoration has on papilla formation and crestal bone loss.

Material and methods: Forty-five single tooth implant were placed in 45 patients, 35 (77.8%) females and 10 (22.2%) males, mean age 41 years (18–70). 37 (71.1%) in fresh extraction sites and 15 (28.9%) in healed sites. Periapical X-rays and clinical photographs were taken at regular time frames during a period of between 12 and 72 months (average 36 months) to evaluate crestal bone loss and healing of the soft tissues. 368 interproximal sites were examined. Presence of papilla with respect to the distance between the highest coronal point of the crestal bone and the crown contact point was evaluated, and the amount of bone loss with respect to the different clinical variables was recorded.

Results: Bone loss: Statistically significant more bone loss ($P > 0{,}05$) was found: in implants placed in the maxilla compared to the mandible ($P < 0.05$ [$P = 0{,}0135$]); employing implants with a length equal to or greater than 14 mm ($P < 0.05$

[$P = 0{,}047$]); in female compared to male patients ($P < 0.05$ [$P = 0{,}016$]). Cut off was fixed at 36 months. Implants placed in fresh sites lost significantly more bone ($P < 0.05$ [$P = 0{,}0491$]) compared to implants placed in healed sites. Interdental papilla showed a mean increase of 0.49 ± 0.1 mm at 36 months. Only when the distance between the highest coronal point of the crestal bone and the crown contact point was greater than 7 mm did the papilla decrease instead of increase.

Conclusions: With a single tooth immediately restore implant, the prosthetic contact point must not be greater than 7 mm from the highest point of the crestal bone. In the interproximal area between an implant and a natural tooth the papilla seemed to be unaffected by peri-implant bone loss, guaranteeing a predictable outcome and good aesthetic results. Immediate restoration does not seem to cause increased bone loss, remembering that some bone loss occurs during the first 12 months after the placing of the implant, be it unloaded or immediately loaded.

065 | Topic Implant Aesthetics

Clinical, aesthetic and radiographic outcome of different implant neck designs

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The aim of this randomized clinical trial was to compare two different implant neck designs, including a smooth machined surface and a roughened surface with threads for aesthetic, radiographic and clinical outcome measures.

Twenty patients (mean age 38.8 years, range 19–61) with a single missing tooth in the maxillary aesthetic zone were randomly allocated to one of two study groups to receive either an implant with a 1.5 mm machined neck (NobelReplace, Nobel Biocare, group I) or an implant with a roughened and threaded implant neck (NobelReplace Groovy, Nobel Biocare, group II). Pre-operatively, two weeks and six months after implant placement, clinical data are collected and standardized X-rays and photographs are taken.

During follow-up one implant in group I failed to integrate and was removed. From two weeks to six months after implant placement a mean marginal bone resorption of 1.1 ± 0.7 mm in group I and 0.9 ± 0.3 mm in group II was found ($P > 0.05$). At six months follow-up no statistical significant differences were noted in Aesthetic Index, Papil Index, Modified Plaque- and Bleeding Index and probing depth ($P > 0.05$).

Within the limitations of this preliminary study no significant differences were found in the clinical, aesthetic and radiographic outcome between implants with a smooth neck topography and implants with a roughened, threaded implant neck design. Larger study groups and a longer follow-up period are necessary to verify these conclusions.

066 | Topic Implant Aesthetics

Implant replacement of congenitally missing lateral incisor in an adolescent

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Implant restorations are commonly used to replace congenitally missing lateral incisors in orthodontic patients. But their use in adolescents is not very common. This case report represents a treatment modality for congenital missing lateral incisor in an adolescent. Missing tooth was achieved by means of implant supported fixed prosthesis following orthodontic space opening procedure. A male adolescent at the age of 16 with congenitally missing right lateral incisor, was referred with the demand of establishment of esthetic and phonetic problems. It was decided to make an implant restoration after the orthodontist stated that the patient has completed the majority of his facial growth. Dental radiographs and diagnostic casts were made. A surgical template was prepared from a wax-up of proposed implant- supported restoration. Narrow platform (3.3 mm diameter) Branemark tiUnite implant was placed for lateral tooth. After a week from the second surgical phase impression was taken. 15° angled esthetic abutment was used and porcelain crown was cemented. At the end of the 2 years follow up period the young patient had a diastema between his central and lateral incisors and radiographic assesment indicates no bone loss around the implant. If implants were placed and restored too early, relative to the patient's tooth eruption, the reaction of the implant will be similar to that of an ankylosed tooth. For this reason patients must complete the majority of their tooth eruption before the implant placement. Additional growth changes after this could be compensated by slight modifications of the prosthesis.

067 | Topic Implant Aesthetics

Anterior tooth replacement with immediate/delayed implants placement: long-term results

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Aim: To report on the clinical result of 189 immediate implants in the anterior region of maxilla.

Methods: Between January-1994 and November-2002, 108 immediate implants and 81 delayed implants were placed in 104 patients to restore missing teeth. Three different Implant System were used (26 Branemark, 67 Straumann, 96 Ankylos). Bone augmentation procedures were combined with implant placement. After prosthetic treatment and in different time intervals mPlI, mSBI, standardized peri-apical radiographs, technical

complications and patient satisfaction, has been registered.

Results: After 6 months of unloaded healing all implants were clinically osseo-integrated and fixed restorations were inserted. 5 implants were not present to recall. During a total observation period of 5.9 years (range 4–12 years), 6 implants were removed and the cumulative survival rate was 96.7%. Biological complications (Suppuration and/or mSBI+) occured in 7.5% of the implants. All other implants presented healthy soft and hard tissue peri-implant conditions (mPlI > 1; mSBI > 1). The vertical bone loss was less then 2 mm in 42% of implants, while the 12% of sites the bone loss was more then 4 mm.

9 crowns presented ceramic fractures. 3 cases of abutments loosening occured. 11 patients with a total of 13 implants were not satisfied with aesthetic of the rehabilitation. The majority part of patients appreciated treatment outcome.

Conclusions: Immediate implants have high survival rate which are similar to those associated with conventional implant placement. The internal-tapered connection have been reported to provide more mechanical stability and a positive influence on the healing and long term stability of peri-implant tissues.

068 | Topic Implant Aesthetics

The immediate temporization of maxillary single tooth implants: 2-years results

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Objectives: To report on the clinical result of 19 immediately loaded implants in the anterior region of maxilla.

Methods: 19 Ankylos implants (Dentsply, Friadent, Mannheim, D) were placed in 16 patients (10 male, 6 female), to restore 8 central incisors, 9 lateral incisors and 2 canine. 12 implants were immediately inserted after tooth extraction, 4 were delayed implants. 12 implants were inserted without flap elevation. All implants were immediately restorated with prefabricated abutments cement-retained provisional crowns. At insertion, none of the restorations had occlusal contacts with the oppositing dentitions (immediate non-occlusal loading). Seven days antibiotic therapy (amoxicyllin 2 gr pro die) and chlorhexidine 0.2% mouth rinse was given as preventive measure.2 months nutritional limitations are advised.

The implants received definitive restorations (fully functional occlusion) 4–6 months after implant placement.

Periapical radiographs, mSBI, mPlI, and technical complications were recorded in different time intervals. Patient satisfation was also evaluated.

Results: 1 implant was removed for mobility five weeks after placament. All other implants became osseoinegrated.

After a total observation period of 24.3 months (range 11–49 months) the overall survival rate was 94.7%. All implants presented a healthy peri-implant soft tissue conditions, showing low values of clinical parameters (mSBI > 1; mPlI>1) and stable gingival contour.Radiografic mean bone loss evaluating both interproximal surfaces was 0.56 mm (range 0.37–1.43 mm). Swelling or suppuration were not observed.

No technical complication occured. All patients appreciated treatment modality, 1 patient was not satisfied with the aesthetic of the rehabilitation.

Conclusions: Immediate temporization of maxillary single tooth implants is a technique that seems to give a satisfactory results in selected cases.

The implant design makes a significant contribution to the primary stability of the implant.

069 | Topic Implant Aesthetics

Immediate implant with immediate loading use the natural tooth

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The most common causes of indication to the placement of implants just after dental extraction are cavities and/or dental fractures without the presence of infectious focus, traumatic dental avulsion with preservation of the alveolar bone, endodontic complications indicating the extraction, radicular fracture, reabsorption of a deciduous tooth associated with agenesis of the permanent tooth, internal or external radicular reabsorption, and radicular reabsorption (post orthodontic treatment). One of the largest concerns and problems is the elaboration of temporary teeth to be placed during the period of osteointegration of the implants, which with this technique is better accepted. Three different patients presented external radicular reabsorptions searched for the Implantology service at the Bioface Institut Clinic with the crown in perfect status. After detailed evaluation and study of this cases, we have concluded that we should options for the placement of an implant in the region and also the placement of immediate loading and use the natural crown of the provisional tooth. This treatment with implants immediately after tooth extraction and placement of an immediate prosthesis is suitable and trustful for the patient and the professional, as well as it reduces time treatment and the number of surgery procedures. Besides, in most of the cases it maintains the gingival anatomy, making the esthetic rehabilitation easier.

070 | Topic Implant Aesthetics

Effect of immediate insertion, immediate temporization and flapless technique in the preservation of gingival architecture

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In this investigation, the influence of the combination of immediate insertion in an adequate position and direction of the implants,

flapless technique and immediate temporization, was evaluated in relation to the preservation of soft tissues contours.

77 implants immediate placed in the aesthetic area using flapless technique were studied. All of them were inserted slightly to palatine and the vestibular gap was filled with autogenous bone without any barrier, and immediate temporization was performed using it to maintain the gingival contours.

The marginal level of soft tissues (ML), the buccolingual width of the ridge (RW) and the papillae level (PL) was measure at the moment of surgery, 3 to 4 months later at the moment of definitive restorations placement and 12 months later. Beside the horizontal gap (HG) between the implant and the vestibular plate of the alveolar bone at the moment of implant placement was measure too.

All the measurements were done on standardized photographs and were analyzed by adequate software.

3 to 4 months results:

ML: average 0.05 SD 0.43 range −1.07 to 1.2

RW: average −0.06 SD 0.49 range −1.76 to 1.7

PL: average −0.29 SD 1.06 range 0.11 to 6

12 months results showed:

ML: average 0.03 SD 0.56 range −0.95 to 1.26

RW: average −0.12 SD 0.66 range −1.57 to 1.34

PL: average −0.13 SD 1.11 range 0 to 6.13

There was no significative correlation (p.005) between HG and ML, RW and PL.

It can be concluded that of the combination of immediate insertion in an adequate position and direction of the implants, flapless technique and immediate temporization is helpful to maintain the shape of the soft tissues from a clinical point of view.

071 | Topic Implant Aesthetics

New extraction socket soft and hard tissue classification: reliability and validation

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Objectives: The aim of this study was to develop and validate a classification of extraction socket in the anterior maxillary immediately following tooth removal for immediate implantation.

Material and methods: Twenty-five teeth from 25 patients (15 men and 10 women; age 18 to 51 years, average = 32.4) in frontal maxilla were extracted. The soft and hard tissue assessments in the extraction sockets were assessed using the classification system developed by 2 independent surgeons. Recommended treatment were also provided and later confirmed in the final outcomes. Weighted Cohen's k was used to calculate inter-observer reliability. Statistical analysis was performed using paired t-test, Kolmagorov-Smirnov and Marginal Homogeneity tests. Twenty-five Straumann® Standard Plus (Basel, Switzerland) dental implants were installed. If the extraction socket was graded as Type I (adequate), immediate implant installation was performed. In Type II (compromised), immediate or delayed implantation with simultaneous soft or hard tissue augmentation was suggested. In Type III (deficient) – staged implantation was indicated after soft and hard tissue augmentation or orthodontic treatment.

Results: Inter-observer agreement and weighted Cohen's k were 96% and 0.94 respectively and indicated high reliability for the classification system. Furthermore, no registered ''deficient'' peri-implant soft tissue assessments were found when used newly developed classification treatment recommendations. Moreover, 80% of cases soft tissue parameters were graded as ''adequate''.

Conclusion: Within the limitation of this study, it can be concluded that the classification proposed here for extraction socket soft and hard tissue is an objective and helpful tool for socket assessment as well as future implant aesthetic treatment planning.

072 | Topic Implant Aesthetics

Correlation between marginal bone-level and dimension of papilla in single-implant

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Object: To evaluate which parameter, (1) marginal bone level of implant or (2) adjacent tooth, correlates with the dimension of interproximal soft tissue in single-implant restorations.

Methods: The subjects of the present study had implant prosthesis in place longer than 1 year. Periapical of 21 single-implant restorations were taken including their adjacent natural teeth. Before taking an X-ray, radiopaque material was placed on the top of the papillae to mark its positions. A virtual horizontal line (**Lp**) perpendicular to the axis of the fixture was drawn, passing through each papilla top. Distances from the most coronal point of the alveolar bone contacting the implant surface to line Lp (**Di**) and from that of the adjacent natural tooth to line Lp (**Dt**) were measured. The dimension of interproximal soft tissue was determined by measuring the shortest distance from the top of the papilla to the alveolar ridge (**Ph**).

The correlation between each variables was calculated using Spearman's rank correlation ($P < 0.01$).

Results: The mean Di was 3.04 ± 0.84 (SD), the mean Dt was 5.23 ± 1.62 and the mean Ph was 3.18 ± 0.97. Between Dt and Ph, correlation was significant (rho = 0.80). Between Di and Ph, however, correlation was not significant (rho = 0.35).

Conclusion: The bone level of adjacent natural teeth seems to have significant correlation with the dimension of interproximal soft tissue between natural tooth and implant.

073 | Topic Implant Aesthetics

Dimension of interproximal soft-tissue on single implant and contra-lateral teeth

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Object: The purpose of this study was to measure and to compare the dimension of soft tissue from the tip of papilla to the crestal bone between 1) single implant and tooth 2) natural teeth on contra-lateral side.

Methods: The present study involved 30 interproximal papillae between single implant (Astra Tech implant) and natural tooth and 30 contra-lateral interproximal papillae between natural teeth in 30 patients. Subjects had implant-supported prosthesis in place longer than 1 yr. All the subjects had history of periodontal treatment (surgical or non-surgical) prior to the implant 1st surgery and enrolled in the maintenance phase of periodontal therapy. The shortest distance from the tip of the papilla to the inter-implant-tooth (PI)/inter-dental (PN) crestal bone was measured with non-invasive method, using radiograph. The soft tissue condition on implant and natural teeth was recorded. Wilcoxon Signed Ranks Test was performed in order to see the dimensional difference between PI and PN.

Result: The mean value of PN was 3.28 ± 0.77 (SD) and mean value of PI was 3.20 ± 0.63 (SD), respectively. Wilcoxon Signed Ranks Test revealed that there was no difference between PN and PI ($P = 0.67$).

Conclusion: The result of the present study showed that in periodontally treated patients, the interproximal soft tissue in natural dentition and contra-lateral interproximal soft tissue between natural teeth and single implant showed similar dimension. Thus, preserving the proximal bone in implant therapy would be crucial for the maintaining the level of clinical papilla.

074 | Topic Implant Aesthetics

The influence of soft tissue thickness on crestal bone changes around implants

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Introduction: It is well documented in the literature that two-piece implants undergo early crestal bone loss within 1 year after delivery of prosthesis. Many factors have been advanced as a possible reasons for this bone change – microgap, polished implant neck, occlusal overload, infection. One more factor – biologic width – the distance between crest of the bone and margin of peri-impalnt mucosa. The formation of biologic width depends on initial gingival tissue thickness before implant placement. We can make hypothesis, that initial tissue thickness can influence crestal bone loss.

Material and methods: Prospective controlled randomised study was initiated, placing 2 implants in different position to bone crest. Before placement, tissue thickness was measured. In total 56 implants were placed. Intra-oral radiographs were taken to evaluate crestal bone loss after 1 year. Results were evaluated using paired samples *t*-test.

Results: The difference of bone loss between test and control groups was statistically significant.

Conclusion: The results of the study imply that in case of thin gingival tissue, we can expect crestal bone loss in the process of biologic width formation.

075 | Topic Implant Aesthetics

Comparison of the implant crown aesthetic index with patient satisfaction

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To evaluate the aesthetics of an implant-supported single crown and surrounding mucosa an index has been developed and published. Aim of the study was to compare results of the Implant Crown Aesthetic Index with satisfaction scores of a patient questionnaire.

In a prospective study 93 patients received a local bone augmentation in a separate session and subsequently a Straumann Standard Plus® dental implant and a crown. All implants were situated in the aesthetic zone of the upper jaw. Colour photographs were rated according the index and results were compared with the patient satisfaction scores.

The mean total score of the index was 4.8 with 66% of the patients with an acceptable result. The patient satisfaction score revealed a mean satisfaction score of 8.5, with an acceptable result for all patients. Index analysis of the crown itself revealed 90% of the patients with an acceptable result. Patient satisfaction concerning the crown showed a mean score of 0.08 with 82% of the patients totally satisfied. Index analysis of the surrounding mucosa revealed 70% of the patients with an acceptable result. Patient satisfaction concerning the mucosa showed a mean score of 0.31 with 43% of the patients totally satisfied. Spearman's rank correlation and linear regression showed only significant relation between index and patient satisfaction for the mucosa (95% confidence interval).

It can be concluded that the surrounding mucosa is rated less satisfactory than the crown by both dental professionals and patients and that professionals are more critical of the aesthetic outcome than patients.

076 | Topic Implant Aesthetics

Clinical and radiographic characteristics of single tooth replacements after augmentation

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Objectives: To assess the influence of 3 augmentation techniques (chinbone with or without a Bio-Gide® membrane and Bio-Oss® with a Bio-Gide® membrane) on clinical and radiographic characteristics of hard and soft peri-implant tissues and adjacent teeth in the reconstructed maxillary anterior region, up to 1 year after functional loading.

Materials and methods: Ninety-three patients requesting single tooth replacement and presenting with a horizontal bone deficiency were included. After augmentation, 93 ITI-Esthetic^{Plus} implants were placed. Clinical variables, standardised photographs and radiographs were analysed to assess the impact on the levels of the marginal gingiva (MGL) and marginal bone (MBL) around implants and adjacent teeth, viz. at pre-augmentation (TPA), pre-implantation (TPI), and 1 (T_1) and 12 (T_{12}) months after final crown placement.

Results: Implant survival was 97.8%. No significant differences were observed in the treatment outcomes of the 3 augmentation modalities other than a slight increase in the implants approximal pocket depth between T_1–T_{12}. Approximal bone loss at the implant between T_1 and T_{12} was 0.14 ± 0.76 mm (mesial) and 0.14 ± 0.47 mm (distal); the approximal MGL slightly increased (mesial: 0.24 ± 0.46 mm, distal: 0.25 ± 0.66 mm), and the buccal MGL decreased (0.11 ± 0.61 mm). Bone loss at the adjacent teeth, although minor, was significant between TPI and T_1. No correlations were observed in changes of MBL and MGL.

Conclusions: The applied augmentation technique procedure did neither influence the characteristics of the MGL and MBL nor the implant survival of single tooth replacements. Peri-implant hard and soft tissues were very stable in the first year after loading.

077 | Topic Implant Aesthetics

Crestal level and aesthetics in maxillary anterior single-tooth implants

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Purpose of the study: Previous animal study showed favourable crestal bone response to the tapered abutment connection. The objective of this study was to evaluate clinically, in maxillary anterior single-tooth implants : crestal bone stability, aesthetic outcome in interdental papilla level and patients' satisfaction with the restorations.

Materials and method: This is a retrospective study of at least one year follow-up. The implant system used in this study was the Ankylos® (Dentsply-Friadent, Germany). Measurements of proximal crestal bone levels were made from digital photographs of pre- and post- loading radiographs. Clinical photographs of the subjects were taken to record the papilla level proximal to implants using Jemt index (1997). Papilla height was measured with metal ruler from the clinical photographs. The subjects self-assessed their satisfaction with aesthetics on verbal rating (VRS) and verbal analogue (VAS) scales.

Results: 75% of the sites showed no change in crestal bone level and only 10% showed a crestal bone loss of > 2 mm. The papillae almost completely filled the embrasure space except for 1 subject who had Jemt index score 1 for both papillae. All subjects were satisfied with their implant-supported restorations.

The implications of these results in relation to biological width and implant abutment design will be discussed.

Conclusions: Preliminary results showed that the Ankylos® implant system is highly successful in maintaining the crestal bone at the initial period of implant healing and loading. The aesthetic outcome was good not only from clinical assessment but also reflected in the high level of patients' satisfaction.

078 | Topic Implant Aesthetics

Immediate provisionalization of single 3.0 mm diameter implants in anterior regions

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Purpose: Immediate provisionalization of single implants with standard diameter has been well documented. When the space is limited, small diameter implants have been documented with success in healed site as staged procedures. However, prospective study documentation of immediate provisionalization of single small diameter implants has not been reported. This presentation describes the preliminary clinical outcome for immediate provisionalization of single small diameter (3 mm) implants in the esthetic area.

Materials and methods: Inclusion criteria were 1) missing single maxillary or mandibular anterior tooth with the presence of adjacent dentition, 2) minimal edentulous mesiodistal space of 5.5 mm, and 3) adequate bone volume to accommodate an implant with a minimal dimension of 3 × 13 mm. 3.0 mm diameter threaded large-grid sandblasted acid-ached implants were placed in healed sites and immediately provisionalized. Implant success rate and marginal bone level using standardized periapical X-rays were evaluated at 0-, 3-, 6- and 12-month follow-up and all of the complication were noted.

Result: 15 implants have been placed in 12 subjects. All implants were functioning successfully for up to 21 months (mean: 11.5 months). Mean of the bone level at 0-, 3-, 6-, 12-month were −0.03 ± 0.10 mm, −0.31 ± 0.39 mm, −0.49 ± 0.52 mm, and −0.41 ± 0.39 mm respectively. All of the data will be updated on the meeting.

Conclusion: The present study shows that small diameter (3 mm) implants can be used successfully as immediate provisionalization of single restoration in healed sites in maxillary and mandibular anterior regions.

079 | Topic Implant Aesthetics

Creeping of midfacial gingival margin in the anterior implant restorations

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Object: 1 mm recession of midfacial gingival margin occurs during the first year of loading. But the amount of recession may be correlated with the implant system type and clinical protocol. The purpose of this case presentation is to show 3 cases of gingival creeping, and to discuss the contributing factors.

Methods: In the first case, the margin of final prosthesis was located at 1 mm supragingival position, at 3.5 mm above the top of implant. After 6 months, the location of margin was changed to subgingival position.

In the second case, the implants were inserted at the crest level of the alveolar bone. By inducing the creeping of midfacial gingiva, the free gingival margin was coronally repositioned. Finally the vertical overlap of anterior teeth was increased.

In the third case, immediate implantation was done and the provisional crown was delivered in a periodontally compromised site. After 8 months, 1 mm creeping of midfacial gingival margin was achieved.

Results: The contributing factors were considered as follows.

1) implant system with minimum crestal bone loss, 2) implant system with narrow neck design, 3) a slight palatal positioning of the implant, 4) thickening of the midfacial connective tissue by undercontouring transmucosal component, 5) avoiding vertical incision during the second surgery, 6) minimizing the frequency of the abutment reconnection.

Conclusion: Creeping of midfacial gingival margin could be achieved during the early modeling phase. Further studies are needed to evaluate the effects of contributing factors on the creeping of gingiva.

080 | Topic Implant Aesthetics

Modification of gum biotype to prevent midfacial gingival recession

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Object: The length of soft tissue from midfacial bone crest to free gingival margin is about 1.5 times larger than the labial gingival thickness. If the labial gingival thickness around implant restoration is increased, the gingival recession might be reduced. The purpose of this study is to find out the effect of biotype modification on the preservation of the midfacial gingival margin.

Methods: 6 maxillary anterior single implant restorations with minimum 6 months of loading were included in this study. Under the topical anesthesia, the gingival thickness at the implant and its contralateral tooth were measured at a point 3 mm apart from the midfacial gingival margin. The gingival height difference of the implant and its contralateral tooth was measured.

Results: In the cases where the gingival thickness of implant was thicker than that of the contralateral tooth, the gingival margin was preserved aesthetically. But in the cases where the gingival thickness of implant was maintained similarly as the contralateral tooth, gingival recession occurred.

The modification of biotype could have been achieved by doing the following protocols.

First, the implant was inserted into the palatal position. Second, soft tissue graft or xenograft was done at buccal side. Third, labial contour of transmucosal component was under-contoured. Fourth, implant system with a narrow neck joint was adopted.

Conclusion: If the biotype is artificially modified to be a thick biotype, the gingival recession could be minimized.

081 | Topic Implant Aesthetics

Prefabricated telescopic copings for implant-supported overdenture in rehabilitated case

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Purpose: There are different approaches for rehabilitation the patient with complete edentulous opposing partial edentulous arch, which still has some natural teeth. The full fixed, removable or combine of prosthesis are difference in function and esthetic results. This case presentation is to present the technique and outcome of prefabricated telescopic copings for retaining the implant-supported maxillary overdenture opposing the mandibular restorations.

Materials and methods: A 56-year-old man was presented with a chief complaint of 'loosening and unacceptable in appearance of maxillary denture'. After treatment options were discussed and consent form was signed, right and left sinus graft was performed simultaneously with 6 implants (ANKYLOS®, Dentsply Friadent, Germany) placement in the maxillary arch. Five implants (Replace Select; Nobel Biocare, Göteborg, Sweden) were placed in the posterior area of mandibular arch. For maxillary arch, the implants supported overdenture was constructed and prefabricated telescopic copings (SynCone®) were selected for retaining the overdenture. For mandibular arch, crowns restoration was constructed on implants and teeth, except the four incisor teeth were restored with direct composite restoration.

Results: After 3, 6 and 12 months follow-up period, base on clinical and radiographic evaluation, all implants and prosthesis were classified as successful. Furthermore, the patient's acceptance on function and esthetic of this restoration design was high.

Conclusion: The case presentation demonstrates that the prefabricated telescopic copings for retaining the implant-supported maxillary overdenture in rehabilitated case is satisfied in clinical outcome and patient's acceptance over the 1 year follow-up.

082 | Topic Implant Aesthetics

Implant supported prosthetic restoration of edentulism with removable telescopic dentures

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Nine patients were treated. Four implants were placed intraforaminally and subnasally. In four cases they were placed in strategic positions (canines). 8 implantations were performed with flap technique, 1 was flapless using Nobel Guide system. No augmentation was used, only remaining bony structures. All bony foundation were Class I or II, alveolar ridge Type D or E. Three systems were used: Nobel Biocare, Alpha Bio, Sky Implants. Primary telescopes were milled mostly from individual abutments with gingival shoulder. External telescopes were made from gold using galvanoforming and then bonded into chrome-cobalt superstructures. The dentures were finished with Ivoclar Press technology. Occlusion was restored with group function. The telescopes were 4–6 mm high with 0 degree milling.

Very good prosthesis stabilization and retention were achieved. Patients had initially problems with denture removal. No corrections were necessary due to decubital abscesses. One implant was lost but it did not affect the denture function. In one case loading of one implant was delayed due to trauma in implantation area. Very good esthetics on denture level was achieved without soft tissue augmentation.

Telescope anchorage of implant supported removable denture is a good alternative to bar solutions as it offers splinting effect with supreme hygiene. Calculus formation and perimplantitis were not observed. The dentures shoved good long-term retention. Method is relatively expensive but can be reduced using pre-manufactured telescopic abutments. It is suitable in cases where implantation in posterior region is not possible and patients can accept removable denture with ideal stabilization.

083 | Topic Implant Aesthetics

Aesthetic outcome of adjacent implant-supported crowns

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Objective: The purpose of this study was to evaluate the aesthetic outcome of two adjacent implant-supported restorations and the peri-implant mucosa. The dental professionals' judgement regarding the aesthetic result was compared with the patients' judgement.

Materials and methods: Patients treated with two adjacent implants in the anterior maxillary zone in the period 1990–2005 at the University Medical Center Groningen, were recalled. 15 of the 18 patients agreed to participate in this study. The following parameters were analyzed: implant survival, marginal bone level, vertical distance between the base of contact point and the crestal bone, Papilla Index, probing depth, Aesthetic Index and patient satisfaction.

Results: Implant survival was 100%. The mean Papilla Index was 0.8 between two adjacent implants and 1.7 between an implant and its neighbouring tooth. The outcome of the Aesthetic Index determined by a prosthodontist was excellent in 0%, satisfactory in 7%, moderate in 53% and poor aesthetics in 40% of the cases. The judgement of the patients was in 47% excellent and in 53% of the cases satisfactory. There were no patients who were of the opinion that the aesthetic result was moderate or poor.

Conclusion: When placing two adjacent implants in partially dentulous patients, it is difficult to create an acceptable aesthetic result according to the standards of dental professionals. The dental professional was less satisfied with respect to the aesthetic result of the crown and peri-implant mucosa than the patient.

084 | Topic Implant Aesthetics

Chairside provisional posterior restorations optimizing the emergence profile – case series

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Prosthetic conditioning of the peri-implant tissues is mandatory to gain desired esthetic results in the posterior region as well as anterior region. Patients' expectations can be challenging even in posterior jaws. It is therefore important to minimize the edentulous post-operative phase of the implant patients by short-term chairside prosthetic applications. This presentation describes chairside techniques by modifying the temporary abutments of different implant systems for fabricating simple posterior provisional restorations. With these techniques it is possible to minimize patients' esthetic discomforts without increasing laboratory costs, and preserve soft tissue starting from the beginning of the treatment plan. Also, creating a pre-emergence profile for the gingiva and pre-contour for the abutment enables us to foresee the permanent crowns' profile and allows as choosing the appropriate angled abutments and superstructure material. Case series treated in our clinic will be presented regarding these chairside techniques.

085 | Topic Implant Surgery

Clinical and biomechanical analysis of immediately loaded implants

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Objectives: The aim of this study is to analyse the clinical and biomechanical results of immediately loaded implants.

Methods: After conventional or CT based implant planning with the SimPlant software (Materialise, Leuven/Belgium) Ankylos® (Friadent GmbH, Mannheim/Germany) implants are placed with a drill guide. A provisional crown is placed at the same day and after six weeks implants are restored with a permanent restoration. Periotest® measurements and periapical radiographs have been taken at baseline and 3, 6, 12 and 24 months postoperatively. Finite Element analysis after μ-CT scans of loaded Ankylos® implants in pig jaws has been performed. The stress, strain and displacement of the implants after loading are displayed.

Results: Up to now 32 patients have been treated. The mean change in cortical bone level after 12 months is +0.04 mm. Increasing density of periimplant bone has been detected after six and twelve months. Only minor differences in Periotest® measurements occurred. After 30 days no further changes have been detected in all cases. The Finite Element analysis correlates with the clinical results, showing loading distribution mainly in the cancellous bone and not in the compacta.

Conclusions: The marginal bone level from the time of implant placement can be preserved. The implant placement and function of the provisional restoration can be significantly enhanced by CT based implant planning and guided implant insertion. The Finite Element analysis results in a good primary implant stability with a homogenous load distribution mainly to the cancellous bone, helping to preserve the marginal bone level.

086 | Topic Implant Surgery

Asepsis during implant surgery and the usefulness of antibiotics

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Objectives: This randomized clinical trial compares the usefulness of pre- and post-operative antibiotics while strict asepsis was followed during implant surgery.

Materials and methods: Two groups of 40 patients with fully or partially edentulous jaws were enrolled. Group 1: 23 men and 17 women, mean age 60, range, 27–82 y, 128 implants, was given oral amoxicillin 1 gram, 1 h preoperatively and 2 grams for 2 days postoperatively. Group 2: 20 men and 20 women, mean age 57, range 26–88 y, 119 implants, received no antibiotics. All patients rinsed with chlorhexidine. Bacterial samples were taken from the perioral skin prior to, and at the end of surgery. They were cultured both aerobically and anaerobically. In 12 patients/group, samples were also taken from the nares. A visual analogue score evaluated symptoms of infection/inflammation such as pain, redness, swelling and pus by both the patient and the periodontologist at suture removal. A *t*-test for independent variables was used.

Results: There was no significant difference ($P > 0.05$) between both groups, neither for the clinical parameters, nor for the microbiota. *S. aureus* was detected in one patient (nares) only. Three patients lost 1 or 2 implants. They all belonged to the no antibiotics group, but there were confounding factors in 2 of them (heavy smoking or parafunction).

Conclusions: Antibiotics do not provide significant advantages concerning postoperative infections in case of proper asepsis. It also does not reduce perioral microbial contamination.

087 | Topic Implant Surgery

Sinus lifting and simultaneous implant installation with xenogenic bone only

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Purpose of study: The aim of this retrospective study was to evaluate the survival and success rate of installed implant in maxillary sinus which had been operated in 1-stage using xenogenic bone only.

Patients & methods: From 2003 to 2005, total 104 implants were installed immediately after sinus lift in 48 maxillary sinuses of 38 patients (M:F = 28:10). All the implants were Implantium® (Dentium Co., Korea) and only xenogenic bone (Bio-Oss®, Swiss) was used. Sixty-two implants were installed where the residual bone was less than 4 mm and 42 implants were installed where the residual bone was between 5 to 7 mm. Bio-Oss® were grafted to sinus cavity and no autogenous bone graft was performed. Average follow-up periods after loading was 23.7 ± 0.4 months and the survival and success rate of implants was evaluated.

Results: Average residual bone height was 4.1 ± 1.4 and the initial stability was obtained through skipping the final countersink drill. Marginal bone loss was 0.2 ± 0.4 mm. All implants were survived but 2 implants showed 1.5 mm marginal bone loss after 2 years so the success rate was 98%.

Conclusion: Simultaneous implant installation with sinus lift can be a predictable treatment for patients having less than 4 mm residual bone height. Xenogenic bone graft only was stable in short term follow-up. Appropriate selection of implant and using the meticulous surgical technique is mandatory for successful surgery in sinus lifting surgery. One stage surgery reduces the surgical procedure and time for implant restoration.

088 | Topic Implant Surgery

Numerical simulation of peri-implant early bone healing

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Objectives: Understanding the biomechanical properties of peri-implant early bone healing is crucial. The purpose of this study was to evaluate the effect of mechanical stimulus on trabecular bone formation around a dental implant.

Materials and method: Stress/displacement analyses were performed using a numerical submodeling technique. In this

regard, a global model with coarse mesh including a dental implant with cortical and trabecular bone was created. Region of interest was defined to study a localized part of global model with a refined mesh. Accordingly, the submodel comprised 0.9 mm wide trabecular bone around implant length of one thread. Numerical models of freshly placed and osseointegrated dental implant were constructed with arbitrary defined trabecular bone morphology. Additional four models to simulate 4 h, 1, 4 and 8 weeks of trabecular bone healing were designed depending on the knowledge obtained from available animal studies in literature. Within and between simulations of peri-implant bone healing, different elastic bone properties and bone-implant interface conditions were considered. 100 N of oblique static load was applied on the abutment.

Results: Higher compressive stresses were localized at implant thread on the side opposite the location of force application at 4 h and 1 week models. Tensile stresses were higher on the side of force application at osseointegrated model, yet distributed evenly. Changes in elastic properties and bone-implant interface conditions did not differed displacement values.

Conclusion: Mechanical stimulus following implant placement did not cause remarkable differences during early healing of trabecular bone around a dental implant.

089 | Topic Implant Surgery

Peri-implant epithelium around ''platform-switched'' implant

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Purpose: The 'platform-switched' implant system has emerged as one of the effective implant treatment. However, supportive basic studies in this system have not yet been reported. To prove the importance of this system, we have done the following studies; the attachment of peri-implant epithelium (PIE) to the implant surface, comparing the four types of 'platform-switched' and 'non-switched' implant model, respectively.

Materials and methods: Six-week-old male Wistar rats were used for the 'platform-switched' and 'non-switched' implant model. The experiments are as follows; the comparison of the extent of penetration of Horseradish peroxidase (HRP) as an exogenous factor, laid on the gingival margin around the implant body, with all models.

Results: The penetration of an exogenous factor: In the 'platform-switched' implants system, strong DAB reaction based on HRP is only seen in the coronal region of the PIE, whereas the reaction is seen in the apical region and the connective tissue in the 'non-switched' implants systems. Of these, the type in which 'platform-switched' level is higher and wider in the implant body can stop the penetration at the high region.

Conclusion: The 'platform-switched' implant system allows PIE to elongate apically. However, this system can inhibit penetration of HRP from the gingival sulcus into the connective tissue under the PIE, compared with 'non-switched' implant system. These findings suggest that this system is effective for the sealing of the epithelium-implant interface.

090 | Topic Implant Surgery

A tool for predicting the long-term outcome of implant surgery

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Long-term stability of implants depends, among other factors, on the mechanical environment around the implant. Numerous algorithms have been implemented to simulate the influence of these forces on the osseointegration. Unfortunately, most of this work is only used as a research tool and does not have any real clinical application. Though, predicting the evolution of bone in the future would allow clinicians to pick the optimal implant position.

The method we propose combines a bone remodelling algorithm with a planning software. Once the position of the implant has been decided on the planner, bone properties around the implant are extracted from the CT scan and fed into a finite element mesh. Then typical forces encountered by a normal implant are applied on the mesh and a remodelling loop starts. Evolution of the bone mineral content around the implant is calculated. The algorithm that has been chosen makes it possible to know the result of the remodelling after a definite period. The result show zones where the bone is most likely to grow or degenerate after this period as well as an evaluation of the implant stability.

Adding advanced technologies such as bone remodelling to planning is the best way to integrate it into the clinical workflow. This method allows clinicians to get a preoperative insight on the biological evolution of a case for the first time.

091 | Topic Implant Surgery

Relevance of soft tissue cutting with an ultra-sonic surgical device

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Introduction: Ultra-sonic bone surgical (USBS) devices became recently available on the market to perform bone surgery, easier and safer than with rotating instruments. With this device, the vibrating tip does not endanger soft tissues when it comes into contact. We report here on soft tissue cutting with a new tip adapted to an USBS device and its surgical relevance.

Material & methods: 10 patients requiring soft tissue surgery on both sides of the maxilla were enrolled. 3 patients had crown lengthening, 3 had sinus elevation, 4 had bilateral implant placement. In a split mouth design, soft tissue surgery was performed with a 15C scalpel and on the other side with a new designed tip adapted to the UBS device. Working conditions

were power 7–9 and frequency 32–38 KHz. The following parameter were compared: 1) ease of straight soft tissue section, 2) ease of curved soft tissue section, 3) bleeding upon section, 4) bleeding 5mn afterwards, 5) swallowing during the first week, 6) pain during the first week, 7) Aspect of soft tissue healing at 2 weeks.

Results: 1) Ease of straight sections was similar for both methods, 2) for curved sections, the scalpel was easier, 3) upon section, heavy bleeding was recorded with the scalpel; no bleeding was recorded with the vibrating tip, 4) bleeding afterwards was heavy with the scalpel and very limited with the UBS, 5 & 6) swallowing and pain were lower at the UBS treated side for 80% of patients, 7) Soft tissue healing at the UBS side was more advanced for all patients.

Discussion and conclusion: The vibrating tip was moved at a high power and high frequency (> 32 KHz). Under these conditions, the vibration amplitude in the X et Y axes are reduced. They allow a precise and effective section of the soft tissues. Because of the high absorbed energy, blood vessels collapse. This results into a durable physical coagulation-like effect. Refinement of the tip should ease curved soft tissue section. However, *absence of bleeding upon cutting, reduction of swallowing and pain during the first week and advanced healing renders this cutting approach attractive* when compared to the classical scalpel one.

092 | Topic Implant Surgery

Early failure rate of orthodontic mini-implants

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Mini-implants are increasingly used for orthodontic anchorage. The advantages of the mini-implant include easy placement, reduced operating time, increased patient comfort and easier maintenance of soft tissue health. However they have a high failure rate. Mini-implants have occasionally been removed because of their mobility and failure is more likely when implants are placed to posterior maxilla. The aim of this prospective study was to assess the early failure rates of mini-implants. 42 patients, 30 female and 12 male ranging in age from 12 to 23 years enrolled in this study. A total of 42 mini-implants (Anchor Plus, MS OMS) were placed to posterior maxilla and mandible. The diamater of the implants 1,2 and 1,4 mm and their lengths were 8,10 and 12 mm. A variety of orthodontic loads were applied. The application of orthodontic force was started 2 weeks after installation. The success rate of mini-implant anchor was %92.9. Failures of mini-implants occured after orthodontic force loading in first month. 3 mini-implants were lost in posterior maxilla due to lack of retention. Of the 3 failed mini-implants the diamaters were 1,4 mm and lengths were 8 and 10 mm. Our study results suggest that mini-implants can be use for orthodontic anchorage. Because of lower density of bone, failure is more likely when implants are placed to posterior maxilla.

093 | Topic Implant Surgery

Osteotome-mediated sinus floor elevation with and without sinus membrane perforation

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The osteotome technique has been successfully used for implant placement when a limited vertical height is available at posterior maxilla. The purpose of this study to evaluate the clinical success of osteotome sinus floor elevation technique in the posterior maxillary region with and without perforation. Twenty five patients (14 male, 11 female; mean age 44 years) who received a total of 48 dental implants together with indirect sinus lifting procedure were included. Patients with minimum 7 mm height of residual bone in the posterior maxilla underwent sinus floor elevation and implant placement using osteotome without any bone grafts simultaneously. The elevation height was maximum 3 mm. All implants were placed following a one-stage protocol. The mean follow-up time was 14 months. Clinical examination and radiographs were conducted. In 12 cases perforation occured. In both two groups no sinus complication was observed during the follow-up. Two implants in perforated sinus membrane were lost in the first month because of the unsufficient bone quantity (D4). Two failed implants were 10 mm in length and 3,3 in diameter. All of the 46 implants gained osteointegration and restored with cement retained metal-ceramic crowns. Osteotome mediated sinus floor elevation with or without perforation was a predictable and safe technique.

094 | Topic Implant Surgery

Evaluation of rfa and ct values at implant placement

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Objectives: The purpose of this clinical study was 1 to evaluate a possible correlation between bone density and implant stability by assessing ISQ values and Hounsfield units in mandibular molar region and 2 to evaluate the value of presurgical CT diagnosis for predicting initial implant stability in dental implants in mandibular posterior region.

Methods: The study sample consisted of 11 subjects with 22 implants in the mandibular molar area. CT machine was used for preoperative evaluation of the jawbone for each patient, and bone densities were recorded in Hounsfield units (HU). Resonance frequency analysis (RFA) was also performed during implant surgery immediately after the implant placement with Osstell machine.

Results: The mean ISQ and HU values were 74.681 ± 4.664 and 655 ± 185 HU at surgery, respectively. Statistically significant

correlations have been found between the RF values, and mean bone density ($P < 0.05$).

Conclusions: According to these results it may be speculated that presurgical CT diagnosis could be helpful for predicting initial implant stability.

095 | Topic Implant Surgery

Immediate loading in 105 expanded-platform implants during 16-month follow-up

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Purpose: The aim of this study was to report on our experience and outcomes with Certain Prevail Implants and immediate loading via the Diem System after a 16-month follow-up period.

Materials and methods: Over a 16-month period, 105 (14 maxilla, 91 mandible) expanded-platform implants were placed in 18 patients (15 females, 3 males; 55.97 ± 7.25 years). Resonance frecuency analysis (RFA) was measured on the day of placement and at 3, 12 and 16 months. All prostheses were screw mounted on IOL DIEM standard abutments. The follow-up time varied between 3 up to 16 months.

Results: One implant (0.9%) failed during one of the final prothetic placements (3 months). The RFA (ISQ) measurements for 4 mm-diameter implants were: 74.96 ± 5.42 at day 0; 66.43 ± 4.57 at 3 months; 75.0 ± 5.39 at 12 months; and 76.13 ± 5.0 at 16 months. The same RFA (ISQ) for 5 mm-diameter implants was: 75.17 ± 3.48 at day 0; 66.50 ± 1.87 at 3 months, 75.50 ± 7.39 at 12 months; and 76 ± 7.77 at 16 months.

Discussion: Peri-implant soft tissue condition, bone resorption, and ISQ values indicated satisfactory results. The cumulative implant survival rate during the follow-up period was 99.1%.

Conclusions: Immediate loading on IOL Diem abutments is a reliable and effective technique for edentulous patients in the maxilla and mandible.

096 | Topic Implant Surgery

Comparison of implant-prosthodontic treatments in cases of intermaxillary dimension loss

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Implant-prosthodontic treatments of two cases of intermaxillary vertical dimension loss are shown. After extensive diagnostic procedures, including manual functional analysis and cephalographic analysis, it was decided in one case to keep the present intermaxillary angle values, hence gaining the needed space by bilateral alveolar ridge reductions. In the second case it was decided to use occlusal splint therapy, thus gaining the needed space by changing the intermaxillary angle.

Following surgical, endodontic and conservative treatment in upper and lower arches of both patients, intermaxillary dimensions were recorded, OPGs were made, and vertical dimensional alveolar ridge measurements were made using specifically designed software. In one case, the measurements showed that surgical reduction of approximately 4–9 mm bilaterally in lower jaw would ensure sufficient intermaxillary space for implant-supported fixed prosthodontic dentures without interfering with the intermaxillary angle. The implant placement was delayed for 2 months after roots removal and ridge reduction. In the second case, after a period of 6 months of the occlusal splint therapy the intermaxillary distance at the medial line was enlarged by 4 mm, and maintained by temporary bridges until the end of implant-prosthodontic therapy.

Following the period of osseointegration, in both cases fixed prosthodontic dentures were made, one without changing the intermaxillary angle, and the other with changing it. Regular 6-months follow up has shown satisfactory results after 4 years.

097 | Topic Implant Surgery

Immediate loading in the mandible rehabilitation with three implants

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Objective: To evaluate the success index of implants and prostheses on total rehabilitation of the mandible, by immediate loading through the insertion of three implants in the anterior region.

Methods: Seven patients (21 implants) over an 18 months period have been appraised and clinically followed for 1, 3, 6, 12 and 18 months, to evaluate implants and prostheses success (Smith and Zarb, 1989). In the surgical procedures, carried out in the Brånemark Osseointegration Center - São Paulo - Brazil, three implants have been inserted (Standard, Nobel Biocare, Gothenburg, Sweden) in the anterior region of the mandible (first premolar region – in agreement with the emergency position of the mental foramen, and at the symphysis region) to support, in an immediate loading procedure, a screw-retained fixed prosthesis with a metallic infrastructure and 10 teeth, installed the next day after surgery.

Results: After the follow-up period, the success index was found to be 100% for both the implants and the prostheses.

Conclusion: Mandible rehabilitation by means of immediate loading, through the insertion of three implants, is a simple, fast and economic protocol that can allow the access of more patients to a treatment with osseointegrated implants, by maintaining similar success indexes. However, more cases by using this treatment and longer clinical follow-up are necessary.

098 | Topic Implant Surgery

Immediate loading of implants presenting a dehiscence defect: a controlled clinical study

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Objectives: To evaluate clinical success and marginal bone loss around immediately loaded Thommen dental implants, with sandblasted/acid-etched endosseous surface, inserted in post-extraction dehiscence defects.

Materials and methods: Twelve patients were selected exibiting a mandibular site with one or more hopeless teeth presenting a periradicular defect involving the buccal bone wall (Test Sites) and one or more contiguous edentulous sites or condemned teeth with intact alveolar bony walls (Control Sites). At surgery (baseline), TS defect maximum height and width was recorded, 14 implants were placed, receiving an autogenous cortical bone particles graft and a collagen membrane, according to GBR principles. Seventeen implants were installed in CS, all surrounded by adequate bony volumes. Implants were positioned at the crestal level, had to be screwed with ≥ 35 Ncm. insertion torque and prosthetically solidarized and immediately loaded through a screw-retained provisional restoration. The permanent restoration was fabricated at six months. Follow-up visits were scheduled at 2 weeks, 1-2-3-4-5-6-9-12 months after surgery; standardized periapical radiographs were obtained after implant installation and 3-6-9-12 month after.

Results: In the TS buccal dehiscence had a baseline mean height of mm. 3.78 and width of mm. 5.46. At 12 months the mean marginal bone level was -0.39 mm in CS and $+0.08$ mm in TS, with respect to the beginning of thr endosseus surface. In TS a mean bone gain of 1.77 mm was observed. The implant success rate was 100% in both groups.

Conclusions: Immediate loading clinical and radiological success is achievable in combination with perimplant dehiscence treatment.

099 | Topic Implant Surgery

Influence of inter-implant distance on bone microstructure: a histomorphometric study in dogs

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The microstructure of the crestal alveolar bone is important for both the maintenance of osseointegration and the location of the gingival soft tissues. The aim of this study was to evaluate and compare the bone microstructure of alveolar bone and of the inter-implant bone in implants inserted at different inter-implant distances. The mandibular bilateral premolars of six dogs were extracted and, after 12 weeks, each dog received eight implants, for a total 48 implants (Frialit, DENTSPLY-Friadent, Mannheim, Germany). Two pairs of implants, one for each hemi-arch, were separated by 2 mm (group 1) and two by 3 mm (group 2). After 12 weeks, the implants received temporary acrylic prostheses. After four more weeks, metallic crowns substituted the temporary prostheses. After an additional 8 weeks, the animals were sacrificed and the hemi-mandibles were removed, dissected, and processed.

The longitudinal collagen fibers orientation was 43.2% for the alveolar bone; 30.3% for the 2 mm group, and 43.9% for the 3 mm group. There was a statistically significant difference between the 2 mm and 3 mm groups ($P < 0.05$). The transverse collagen fibers orientation was 47.8% for the alveolar bone; 37.3% for the 2 mm group and 56.3% for the 3 mm group. There was a statistically significant difference between the 2 mm and 3 mm groups ($P < 0.05$). The marrow spaces were 34.87% for the alveolar bone, 52.3% for the 2 mm group while 59.9% for the 3 mm group. There was a statistically significant difference between alveolar bone and the 3 mm group ($P < 0.05$). The low mineral density index was 36.29 for the alveolar bone, 46.76 for the 2 mm group and 17.91 for the 3 mm group. There was a statistically significant difference between the 2 mm and 3 mm groups ($P < 0.05$). The high mineral density was 87.57 for the alveolar bone, 72.58 for the 2 mm group and 84.91 for the 3 mm group. There was a statistically significant difference between alveolar bone and the 2 mm group ($P < 0.05$).

The collagen fiber orientation resulted in statistically significant differences in both 2 and 3 mm groups compared with alveolar bone. The marrow spaces appeared significantly increased in the 3 mm group compared to alveolar bone. The low mineral density index was significantly higher in the 2 mm group while the high mineral density index was significantly higher in the alveolar bone.

Considering the bone microstructure characteristics, evaluated in the present study, the interimplant distance should not be less than 3 mm.

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A multicenter prospective study for the rehabilitation of the atrophic edentulous maxilla: immediate load and tilted implant

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Objectives: The aims of this prospective study were to assess the treatment outcome of immediately loaded full-arch fixed bridges anchored to both tilted and axially placed implants for the rehabilitation of fully edentulous maxillae and to compare the outcome of axial versus tilted implants.

Material and methods: Forty-one patients with edentulous maxillae were included in the study. Each patient received a full-arch fixed bridge supported by four axial implants and two distal tilted implants. Loading was applied within 48 h from surgery. Patients were scheduled for follow-up at 6 months, 1 year and annually up to 5 years. Radiographic evaluation of marginal bone level change was performed at one year.

Results: One patient died four months after surgery. Thirty patients were followed for a minimum of one year (range 3–42

months, mean 22.1 months). Three failures were recorded at one-year follow-up (two axial implants and one tilted). Two more implants (one tilted and one axially placed) were lost within 18 months of loading. The one-year implant survival rate was 98.8% for both axial and tilted implants. Prosthesis success rate was 100% at one year. Marginal bone loss around axial and tilted implants at 12-month evaluation was similar, being respectively 0.9 ± 0.4 (standard deviation) mm and 0.8 ± 0.5 mm.

Conclusions: The present preliminary data suggests that immediate loading associated with tilted implants could be considered a viable treatment modality for the atrophic maxilla and that there seems not to be a different clinical outcome between tilted and axial implants.

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A multicenter, randomized controlled clinical trial: immediate non-occlusal versus early loading of dental implants in partially edentulous patients

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Purpose: To compare the efficacy of immediate non-occlusal loading (test group) versus early loading (control group) in partially edentulous patients.

Materials and methods: Fifty-two patients were randomized in 5 Italian private practices: 25 implants Osseotite NT (3i, West Palm Beach, USA) in the immediately loaded group and 27 in the early loaded group. To be immediately loaded, single implants had to be inserted with a torque ≥ 30 Ncm, and implants going to be splinted with a torque ≥ 20 Ncm. Implants in the immediately loaded groups were provided with full acrylic non-occluding temporary restorations within 48 h after placement. After 2 months full occluding provisional restorations were provided. Implants in the early loading group were not submerged and were loaded after 2 months. Eight-month post-insertion provisional restorations were replaced with definitive gold-ceramic prostheses. Outcome measures were prosthesis and implant failures as well as biological and prosthetic complications recorded by non-blinded assessors. Fisher's exact test was used to compare the proportion of implant failures.

Results: Fifty-two implants were placed in the immediately loaded group and 52 in the early loaded group. No drop-out or complications occurred. One single implant failed in the immediately loaded group after 2 months of loading. There was no statistically difference for the tested outcome measures between the 2 procedures with a implants cumulative success rate of 99.48% after 22 months of follow-up ($P = 1.00$).

Conclusions: Implants can be successfully loaded immediately when non-occluded for the first two-months in partially edentulous patients.

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Guiding process for full arch immediate loading in maxilla

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Objectives: The classic protocol of treating the edentulous maxilla with implants has been successful but leads to a long period of wearing ill-fitting dentures before the final restoration. The purpose of this study is to determine a guiding process concept for full arch immediate loading in the maxilla with 6 morse-taper design implants with provisional screw-retained acrylic prosthesis used for surgical and prosthetic guide.

Material and methods: According to the principle of cross-arch stabilisation and pick up technique, six implants Ankylos® (Denstply-Friadent GmbH, Mannheim/Germany) have been strategically positioned to allow the placement of an immediate full arch screw-retained provisional, in one-stage procedure and in bi-lateral position 3 (cuspid), 4, 5 (premolars).

Twenty four (24) implants were placed in at 1.5 mm ± 0.5 mm under level of the alveolar crest with a surgical guide. The implant length ranges from 11 to 14 mm with a diameter of 3.5 mm or 4.5 mm. During the time frame of the observations, there was neither loss nor loosening of an implant. There is no vertical bone loss detected around the peri-implant bone.

A final screw-retained metal-ceramic prosthesis replaced the provisional prosthesis after 18 weeks. In this protocol, the provisional prosthesis is used to transfer impression, master cast confection, dimensional and aesthetic set-up for the definitive prosthesis. All cases are summarised and one of them described.

Results and conclusion: The preliminary above results showed that direct loading of the totally edentulous maxilla on six implants is possible with a predictable treatment time and reliable success rate but the construction of provisional prosthesis is crucial as well as the patient selection. An increased number of patients and a longer observation time are necessary to confirm these initial results.

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RFA diagnostic efficacy in immediate loading protocol. A multicentric study

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Objectives: 1) to measure primary implant stability and its changes in the immediate loading protocol by RFA; 2) to compare ISQ values yielded at the implant placement, 4 months after and 12; 3) validate RFA for the follow-up of the osteointegration process.

Methods: A multicentric study was performed: 3 patients were recruited for each of 5 different dental offices. In each patient were placed 5 to 6 implants (total 92 Defcon® implants) in interforaminal region. On 10 patients RFA measurements (at the surgery; after 4 months and after 1 year) where taken for a total of 52 implants and 156 measurements.

Results and statistics: No failures at 1 year. The intrasurgery measurement showed that all implants had good primary stability (ISQ mean values 71.14); in the second a slight ISQ decrease (ISQ mean values 67.20); in the third a distinct increase, before remaining stable (ISQ mean values 71.30). Descriptive statistics. Wilcoxon rank-sum test for statistical significance ($P < 0.05$): a statistically significant ($P = 0.002$) decrease in ISQ between T1 and To. A statistically significant recovery ($P = 0.001$) between T2 and T3.

Conclusions: Within the limitation of this study it is concluded that the starting RFA values decrease in the following months after loading because of osteointegration process that is completed at the forth month.

Thus it is necessary to collect more data to formulate the scientific basis for guidelines to surgical and loading protocols to validate the RFA as a reliable tool to determine implant stability and long-term clinical outcome.

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V-Two-V Technique: case series

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Purpose: The aims of this report were to evaluate the V-Two-V technique for the immediate rehabilitation of edentulous maxilla and to compare the outcome of axial versus tilted implants.

Material & methods: Fourteen maxillae had been rehabilitated with this new method. The V-Two-V technique consists of an of immediately loaded full-arch fixed bridge anchored to both tilted and axially implants: two anterior implants (NobelSpeedy™ Groovy®, Nobel Biocare AB, Göteborg, Sweden) were placed axially in the pre-maxilla, parallel to the midline while two other implants for each side were placed tilted relative to the occlusal plane. One of these was tilted distally approximately 30°–35° relative to the vertical plane parallel to the anterior sinus wall while the last one was placed tilted mesially 30°–35° parallel to the posterior sinus wall.

Loading was applied within 2 h, while the final restoration were placed after 6 months. Periapical radiographs using a paralleling technique and an individual X-ray holder were performed at each follow-up visit.

Results: The follow-up range was 4–13 months. No implant failure was recorded up to date, leading to a cumulative implant survival and prosthesis success rate of 100%. Marginal bone loss around axial and tilted implants was not significantly different after six months of loading.

Conclusion: The present preliminary data suggests that the V-Two-V could be considered a viable treatment modality for the immediate rehabilitation of the edentulous maxilla.

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Dental implants placement after maxillary sinus floor augmentation with anorganic bovine bone and autogenous bone

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Objectives: The purpose of this study was to evaluate the clinical success of dental implants placed in maxillary sinuses augmented with anorganic bovine bone and autogenous bone.

Materials and methods: In 48 consecutive patients, 65 maxillary sinuses were augmented with mixture of a 1: 4 autogenous bone/ anorganic bovine bone (Bio-Oss) mixed with platelet rich plasma. 138 implants were placed on 7 months after sinus grafting. Loading of implants was allowed following an average time of 6.1 months. The follow time was 10–32 months after implant placement. The survival rate of implants and percentage of sinus membrane perforation were evaluation.

Results: During the augmentation procedure, 18 perforations of the Schneiderian membrane were observed with a perforation rate 27.7% (18 perforations/65 treated sites). Symptoms sinusitis were observed in 9 patients and successfully treated with antibiotics. 19 of 138 inserted implants in 10 patients were lost during the follow-up (12 before loading and 7 after functional loading), for survival rate 86.3%.

Conclusions: Acceptable short-time results can be obtained with implants placed after maxillary sinus floor augmentation.

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Sinus floor augmentation and simultaneous implant placement: a histomorphometric analysis

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Clinically, a minimum of four mm of residual crestal bone height is regarded a necessary condition when performing sinus floor augmentation and simultaneous implant placement.

It has been our aim to test this empirical assumption in an experimental animal trial.

In eight minipigs three maxillary premolars and two molars were removed unilaterally. Three months later the height of the alveolar crest was reduced to 2, 4, 6 and 8 mm, respectively. 6 implants (Xive, Dentsply Friadent, diameter 3.8 mm, length 13 mm) were placed on each side of the maxilla and a sinus floor augmentation was carried out. Implant stability was assessed by resonance frequency analysis (RFA). After six month of loading, the animals were sacrificed and the implants were retrieved together with the adjacent bone. Histologic specimens were prepared and histomorphometric analysis was performed.

An analysis of variance revealed that neither the bone-to-implant contact (BIC) ratio ($P = .20$) nor the interthread bone area ($P = .25$),

the peri-implant bone area ($P = .39$), or the crestal bone resorption ($P = .25$) were influenced by the residual bone height. On the other hand histomorphometric data were significantly correlated with resonance frequency after six month of loading ($P < .01$).

From an experimental point of view, the assumption that 4 mm residual crestal bone height are a relevant threshold for simultaneous implant placement and sinus floor augmentation, is not supported.

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A randomized clinical trial to evaluate nobel biocare replace implant system

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Purpose: The aim of the study was to evaluate the performance of Nobel Biocare Replace implant system.

According to the CONSORT STATEMENT's indications a multicentric clinical randomized trial with 5 year follow – up was designed. A total of 1000 implants were placed in 21 different clinical centres. Here we present the pilot study.

Material and methods: 43 patients recruited starting since 2003 received 97 implants. Only TiUnite surface was used, both with Tapered and Straight profile. Receiving bone was described through Lekholm and Zarb classifications on bone's quality and quantity; all information on surgery technique, insertion torque, and loading timing was recorded at the baseline. After 6 month, 1, 2, 3, 4, 5 years since the loading soft tissue were clinically controlled and bone level was measured by radiographic exam.

Results: The cumulative success rate after 12 month since the loading was 96.8%; the average bone loss was 1,36 millimetres. The Tapered profile implants had less bone loss than the Straights.

Conclusions: The results suggest a high reliability of the system. We aim to complete the 5 years of follow-up in order to obtain a more significative outcome.

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Surgical management of severe bone atrophy of the alveolar ridge for implant placement

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Aim: The aim of this study was to evaluate and compare different surgical techniques of guided bone regeneration, for the rehabilitation of severely resorbed alveolar ridges for implant placement.

Material and method: 36 adult patients (17 males, 19 females) with severe bone atrophy in the maxilla or mandible participated in the study. In all cases implants placement was decided as part of the oral rehabilitation therapy. 12 cases concerned horizontal augmentation, 18 cases vertical augmentation (including sinus membrane lift) and 6 cases 2-dimensional reconstruction. As bone graft materials were used: 1. intraoral (17 cases) and extraoral autologous bone grafts (harvested from the iliac crest and tibia) (5 cases), in the form of blocks or particulated. 2. particulated autologous bone graft mixed with allograft (14 cases). In 20 cases resorbable and in 16 cases non-resorbable barrier membranes were used. Implants were placed at the same time in 10 cases, where initial stability could be achieved. In the other 26 cases second stage surgery took place 5–7 months later. All patients had a detailed clinical examination every month during observation period.

Results: In all cases bone augmentation was evident and implants could be placed as planed or the osseointegration was achieved. In 3 cases where autologous bone graft in the form of block was used along with non-resorbable membrane, the resorption of the graft was minimal. Better result regarding bone graft resorption revealed, in general, in the cases were non-resorbable membranes were used. In 2 cases the non-resorbable membranes were exposed before the 6th week. The complication was faced with antibiotic prophylaxis and chlorexidine rinses until the 6th week and the membranes were removed with no further problems. No other complication observed.

Conclusion: The use of autologous bone graft in the form of block and non-resorbable membrane demonstrated more predictable results. No serious complications that could jeopardize the placement or the survival of implants was observed, regardless the augmentation technique used.

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Clinical evaluation of two implant systems using reduced healing time

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The aim of this study was to evaluate the success rate of two different implant systems with sandblasted and acid-etched modified surfaces loaded after reduced healing periods. Studies demonstrate a successful use of SLA surfaced implants under reduced healing times, but there is no study regarding shortened healing periods with Promote surfaced implants. All 532 (117 patients) placed implants showed an unloaded healing time of 6 weeks (mandible) and 12 weeks (maxilla). 463 implants with the Promote surface and 69 ITI implants with an SLA surface were inserted. At abutment placement a torque value of 35 Ncm was one of the primary variables and the success of the implants over time was determined by the criteria of Buser. Three implants were lost prior to abutment connection in three edentulous patients. The five-year

survival for each implant type was 99.76% for Camlog RootLine and 98.5% for ITI. Regarding the data found in this investigation we can conclude that implants with Promote® or SLA® surface show equivalent success rates when the time of unloaded osseointegration was shortened. Sandblasted, acid-etched implants placed in the maxilla regardless of the location can be restored after a 12-week healing period with a high predictability of success.

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Immediate function of dental implants in alveolar ridges augmented with bio-oss

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Objective: The present case series aims to illustrate the applicability of a ridge augmentation with deproteinized bovine bone mineral aiming to allow an immediate function of two different dental implants system and compare them.

Methods/Materials/Procedures: The study comprises patients where at tooth extraction it was impossible to place a dental implant. An augmentation procedure was carried out at tooth extraction with Bio-Oss® and Bio-Guide® (Geistlich Pharma AG, Wolhusen, Switzerland). A second stage surgery was performed to allow an immediate function of two dental implants system (Camlog® Camlog Biotechnologies AG, Basel, Switzerland or Nobel Biocare® Nobel Biocare AB, Göteborg, Sweden) with a flapless technique.

Results and conclusions: In a group of 36 patients of a mean age of 48 years (20 to 65) a total of 52 implants has been placed. Twenty height Nobel Biocare® and 24 Camlog®. With a follow up to 44 months (mean 24), 3 implants were lost at 3 to 6 months follow up and could be successfully replaced. The cumulative success rate of the present technique was 94,2%.

All implants were inserted with a torque resistance at least of 30 Ncm and achieved a primary stability in a regenerated bone with the Bio-Oss.

Severely deficient alveolar ridge at tooth extraction can be effectively rehabilitated with a combined technique of augmentation procedure with Bio-Oss followed with immediate function in a two-stage fashion. The results were the same between the two implants system and compares favorably with classical non-augmented bone.

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Peri-implant bone reactions at delayed and immediately loaded implants

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Objective: The aim of this study was to compare the peri-implant bone reactions of implants subjected to immediate loading with those subjected to delayed loading.

Study design: In six mongrel dogs, bilateral, edentulated, flat alveolar ridges were created in the mandible. After three months of healing, one implant was placed in each side. On one side of the mandible, the implant was loaded immediately with a force of 20 N that was applied at a 120° angle with the tooth longitudinal axis at the labial surface of the crown for 1800 cycles per day for ten weeks. On the opposite side, after a delay of three months to allow osseointegration to take place, the implant was loaded with the same force used for the immediately loaded implant. Ten weeks after loading, micro-computed tomography at the implantation site was performed. Osseointegration was calculated as the percentage of implant surface in contact with bone. Bone height was measured in the peri-implant bone.

Results: The mean osseointegration was greater (65.5%) for the delayed-loading implants than the immediately loaded implants (60.9%; $P < 0.05$). The mean peri-implant bone height was greater (10.6 mm) for the delayed-loading implants than the immediately loaded implants (9.6 mm; $p < 0.05$).

Conclusion: Delayed loading of implants can achieve results superior to immediate loading of implants. The specific improvements of this technique include enhanced osseointegration of dental implants and increased bone height.

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Graftless cemented rehabilitation of the atrophied jaws using immediate function

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Objectives of the investigation: The rehabilitation of the edentulous maxilla and mandible, is very often a complicated procedure in those patients who desire for non removal and aesthetic prosthesis. Very often the placement of implants in the posterior maxilla and mandible, is impossible without prior bone grafting. Graftless rehabilitation by placing implants in remaining bone volume is a challenge. Immediate function and immediate loading on implants placed on post extraction sockets add to this challenge.

The objective of this study was to evaluate a simplified treatment concept for fixed and cemented rehabilitation of the atrophic jaws, using implants inserted at an extreme angle and subjected to immediate function.

Experimental method: 103 implants with oxidized surface in 49 patients, were placed in extreme angularity up to 45 degree located mesially to the maxillary sinuses, or to the mental foramens. Additional 2–6 oxidised or rough surface implants were placed at the anterior zone supporting altogether 53 fixed partial or full arch prostheses. Immediate function was applied on all titled implants in addition with 2 implants at least at the anterior zone. The patients were followed for 6–36 months after the surgery. Clinical and radiographic evaluation of the change of the marginal bone level was performed.

Results: 3 titled implants were failed in 3 patients, giving a cumulative survival rate of 96.4% in the maxilla and 100% in the mandible.

Conclusion: Graftless rehabilitation of the atrophied maxilla and mandible, using titled implants with immediate function may be a viable treatment approach with considerable benefits.

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Histomorphometric analysis of an immediate non-functional loaded implant in dogs

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The purpose of this study was to investigate the effects of immediate non-functional loading by analyzing histomorphology around the implant tissues in dogs. Five eight- to nine-month-old full-grown dogs weighing around 12 kg were used in the study. Group I (control group) comprised those in which delayed loading was applied to the right side of the mandible, and Group II (experimental group) consisted of dogs in which immediate loading was performed on the left side of the mandible. Resorbable blast media (RBM)-treated double-threaded US III implants (OSSTEM Implant, Seoul, South Korea) measuring 3.5 mm in diameter and 11 mm long were used in the study. Each animal received four implants in each group, for a total of 40 implants. Cemented type abutments were used after implantation. An 8-week period was allowed for bone healing and an abutment was placed after exposing the periosteum for loading. The same method was used in the experimental group, with an abutment placed for early loading following suturing. A temporary prosthesis was prepared using temporary resin. Occlusion was adjusted in all groups to avoid direct contact with the implants. An implant sample was obtained from bone blocks taken when the dogs were killed at 16 weeks after loading. A Mann-Whitney U-test was performed to evaluate statistical significance. Student's *t*-test was used for the histological evaluation. The bone formation ratio in Groups 1 and 2 was 88.23 and 86.41%, respectively. No significant difference in new bone formation was observed in the two groups. As no significant difference was seen in new bone formation between the delayed and immediate loading groups, early loading might be possible after implant placement.

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Influence of implant insertion depth and size on stress distribution

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Purpose: To investigate the effect of the different implant insertion depth, length and diameter on stress distribution around implants.

Materials and methods: The standard 3-D finite element implant model (diameter, 4.0 mm; length, 13.0 mm; insertion depth, equi-crestal bone level) was simulated on the mandibular first premolar region. A model simulating an implant with insertion depths of equi, 1 mm-below, 1 mm-above to crestal bone level was developed to investigate the influence of the insertion depth factor. The influence of different diameters was modeled using implants with diameters of 3.5 mm, 4.0 mm and 4.5 mm. Also, Implants with 11.5 mm, 13.0 mm and 15.0 mm lengths were used to investigate the influence of the implant length. Loads at 100N were applied at the following directions; 1) vertically; 2) 30° buccally; and 3) 30° lingually. Values of von Mises equivalent stress at the implant-bone interface were computed using the finite element analysis for all variations.

Results: when the diameter and length of the fixtures were the same, the maximum stress in cortical bone was smaller in the '1 mm-below' insertion depth, compared to the 'equi level' or '1 mm-above'. An increase in the implant diameter also led to a decrease in the maximum von Mises equivalent stress value. However the influence of the length of the implant, was not as certain as that of a diameter.

Conclusion: Within the limitations of this study, the magnitude of maximum stress was reduced in the '1 mm-below to the crestal bone level' insertion depth and larger diameter conditions.

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Effect of implant designs on implant stability

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The purpose of this study was to evaluate whether there was a correlation between ISQ value and insertion torque; and to determine whether implant design has an influence on either insertion torque or ISQ value. Depending on the implant fixture design, 3 types of implant were used. Group1: Brånemark type parallel implant in 3.75 × 7 mm (Warrantec, Soul, Korea). Group2: Oneplant type straight implant in 4.3 × 8.5 mm (Warrantec, Soul, Korea). Group3: Oneplant type tapered implant in 4.3 × 8.5 mm (Warrantec, Soul, Korea). Depending on the density of the bone, 2 types of block bone were used: block I bone and block II bone. With the insertion of the implant in block I and block II bone, the insertion torque was measured, then the ISQ value was evaluated, and then the correlation between insertion torque and ISQ value was analyzed. From this study, we could conclude that: 1) Within the 3 different implants, the insertion torque value and ISQ value were higher in block I bone, when compared with block II bone ($P < 0.05$). 2) In block I and block II bone, Oneplant type tapered implant has the highest value in insertion torque ($P < 0.05$). 3) In block I and block II bone, there was no difference in ISQ values among the 3 types of implant. 4) Significant linear correlation was found in Brånemark type parallel implant: 3.75 × 7 mm in block II bone.

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Implant position in relation to adjacent teeth after 2 years in patients with multiple aplasia

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Background: Congenital absence of second teeth in the mandible necessitates the placement of dental implants. There are concerns about the influences of implants on the growth of the adjacent teeth. Here we studied the vertical difference of dental implants and the adjacent teeth in the anterior and posterior mandible in young patients over time.

Material and methods: To evaluate the position of dental implants in relation to the adjacent teeth, we included 13 patients aged 9 to 15 years (median age 13) with aplasia in the study. Orthopantomograms were taken immediately after implant placement and 2 years post-operative. The vertical difference between the lower mandibular margin and the implant shoulder as well as the alveolar ridge of the adjacent tooth was assessed. Data were observed from the anterior and the posterior mandible.

Results: Over two years, in the anterior mandible, the difference between the implant shoulder and the alveolar ridge of the adjacent tooth increased from 0.87 ± 1.86 mm immediately after implant placement to 1.72 ± 2.00 mm after 2 years ($P = 0.04$). Also in the posterior mandible, an increased from 0.10 ± 2.34 mm immediately after implant placement to 1.22 ± 1.68 mm after 2 years was observed ($P = 0.007$).

Conclusion: The data suggest that the implant position in relation to the adjacent teeth can change in the anterior and the posterior mandible of young patients. Our findings suggest that tooth movement is not suppressed in close proximity to dental implants, independent from the position in the jaw.

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Rehabilitation of the complete edentulous maxilla with four zygomatic implants

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The rehabilitation of the edentulous posterior maxilla is a serious challenge to surgeons due to the low bony density, the pneumatization of the maxillary sinus and the atrophy of the alveolar ridge. Several therapeutic options have been developed: sinus lift, onlay bone grafts, alveolar distraction or specially designed implants (zygomatic, pterygoid).

Zygomatic implants present the advantage that the malar bone is not resorbed in the edentulous patient, therefore it becomes a good alternative allowing to avoid the manipulation of the maxillary bone. In the classical technique of the rehabilitation of the complete edentulous maxilla, two billateral zygomatic implants are inserted in combination with anterior maxilla implants. We have modified that technique in patients with severe resorption of posterior and anterior maxilla, inserting four billateral zygomatics implants in combination with pterygoid implants.

Since November 1998 to December 2006 a total number of 134 zygomatic implants were inserted in 71 patients. In 14 complete edentulous patients, four billateral zygomatics implants were inserted in combination with pterygoid implants.

No technical complication was reported during surgery. Several patients referred minor complications:acute sinusitis, facial celulitis and cutaneous fistula. No osseointegration failures or prosthodontic complication have been detected during the period of review.

In our experience, not only the classical but also the modified technique with four zygomatic implants, is a good solution for the rehabilitation of the complete edentulous maxilla. The low index of surgical and prosthodontic complications, and the high degree of osseointegration achieved, allows us to encourage the use of this procedure.

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Treatment of atrophic maxillae and complex cases with zygomatics implants

Moraes E[1], Moraes N[2]

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Objective: The authors present a clinical retrospective study of total maxilla rehabilitations using zygomatic implants in patients of their private center (Rio de Janeiro – Brazil). The purpose of this study is to present treatment options and evaluate the survival rate of 34 zygomatics implants in 14 patients with athrophic maxilla, sequelae of implants complications and postmaxillectomy deficiency.

Materials and methods: Between July 2001 and February 2006 a total of 14 patients (5 women and 9 men with mean age of 58 years) were rehabilitated with fixed prosthesis (12 patients) and removable prosthesis (2 patients) in the treatment of atrophic maxillae. Including 1 patient with oroantral fistulae and other one with secondary oroantral communication, 1 patient with postmaxillectomy deficiency, 5 patients with 2 zygomatics implants and conventional implants in anterior region and 6 patients with implants submitted to immediate load (2 patients with 4 zygomatics implants and 4 patients with two zygomatics implants and conventional implants). Aspects of placement technique or postoperative complications related to surgical procedure likely to affect the implant failure rate were detected and critically discussed.

Results: Osseointegration was evaluated using reverse torque test and percussion. Only 1 patient presented postoperatory clinical complications during the evaluation period which resulted in loss of 1 zygomatic implant (2,9%).

Conclusion: The rehabilitation of atrophic maxillae with zygomatics implants is a predictable treatment in conventional cases with standard implants and 2 zygomatics implants, complex

cases with 4 zygomatics implants, immediate loading and in the complications treatments.

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Treatment of complex cases with immediate loading implants: a clinical report

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Objective: The authors present a clinical retrospective study of total maxillae mandibles rehabilitations using conventional implants and zygomatics implants submitted to immediate loading in patients of their private center (Rio de Janeiro – Brazil). The purpose of this study is to present treatment options in 7 patients with implants complications, prosthesis complications, odontogenic tumor and postmaxillectomy deficiency.

Materials and methods: Between January 2002 and February 2006 a total of 7 patients (3 women and 4 men with mean age of 66 years) were rehabilitated with 23 osseointegrated implants (17 conventional implants and 6 zygomatics implants). Six patients were rehabilitated with fixed prosthesis and 1 patient with overdenture in the treatment of maxillae and mandible. Including 2 patients with overdentures problems, 2 patients with implants complications in the mandible, 1 patient with implants complications in maxilla, 1 patient with odontogenic tumor in the mandible and 1 patient with postmaxillectomy deficiency. Five patients with conventional implants, 1 patient with 2 zygomatics implants and conventional implants in anterior region and 1 patient with 4 zygomatics implants. Aspects of placement technique and prosthetical rehabilitation were related and critically discussed.

Results: Osseointegration was evaluated using reverse torque test and percussion. None failure was detected.

Conclusion: The immediated loading it is an important option of treatment with good results in the maxilla and mandible. It is a predictable technique in standard implants, zygoma fixtures and to the clinical solution of complex cases.

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Marginal bone reaction depending on depth of implant placement

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Aim of the study: The aim of this retrospective study was to determine the marginal bone reaction depending on crestal and epicrestal implant placement and the survival rate of Camlog Implants.

Patients and methods: From August 2001 until August 2005 382 Camlog Implants were inserted in 125 Patients. In a retrospective study, all Patients were contacted for clinical and radiological examination. Indications were: partial denture $n=205$; single tooth $n=61$; edentulous $n=116$, Implant Diagnosis were: caries $n=149$; periodontitis $n=128$; trauma $n=18$; tumor $n=34$; cleft palate $n=3$; atrophy $n=9$. 73 patients with 215 implants were re-examined using a standardised protocol to evaluate periimplant hard- and soft tissue situation. We lost twelve Implants. 143 Implants were placed epicrestal, 72 Implants crestal. Bone loss was measured mesial and distal of the implant by using digital dental radiographics.

Results: The Survival rate was 94%. Median of epicrestal implant placement bone loss was 1 mm, median of crestal implant placement was 1,5 mm Epicrestal implant placement shows significant less bone resorption than crestal placement.

Conclusion: The marginal bone reaction can be influenced by epicrestal or crestal implant placement Regarding the critical diagnosis in this study, the survival rate of 94% is a good result.

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Microscopical examination of osteotomies with ultrasonic, laser and classical procedures

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Objectives: A precise osteotomy is very important in Implant Dentistry. The preparation of hard tissue with ultrasonic technology may secure soft tissue separation in the adjacent areas of an osteotomy. However, it has been discussed that Laser preparation of bone is related with overheating. Unfortunately, there is no study today comparing these two methods in the SEM. The aim of this study was to demonstrate microscopically differences between ultrasonic, Laser und classical osteotomies performed under same in vitro conditions.

Material and methods: Among these were the Piezosurgery procedure, an Er, Cr:YSGG-Laser and an oscillating microsaw. At least six cuts per method were performed on pig rips. The width of the osteotomy was measured by epiluminescence microscopy and the surface was analysed by SEM.

Results: According to precise working the ultrasonic and the Laser osteotomies showed quite equal widths in the epiluminescence microscopy. With the oscillating microsaw it was possible to produce the most precise cuts. The SEM examination showed that all instruments left cracks and melting. Cracks were restricted to the corticalis and meltings to the spongiosa. After use of ultrasonic the border to corticalis was destroyed and presented cracks. Melting was found behind the primary prepared surface in the spongiosa. The Laser prepared osteotomy showed no cracks but some melting. In contrast to that, the oscillating microsaw left cracks (less dramatic than ultrasonic) in the corticalis and nearly no meltings in the spongiosa.

Conclusion: The ultrasonic and the Laser osteotomies presented more difficulties to produce a precise cut than the oscillating microsaw. According to the occurance of cracks and meltings in the SEM, the Ultrasonic method was the worst.

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The novel osteotome sinus floor elevation by tissue-engineered bone

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The objectives of the investigation: The purpose of this prospective study is to evaluate the effects of injectable tissue-engineered bone (TEB) on osteotome sinus floor elevation for the severe bone resorption of the alveolar arrest in the maxilla with simultaneous implant placement for earlier bone regeneration and by minimal invasive operation.

Experimental methods used: This new technology, TEB bone regeneration, used mesenchymal stem cells (MSCs) as cells of three elements in tissue engineering and PRP, which provides signal molecules, as an autologous scaffold. The new regenerated mineralized tissue was evaluated by radiographic examination, computed tomography (CT) and orthopantomograph. Twenty-three implants were placed in 8 patients using osteotome sinus floor elevation with injectable TEB.

Results: The residual vertical height of bone between the sinus membrane and nature bone was 7.6 ± 1.8 mm on average. The mean lift-up bone height of osteotome sinus floor elevation by TEB technology was 5.5 ± 1.6 mm. And no perforations of the Schneider membrane were detected.

Conclusions: This new application, osteotome sinus floor elevation technique with TEB technology, would stably predict the earlier success of bone formation and dental implants, reduce patient burden, and provide minimally invasive cell therapy for the patient instead of sinus floor elevation.

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Osteotome sinus floor elevation without grafting material: a 3-year follow-up

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Objectives: In a previous study (Nedir et al. 2006), the predictability of an osteotome sinus floor elevation procedure with ITI-SLA implants without grafting material was evaluated in maxilla with limited residual bone height (RBH). Implants have now been inserted for at least 3 years. The endo-sinus and crestal bone levels (CBL) are reported herein for the same patient group.

Material & methods: 25 ITI-SLA implants were placed in 17 patients to rehabilitate 16 molar and 9 premolar sites with 4 single crowns and 13 fixed partial dentures. Most implants (21/25) were 10 mm long. The mean RBH was 5.4 ± 2.3 mm. At the 1-year control, all implants were clinically stable and showed a mean endo-sinus bone gain of 2.5 ± 1.2 mm and CBL of 1.2 ± 0.7 mm. At the 3-year control, endo-sinus bone gain and CBL were measured on apical radiographs.

Results: Three years after placement, all implants fulfilled success criteria. The mean endo-sinus bone gain was 3.1 ± 1.0 mm and the mean CBL was 0.9 ± 0.7 mm. During the last two years, 21 sites have kept on slightly gaining bone under the sinus and CBL has not increased except for three implants (+0.3 mm).

Conclusion: All implants gained endo-sinus bone during the first year and this gain has slightly increased for most of them over the two following years. The CBL, limited after one year, has stabilized over the two following years of survey. Despite a limited RBH at implant placement, the endo-sinus bone gained during the first year lead to a predictable long-term implant function.

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Immediate and early loading of straumann® slactive implants

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Objective: The purpose of this presentation is to show the 5 and 12 months results (survival rates), of a 3-year prospective randomized controlled multicenter study of the new chemically modified SLActive surface in immediate and early loading in the posterior region.

Methods: Patients of both genders ≥ 18 years of age with one or more missing teeth in the posterior maxilla or mandible were enrolled in this study. Following implant placement, patients either received a temporary restoration on the day of surgery (immediate loading) or 28–34 days after surgery (early loading); restorations with a single crown or 2–4 unit bridges; loading was done in all 4 bone type qualities if primary stability was achieved. Permanent restorations (PR) were placed 20–23 weeks following surgery. Standardized radiographs were taken at baseline, at PR and at 12 months.

Results: At 5 months, 266 patients were enrolled in this study (118 male and 148 female), and a total of 383 implants were placed, 322 implants could be evaluated for bone level changes between surgery and 5 months post surgery, 170 immediate and 152 delayed. Mean bone level changes over both groups were 0.70 mm. Mean patient age was 46.3 ± 12.8 years. Implant survival rates were 98% and 97% in the immediate and early group respectively. Besides these preliminary results we will report on the descriptive 12 months data and a study update indicating the actual status of our research.

Conclusions: Results show good implant survival rates despite aggressive protocol. (Financial support by ITI Foundation)

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Fluorescence study of bone remodeling after loading in platform switch implants

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Background: Interimplant distances and its effects on the bone response have been in the focus of attention for the last few years. However, tha main concern was the effect that different interimplant distances have on papilla formation and crestal resorption, little attention is paid on the effect that loading may have on the bone when separated by different interimplant distances.

Purpose: The aim of this study was to evaluate, in dogs, the effect that different interimplant distances, after prosthetic restoration, will have on bone remodeling in submerged and non-submerged implants with a 'platform switch' through fluorescence analysis. 56 Ankylos implants were placed, 1.5 mm subcrestally, in 7 dogs. They were placed so that two bridges, with 3 interimplant contacts, with 1, 2 and 3 mm distances could be constructed on each side. The sides (sub or non-sub) and the position of the groups were randomly selected. 3 days before placement of the prostheses, at 12 weeks post-implantation, Calcein green was injected and 3 days before sacrifice, at 8 weeks post-loading, Alizarin red was injected. Statistical analysis was performed through ANOVA comparing the distances of 1, 2, 3 and free-ends of the bridges, before and after loading in sub or non-sub implants.

Results: The results showed a statistical significant difference ($P < 0.05$) when comparing the distances of 1 (23.0%; 27.0%) (23.1%; 25.2%), 2 (18.2%; 21.3%) (18.1%; 19.9%) and 3 mm (17.3%; 18.5%) (17.3%; 19.0%) and free-end (16.6%; 17.0%) (17.4%; 18.4%) for sub and non-sub implants before and post-loading, respectively. Also, the 1 mm distance presented more, statistically significant ($P < 0.05$), bone remodeling than the free ends, and the 2 and 3 mm distances for sub or non-sub implants.

Conclusion: In conclusion, loading increases bone formation for sub or non-sub implants and the interimplant distance of 1 mm appears to have more pronounced bone remodeling than the 2 or 3 mm distances in implants with a 'platform switch'. Sponsored in part by Dentsply Friadent.

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Influence of loading and interimplant distances on the dynamics of the bone remodeling. A fluorescence analysis

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Purpose: The aim of this study was to evaluate the influence of different inter-implant distances on the dynamic of bone formation after prosthetic restoration with a 5 mm distance between the contact point (CP) and the bone crest (BC), using the administration of bone markers in different periods of healing.

Methods: Firstly, the bilateral mandibular premolars of 6 dogs were extracted and after 12 weeks each dog received 8 Frialit implants, totaling 48 implants in the experiment. Two of these were separated by 2 mm (group 1) and two by 3 mm (group 2) in each hemi-arch. Past 12 weeks of healing, provisional acrylic prostheses were placed using the distance of 5 mm between CP and BC. After 4 weeks, the temporary crowns were replaced by the metallic bridges, maintaining the distance between CP and BC in 5 mm. Then after another 4 weeks, when the animals were sacrificed, their hemi-mandibles were removed, dissected and processed. During the experimental period, two bone markers were administered to observe the rate and extent of new bone formation. The calcein green was administered at the re-entry, immediately after the prostheses installation, when there was no influence of the loading on the bone. The alizarin red was administered 3 days before the sacrifice, marking the possible influence of the loading during the experimental period.

Results: The means of bone marked for the calcein at the interimplant area (IA) were 33% in group 1 and 37% in group 2 ($P \geq 0.05$), and for the alizarin were 34% in group 1 and 36% in group 2 ($P \geq 0.05$). At the free ends of the bridges (DR), the percentage of bone marked by calcein green was 22% in group 1 and 23% in group 2 ($P \geq 0.05$). For alizarin it was 22% in group 1 and 20% in group 2 ($P \geq 0.05$). When comparing IA with DR, for both bone markers, no statistically significant differences were obtained ($P \geq 0.05$).

Conclusion: According to these conditions it could be concluded that the distances of 2 and 3 mm between implants experienced similar bone formation before and after the loading. However, the inter-implant areas showed numerically better bone apposition when compared to the free ends of the bridges in both interimplant distances.

Sponsored in part by Denstsply Friadent.

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The effect of the recipient site depth and diameter on the implant primary stability

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Purpose: This study was performed to compare and evaluate the effect of recipient site depths and diameters of the drills on the primary stability of implant in pig's ribs.

Materials and methods: An intact pig's rib larger than 8 mm in width and 20 mm in height; RBM (Resorbable Blasting Media) surface blasted ø3.75 mm and 8.0 mm long USII Osstem Implants (Osstem Co., Korea) were used. To measure the primary stability, Periotest® (Simens AG, Germany) and Osstell™ (Model 6 Resonance Frequency Analyser: Integration Diagnostics Ltd., Sweden) were used. They were divided into 6 groups according

to its recipient site formation method: D3H3, D3H5, D3H7, D3.3H3, D3.3H5, D3.3H7. Each group had, as indicated, 10 implants placed, and total 60 implants were used. The mean value was obtained by 4-time measurements each on mesial, distal, buccal, and lingual side perpendicular to the long axis of the implant using Periotest® and Osstell™. For statistical analysis One-way ANOVA was used to compare the mean value of each group, and the correlation between placement depths and the primary stability, and that of measuring instruments was analyzed using SPSS 12.0.

Results: The primary stability of the implants increased as the placement depths increased ($P < 0.05$), and showed a proportional relationship ($P < 0.01$). The primary stability increased when the diameter of the recipient site was smaller than that of the implant but with no statistical significance. There was a strong correlation between Osstell™ and Periotest® ($P < 0.01$).

Conclusion: These results suggest that increasing the placement depth of implants enhances the primary stability of implant.

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A modified segmental ridge expansion for immediate placement of implants

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Aim: The objective of this preliminary report of an ongoing prospective study is to present a modified segmental ridge expansion with simultaneous implant insertion.

Materials and methods: Five consecutive patients (3 male, 2 female mean age 52.5 years) with a class IV (Cawood e Howell, 1988) atrophic ridge were selected for ridge augmentation. A mucoperiosteal flap with no vertical releasing incisions was raised up to the mucogingival line. The ridge was expanded using bone chisels and osteotomes. Tapered Screw-Vent implants (Zimmer, Carlsbad, CA, USA) were placed. Spiral drills were used to perforate buccal and palatal bone walls at mesial and distal aspects and resorbable sutures were passed through for bony plates stabilization. A xenograft (Biogen® Bioteck, Vicenza, Italy) was packed between the implants and a collagen membrane (Biocollagen® Bioteck, Vicenza, Italy) covered the ridge. No primary closure was achieved. Cyanoacrylate monomer (Histoacryl®, Braun Petzold GmbH, Schwarzenberger, Germany) was used to seal the crestal gap to avoid flaps displacement.

Edentulous ridge changes were evaluated on CT Scan at baseline and at abutment connection. Implant survival and success rates were reported.

Results: A total of 15 implants (4.7–3.7 mm Ø × 11.5–13 mm) were placed with good primary stability. No intra-operatory complications were recorded. At 1 year follow-up all implants (100%) met Albrektsson et al. (1986) criteria for success. An increase in keratinized tissue was recorded.

Conclusions: The preliminary results showed that this novel technique may be a viable therapeutic alternative for implant placement in areas that otherwise would not be suitable for implants.

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Immediate loading of implants with mandibular overdentures using ball attachments: one-year results of a prospective study

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Purpose: The aim of this multicentric prospective clinical trial is to present implant and clinical outcomes at one year of an immediate loading protocol of a 2 implants with mandibular overdentures in edentulous patients.

Materials and methods: 43 completely edentulous patients aged between 28 and 80 (mean 61) were selected in this study. Prior to surgery, all patients were treated with conventional complete dentures in accordance with standardized clinical and laboratory procedures. Two implants (TiUnite, Brånemark system®, NobelBiocare) were placed symmetrically in the anterior mandible. Implant length ranged from 10 to 15 mm (mean 12 mm). All implants were placed by using a surgical template. Moreover, all implants were set with a final torque superior to 40 Ncm and their primary stability was confirmed by a resonance frequency value of more than 65 ISQ (Osstell, Integration Diagnostics AB, Sweden). Bone distribution density was respectively, 1 for 10 implants, 2 for 27 implants and 3 for 49 implants.

At the end of the surgery, ball-abutments were screwed on the implants and torqued to 20 Ncm. Immediately after surgery, the mandibular denture was transformed in overdentures by the incorporation of Dalbo-Plus matrices (Cendres et Métaux, Switzerland). The follow-up consisted of clinical and radiographic examinations. Using a standardized technique with a modified bite-block, periapical radiographs were taken after the surgery, as well as after 3, 6 and 12 months. Clinical examination included resonance frequency analysis after the 3rd, 6th and 12th month.

Results: Only 3 out of 86 implants failed. No implant had more than 1.2 mm marginal bone loss. Implant success rate was 96.5% with a 95% confidence interval. ISQ average value at implant placement was 73.8. At 3, 6, and 12 months, the average values were respectively 72.35, 72.89 and 73.28.

Conclusion: These one-year prospective clinical trial results revealed that successful immediate loading of unsplinted implants using ball anchors with mandibular overdenture is possible.

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Evaluation of patient satisfaction in a prospective clinical trial with an immediate-loading protocol of a mandibular overdenture

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Purpose: The aim of this report is to assess patient satisfaction with two-implants retained mandibular overdenture in a prospective clinical trial using an immediate loading protocol.

Materials and methods: 43 edentulous patients treated by conventional upper and lower dentures were included. The quality of the mandibular denture was measured according to objective criteria before inclusion. Insufficient quality (< 50 on a 0 to 100 scale) inhibits the inclusion. All patients received two implants in the anterior mandible. Implants loading was immediate with transformation of the mandibular denture into overdenture using Dalbo Plus® ball attachments (Cendres et Metaux©, Switzerland).

Patient satisfaction was scored with a ten-items questionnaire on 100-mm visual analogue scale. General satisfaction, ability to clean the denture, to speak and to chew, comfort and aesthetics were explored. Feelings about the denture were also evaluated.

Satisfaction results with conventional denture were compared to the overdenture results, 3 months after surgery, using a t-student test.

Results: The average score for the quality of the dentures was 86 (minimum 56, maximum 100). General satisfaction before surgical treatment was 65.56 ± 27.6 versus 91.49 ± 8.7 after 3 months. All items but one show an improvement with statistical significance (ability to chew 52.86 ± 26.1 vs. 87.65 ± 11.8). The overdenture seemed more difficult to clean although the result was not statistically significant (89.6 ± 11.6 vs. 86 ± 19.9 after treatment).

Conclusion: Immediate loading of overdenture improves the quality-of-life of edentulous patients. Quality of the denture is an important factor related to high satisfaction.

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Immediate loading in the maxillary arch in compromised bone qualities

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Introduction: The concept of immediate loading (IL) in the maxillary arch and in areas with insufficient bone qualities has not been well documented.

Objectives: The purpose of this study was to present the success rate of immediately loaded implants in the maxillary arch, obtained from two sets of clinical data.

Materials and methods: Clinical data in this study was obtained from two groups of Databases. The first group (group 1) of data was obtained from patients at the University of Frankfurt, Germany. The second group (group 2) was obtained from a Database in the Dept. of Periodontol/Implant Dentistry at NYU. All patients were included in a protocol approved by the Ethics Committee of the Universities.

Fifteen (group 1) and ten patients (group 2) were included in this study. Six (group 1) and eight implants (group 2) were placed in the maxilla and immediately loaded after surgery. In sites with insufficient bone quantity augmentation procedures were performed simultaneously with implant placement. Cross-arch stabilization was utilized immediately after implant placement. Soft/liquid diet was used initially after surgery of all patients. Bone loss has been evaluated in order to consider the 'success rate' as a success parameter.

Results: The average success rate was: 97.9% (96.6% group 1; 99.2% group 2) after a total loading period of 27.36 ± 21.33 months.

Conclusion: The IL in the maxillary arch may be successful if primary implant stability, adequate splinting and soft/liquid diet protocol are taken into consideration. Further research using the IL protocol with other implant designs and surfaces is needed to evaluate the factors necessary for long-term predictability.

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Immediate vs. delayed loading on implant survival and bone quality

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Introduction: The concept of immediate loading (IL) in the maxillary arch and in areas with insufficient bone qualities has not been well documented.

Objectives: The purpose of this study was to present the success rate of immediately loaded implants in the maxillary arch, obtained from two sets of clinical data.

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Results: The average success rate was: 97.9% (96.6% group 1; 99.2% group 2) after a total loading period of 27.36 ± 21.33 months.

Conclusion: The IL in the maxillary arch may be successful if primary implant stability, adequate splinting and soft/liquid diet protocol are taken into consideration. Further research using IL protocol with other implant designs and surfaces is needed to evaluate the factors necessary for long-term predictability.

133 | Topic Implant Surgery

CO_2 laser in implant dentistry. clinical experience and literature analysis

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Introduction: The CO_2 laser has a variety of uses in the oral cavity, especially for excision and ablation of soft tissues. However, there are few reports of the use of CO_2 laser in Implant Dentistry.

Purpose: The aim of this study was to demonstrate our clinical experience with the use of CO_2 laser in Implant Dentistry as well as to present a literature analysis of CO_2 laser applications in the treatment of periimplantitis.

Materials and methods: According to a literature search analysis using MEDLINE, the parameters of use we evaluated, as well as the effects of the CO_2 laser on the implant surface and periimplant tissues.

Results: The CO_2 laser demonstrated an absence of bleeding or intra- or postoperative pain as well as excellent tissue coagulation when used for second stage surgical implant exposure. The wound healing of the oral soft tissues appears to be delayed by several days. The use of the CO_2 laser in the treatment of periimplantitis has been documented in 71 articles from peer reviewed journals published in English. Based on the literature review the CO_2 laser was able to significantly reduce the bacteria and to maintain, without change, the implant surface morphology. It appears to be useful clinically in the treatment of periimplantitis improving histological reosseointegration.

Conclusion: The CO_2 laser should be considered as an adjunctive surgical tool in Implant Dentistry in areas where excellent bacteria reduction and bleeding control are important. Further investigation comparing conventional treatment protocols vs. CO_2- or other lasers should be performed in additional clinical studies.

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Sinus lift and simultaneous implant placement: impact of residual bone height on implant prognosis

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Sinus floor elevation allows implant placement in atrophied posterior maxilla. According to literature, a minimal bone height of 5 millimetres is mandatory to perform sinus lift and implant placement within the same surgical step. In this study, we investigated the impact of residual bone height (RBH) on implant survival rate (ISR).

120 patients were treated by simultaneous sinus floor elevation and one-stage non-submerged implant placement. Surgical protocol and implant design were carefully selected so as to insure optimal primary stability. RBH at implant sites were measured through pre- and post-operative CT-scans. Implants were ranked in 3 groups according to their RBH: Group A, RBH $\leq$3 mm; Group B, 3 mm <RBH $\leq$5 mm; and Group C, RBH >5 mm. All patients were followed from surgical procedure to prosthetic rehabilitation. ISR was assessed in each group.

A total of 235 implants were inserted into 122 sinuses. 45 implants were included in group A, 113 in group B and 72 in group C. 2 implants could not be stabilized at placement and 3 failed during the healing phase. 230 implants successfully osteointegrated and received a prosthetic rehabilitation after 4 to 9 months. Group A, B and C showed similar ISR, respectively 97.7%, 98.2% and 97.2%. In the present study, no statistical difference between groups was found.

Most authors advocate to delay implant placement if RBH doesn't exceed 5 millimetres, and implant submersion is usually recommended in case of implantation. Provided that implant proper primary stability is reached, our data suggest that ISR is not correlated to RBH, even with non-submerged approach and limited RBH. A single-step approach significantly reduces the number of surgeries and the subsequent delay before prosthetic rehabilitation.

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Hydroxyapatite fiber material as bone substitute: clinical studies

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We had developed fibrous material (HF) consisting of 100% hydroxyapatite fibers of 5–15 micron meter in diameter. We had already confirmed that HF supports proliferation and differentiation of osteogenic cells and that it is effective as bone in animal experiments. To evaluate clinical efficacy of HF as bone substitute we conducted the following clinical study at 'Yaesu Chuoh Dental Clinic'. After obtaining informed consent from patients we used HF in 64 cases of 55 patients. In 36 cases HF was applied to the bone defects around the implants and in 24 cases HF was used for sinus floor elevation together with implant installation. In 4 cases HF was applied to both bone defects around the implants and sinus floors. The treated areas were examined with dental X-ray and observed periodically. In all 64 cases there was no complication other than inflammation usually accompanied in these surgeries. In the cases of the bone defects around the submerged implants, hard bone-like tissue was observed around the implants. In the sinus lift cases, the radio-opaque HF gradually decreased the height and

smoothly fused to the sinus floor bone with time. In 64 cases we installed 155 implants and all of these implants are in function without any problem at present. Since the texture of HF is like cotton, handling HF in grafting procedure is easy. Furthermore, this material is completely manufactured, neither animal- nor cadaver-derived material. Conclusively, HF would be resorbable, exchangeable and safe bone substitute in dental implant treatment.

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Influence of platform switching on crestal bone level changes

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Objectives: The aim of the present study was to histomorphometrically investigate the influence of platform switching on crestal bone level changes at non-submerged wide-body titanium implants in a dog model.

Materials and methods: One stage insertion of sand blasted and acid-etched screw-type implants with either matching (CAM) or smaller-diameter healing abutments (CPS) were randomly assigned to the lower jaws of nine beagle dogs. The animals were killed after 7, 14, and 28 days of non-submerged healing. Dissected blocks were processed for histomorphometrical analysis. Measurements were made between the implant shoulder (IC) and: – the apical extension of the long junctional epithelium (aJE), – the most coronal level of bone in contact with the implant (CBI), and – the level of the alveolar bone crest (BC).

Results: At 28 days, histomorphometrical analysis revealed significantly increased mean IC-aJE, IC-CBI, and IC-BC values in the CAM group. In contrast, aJE tended to stop at the level of the inner horizontal part of the circumferential plateau at CPS implants, resulting in significantly lower mean IC-aJE, IC-CBI, and IC-BC values.

Conclusions: Within the limits of the present study, it was concluded that CPS implants reduced crestal bone level changes after 28 days of healing. However, a certain amount of marginal bone resorption appears to be biologically inevitable.

The study was supported by a grant of Camlog Biotechnologies AG, Basel, Switzerland.

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Stability development of immediately loaded dental implants

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Objectives: The aim of the study was to assess the stability-time dependence of immediately loaded implants inserted into the interforaminal region of the mandible.

Methods: Two hundred eighty Impladent® STI-Bio implants (Lasak, Prague, Czech Republic) were included in the study. ISQ was measured using the Osstell device (Integration Diagnostics AB, Sweden) immediately after insertion and after 3 months of functional loading. The implants were divided into 3 groups according to change of stability during this period (group A – drop of stability, group B – no change, group C – increase of stability). Another 27 implants were measured longitudinally, once a week during the first 10 weeks of loading.

Results: The success rate of implants achieved 99.3%; the mean value of primary stability was 72.1 ± 5.3. Group A was characterized by primary stability 73.4 ± 5.0; mean primary stability of group B was 70.7 ± 5.0; and in group C, it measured 67.4 ± 5.2. The difference between group A vs. B or C was highly statistically significant ($P = 0.0001$). In the group of longitudinally observed implants no stability change during healing corresponded to primary stability 70.4 ± 5.7.

Conclusions: Within the limits of the study, immediately loaded implants with a primary stability lower than 70 increase their stability during first 3 months of functional loading, whereas those with a higher primary stability decrease their stability over this period. A primary stability of approximately 70 should not be significantly affected during healing.

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The distribution of endopore implant patients and survival rate

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This study is an analysis of distribution of patient who installed Endopore® in Chosun University Dental Hospital and types of implant for about 4 years recall check and cumulative survival rate. 86 implant were used in this study. It shows the conclusion below:

1. 42 patients received 86 Endopore® implant in their maxilla and mandible. Posterior area accounted for 95.4% of the whole implant surgery.

2. The mean follow up period was 49 months and the longest follow up period was 64 months.

3. The majority of implants were those of 7,9 mm in length(89.5%) and regular diameter in width(52.3%).

4. The total 86 implants were placed and 2 implants were failed. The one had standed for 36 months and had functioned for 33 months. The other had standed for 13 months and had functioned for 10 months.

The result provided us with basic data on patients type, implant distribution and survival rate. This data with Endopore® implant showed excellent survival rate.

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Clinical evaluation of implant stability by RFA during healing

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The purpose of this study was to measure the primary stability of implants placed in both jaws and to evaluate the changes in implant stability at different time points during healing by using resonance frequency analysis device. Factors that may affect implant stability quotient (ISQ) have also been evaluated. Twenty-nine Swissplus, (Zimmer® Carlsbad, CA) implants (3, 7 mm × 10 mm) have been placed to 14 patients with a mean age of 51 ± 7.4. The ISQ was recorded with Osstell® mentor device (Integration Diagnostics AB, Sweden) at implant placement and after 1, 2, 4, 6, 8, 10, 12 weeks. ISQ was similar at time of implant placement both in mandibula and maxilla. However, ISQ was significantly higher in mandibula than maxilla at 2, 4, 6, 8 weeks ($P < 0.05$). A statistically significant reduction ($P < 0.05$) in ISQ starting at week 4 and contiuning to week 12 was observed in maxilla, no lower than 65, but no statistical difference was observed in mandibula after 12 weeks. There were no statistical difference in type I and II bone between any time points, however there was statistically significant reduction ($P < 0.05$) at weeks 4, 6 and 8 compared to the time of implant placement in type III bone. When ISQ was compared between male and female patients, only statistically significant difference ($P < 0.05$) was observed in maxilla at week 8. According to the results of this study it can be concluded that the ISQ stays stable in mandibula but with a reduction in maxilla also implant stability reduces only in type III bone during healing.

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Immediate implant restoration for fully edentulous using Straumann Implant System

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Objectives: This clinical investigation was conducted to confirm the benefit and predictability of immediately loaded implant restorations in completely edentulous maxilla and mandible using Straumann Implant System in private practice surroundings.

Materials and methods: Twenty-two consecutive totally edentulous jaws (11 maxilla and 11 mandible) were treated utilizing immediately loaded restorations from 2004 to 2007. Total 19 patients (12 males and 7 females) were anticipated this study and the mean age of patients was 59.1 and 63.1 in male and female, respectively. These cases were retrospectively assessed using patient charts, radiographs, CT data and our database. Bone quality corresponded to the implant positions were subjectively measured as Hounsfield unit on computer software Simplant®. Treatment procedures were carried out by following our original loading protocol. As the definitive prostheses, screw-retained fixed prostheses were provided. Every complication during the treatment was investigated.

Results: A hundred and thirty-eight rough surfaced implants were used in this study. Mean (SD) Hounsfield unit was 611.9 (158.4) in the maxilla and 880.5 (231.3) in the mandible. No implants were lost during the investigated period. Success rate of implant was 100%. Median (interquartile range) duration of function of prosthesis was 11 (5–23) months.

Conclusions: Although the relatively short follow-up period our immediately loading protocol for completely edentulous jaw using Straumann Implant System brought successful treatment outcome.

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Tripodal implant placement for severely resorbed posterior region in maxilla

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Objectives: Although clinical results of the maxillary sinus floor elevation have seemed to be predictable, the surgical invasiveness has caused a negative impact for the patients. In this pilot study, we propose a tripodal implant placement procedure, in which three implants are offset bucally and/or palatally in cases that have limited anterior-posterior length, as the other non-grafting treatment option.

Materials and methods: Seventeen partially edentulous patients (8 males and 9 females) in molar region in maxilla with severe bone resorption were selected during 1999 and 2007. Mean (SD) age of the patient were 53.1 (14.1) and 54.1 (6.9) in male and female, respectively. Computed tomography (CT) examinations were carried out for all the patients before the surgery. After three month of wound healing, screw or cement retained superstructures were fabricated. Descriptive statistics of the implants, inflammation of the peri-implant soft tissue and other complications were investigated retrospectively.

Results: Fifty-two implants were placed. Eight-three percent of the implants had regular platform. Median (interquartile range) length of implants was 8.0 (8.0–10.0) mm. Median (interquartile range) duration of function of superstructure was 13 (5 – 22) months. No implant was failed and success rate of the implants was 100%. No inflammation was found in peri-implant soft tissue and no significant bone resorption was found. Any complications were not reported during the investigated period.

Conclusions: Within the limitation of this study, it could be demonstrated that tripodal implant placement procedure in molar in maxilla is shown beneficial effects to avoid bone grafting.

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Clinical outcome of submerged versus non-submerged implants in extraction sockets

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Aim: To compare the clinical results of submerged versus non-submerged implants placed into fresh extraction sockets.

Methods: A prospective, controlled, multicenter, randomized, clinical trial was designed. Patients planned for an immediate post extractive implant procedure were included in the study if : there were no contraindications to implant surgery, no implants were adjacent to the root to be replaced, horizontal peri-implant bone defect was < 2 mm, primary stability could be achieved, smoking less than 10 cigarettes per day was allowed.

The patients were randomly allocated to non-submerged (NS) or submerged (S) treatment groups immediately after tooth extraction. Tapered implants were used and no bone augmentation procedure should be used. 8 weeks after the first surgery healing abutments were connected in the S group. All the implants of the study were loaded with provisional restoration 12 weeks after the first surgery and with definitive restoration 12 weeks later.

Clinical and radiographical parameters were evaluated at baseline, at implant loading, and at 1 year follow up visit.

Results: The results showed no statistically significant differences between the two groups for all the parameters except for the height of keratinized tissue that was significantly reduced for submerged implants.

Conclusion: The use of post-extractive TE implants is effective regardless of the choice between submerged and non submerged approach. It must be noticed that since the submerged approach causes a clinically and statistically significant reduction in the height of keratinized tissue, the non submerged fashion should be preferred.

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Microbiological evaluation of immediate intrasocket implant placement in compromized periodontal sites

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Aim: This study was performed to elucidate the changes in the composition of the subgingival microflora before the extraction of severely periodontaly involved teeth and one year after immediate implant placement into the extraction socket without flap elevation followed by immediate provisionalisation.

Materials and methods: The sulcular microflora of 20 periodontaly involved maxillary incisors from 10 individuals without any systematic disease was investigated before and one year after the immediate intrasocket implant placement. For all sites clinical parameters were recorded. Crevicular plaque samples were taken using 3 paper points for 10 s, diluted in RTF, plated on selective and non selective media, incubated anaerobicaly and in 10% CO_2. From the total flora 14 target species were identified and calculated in CFU/ml. Dark field microscopy observations were also preformed.

Results: The clinical parameters 12 months after implant placement presented great improvement. The target species isolated from periodontal and periimplant sites were similar, while pronounced quantitative and isolation frequency differences were observed. Concentrations of periodontopathogens in the periodontal sites were heavily reduced in the periimplant sites whereas the relevant counts of the beneficial microorganisms were increased.

Conclusion: The clinically observed health improvement that occurred when compromised periodontal sites were immediately converted into periimplant sites was found to be compatible with a less pathogenic flora.

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Impact of implant geometry and loading on early bone formation

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Objectives: Under the immediate loading state, force transmission without threading the biomechanical competence of the surrounding bone can promote bone formation; and is related to the implant's shape. Aim of the study was to compare the bone formation around immediately loaded versus unloaded implants for two different implant macro-designs.

Materials and methods: A repeated sampling bone chamber with central implant was installed in the tibia of 24 rabbits. Highly controlled immediate loading experiments with implant micromotion up to 50 μm were designed for a cylindrical (CL) and screw-shaped (SL) implant, while the unloaded implants (CU and SU) served as control. An F-statistic model with $\alpha = 5\%$ determined statistical significance.

Results: The bone tissue filling of the bone chamber was significantly highest when loading the implant (CL vs CU: $P = 0.0408$; SL vs SU: $P < 0.0001$). Similarly, implant loading resulted in a significantly positive effect on the mineralized bone fraction (CL vs CU: $P < 0.0001$; SL vs SU: $P < 0.0001$) and on the bone-to-implant contact incidence (CL vs CU: $P < 0.0001$; SL vs SU: $P < 0.0001$). For loaded implants, a geometry effect was found when the amount of BIC was observed (SL vs CL: $P = 0.01$).

Conclusions: Well-controlled immediate implant loading has an osteogenic potential. Owing to a distinct biomechanical coupling, early peri-implant osteogenesis is favoured at the interface of a s screw-type implant compared to a cylindrical shape.

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Current status of implant training in europe – a questionnaire-based survey

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Thanks to their predictably high success rates dental implants have gained a firm place among the treatment options for edentulous and partially dentate patients in state-of-the-art dentistry. As a result, the need for high-level basic and continued training in implant dentistry is increasing. The present questionnaire-based survey was designed to shed light on the current state of implant training, any points of criticism and the need for a standardized training format in Europe.

Material and methods: Between July and November 2006, a 14-item questionnaire was sent to 39 opinion leaders in 30 European countries. The questionnaires sent back were processed electronically and evaluated statistically.

Results: 83.3% of the participating opinion leaders responded. In the majority of the participating countries (87.5%) courses are financed by the industry. Most of the courses (43%) are confined to a few days and mainly consist of lectures in theory and hands-on training. Of the attendees, most are general dental practitioners (29%). These perform as many implant treatments as specialized dentists. In 83% of the participating countries a standardized certified training format in implant dentistry is thought to be needed.

Conclusion: As implant dentistry is increasingly shifting from competence centers to office-based dental practitioners, standardized training concluded with a certified diploma has become necessary. This would provide for more transparency and for disseminating state-of-the-art knowledge independent of the implant manufacturing industry.

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The role of the crestal level of implant-abutment connection: a radiographic retrospective analysis

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Changes in crestal bone height around two-piece implant systems have been associated with micro-motion and bacteria infiltration at the implant-abutment connection. The aim of this study was the retrospective radiographic evaluation of the crestal bone loss around two-piece screw-type implants with the abutment connection varying in height with relation to the crestal level.

250 screw-type implants have been selected for this study from patients who have normally enrolled for implant therapy in the Department of Surgical Implantology of A.U.Th. The criterion for each case was the existence of clear and distinct peri-apical radiographs either immediately after implant placement, or 1–2 years, or 3–4 years following restoration. The distance between the abutment connection and the crestal level was recorded for all above periods and the cases were assigned into 3 groups according to abutment connection height with relation to the crestal level immediately after implant placement: Group A: 1–2 mm supra-crestally (84 implants), group B: 0.5–2.0 mm sub-crestally (70 implants) and group C: at the crestal level (96 implants). Each group was subdivided into 3 groups depending on the 3 evaluation periods. Data has been collected and analyzed.

The mean values for bone loss during 1–2 years and 3–4 post-restoration periods were, in group A: 0.27 mm and 0.60 mm, in group B: 1.72 mm and 1.79 mm and in group C: 0.98 mm and 1.09 mm respectively. Statistically significant differences existed between all sub-groups both in 2–3 years and 3–4 years evaluation periods.

The results of this study showed that the placement of the implant-abutment connection supra-crestally, led to lower bone resorption around the cervix of the implant compared to crestal and sub-crestal installations.

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Immediate loading of short straumann te implants

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The aim of present study was to compare the influence of implant length on the clinical results of immediate loading procedure. Implants with length $\leq$ 8 mm are define as ''nonstandard length'' or ''short'' implants. The hypotheses of this study has been that new design of Straumann TE® implant, will provide successful results in procedure of immediate loading even for implants with nonstandard length.

The implant stability was assessed according two different implant lengths and functional loading. Study was performed on 12 patients and 72 Straumann TE™ implants (ø4,1/4,8 mm) 8 and 10 mm length, were installed bilaterally in positions of second premolar, first and second molar. Implants on one side (36) were immediate (IL) and 36 implants on the other side were early loaded (EL) 6 weeks after implantation. Thirty-four implants 8 mm length (17 IL, 17EL) and 38 implants 10 mm length (19 IL, 19 EL) were analyzed in this study. Each implant was tested for primary stability with resonance frequency analysis (RFA – Osstel Mentor) and RFA was performed at examinations 6, 12 and 52 weeks following surgery.

Results: After 12 months survival in the both groups was 100%. Mean of primary implant stability for 8 mm implants was 74,15 ± 7,26 ISQ (IL – 73,88 ± 7,97; EL – 74,41 ± 6,70) and for 10 mm implants was 79,57 ± 5,17 ISQ (IL – 81,00 ± 3,13; EL – 77,41 ± 6,06). The primary stability of 10 mm implants was significantly higher then in the group of implants 8 mm length ($P = 0{,}01$). The increase of ISQ values has been noted for each analyzed groups, 6, 12 and 52 weeks after implant placement. Implant stability in the group of implants 8 mm length, increased markedly until 52nd week (IL - 82, 23 ± 4, 10; EL – 79, 94 ± 3, 96 ISQ). The same result has been noted in the group of implants 10 mm length (IL – 83, 72 ± 2, 45; EL – 82, 41 ± 2, 34 ISQ). Differences between analyzed groups were statistically insignificant ($P > 0.05$).

Conclusion: Based on these results Straumann® TE™ implants 8 mm length inserted in posterior mandible appear to be included in immediate loading protocol.

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Peri-implant hard tissue around calcium phosphate - coated dental implants in baboons

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The purpoes of this study was to investigate the influence of loading and non-loading on the peri-implant hard tissue around calcium phosphate (CaP)-coated and machined surface (MS) screw-type dental implants after 27 months of placement.

Implants were inserted in the anterior upper and lower jaw of adult baboons. The CaP coating was similar in composition and CaP ratio to hydroxyapatite produced with a magnetron sputtering technique. MS implants served as a control. Each group of implants was separeted into submerged implants (group 1) and uncovered implants with gingivaformer (group 2). After 27 months of placement all implants investigated were successfully integrated in the jawbone and histologic and histomorphometric analysis were carried out. Implants with ultra-thin, 0.1 µm crystalline CaP coating did not show any contrarious tissue reactions, even after 18 months of loading. Bone area within 1 mm around implants was not significantly different neither in group 1 (CaP: 44.03% ± 3.97, MS: 49.7% ± 4.2; $P > .05$) nor in group 2 (CaP: 35.95% ± 3.47, MS: 36.67% ± 3.33; $P > .05$). Calculating the percentage of bone-to-implant contact showed no significant difference between CaP and MS in group 1 (CaP: 68.43% ± 6.82, MS: 68.2% ± 7.21; $P > .05$) and group 2 (CaP: 52.48% ± 6.34, MS: 57.41% ± 6.16; $P > .05$) respectively.

Overall, the data presented did not show any significant differences in peri-implant hard tissue conditions around CaP and MS implants. These findings apply to both group 1 and group 2. Moreover, plaque accumulation and propagation of peri-implant mucositis was not influenced by this kind of surface modification in baboons.

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Immediate implant placement - what are the limitations?

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Literature reviews found similar implant survival rates for immediate and delayed implant placement (Schwartz-Arad 1997; Chen ST 2004). Immediate implant placement offers several advantages for the patients as well as the clinicians, including shorter treatment time, less bone resorption, fewer surgical sessions, shorter healing time. Although there are several reports that high success rate over 4–11-year observation period (Schwartz-Arad & Chaushu 1997; Wagenberg & Ginsbutg 2001), there still fewer indicate that factors influence the outcome. This presentation will discuss some factors that affect of immediate implant placement can perform or not, such as primary stability, type of bone architectures, soft tissue biotype and factors influences the facial bone horizontal resorption such as bundle bone concepts.

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Options and limits of bone expansion in narrow ridges: 7-year study

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Background: The aim of this prospective study was to determine whether bone splitting and/or spreading were predictable procedures for the treatment of extremely narrow ridges during implant placement.

Material and methods: 107 implants (Screw-Vent, Zimmer dental) were placed in 54 patients presenting horizontal bone defects in the maxilla, from April 1999 to July 2006. A periodontal probe measured the width of the crest before the expansion. Different instruments were used: Bone chisels, osteotomes and special oval and bullet-shaped design. An innovative lateral osteotomy marked with bone chisels away from the implant's body (to avoid exposing the implant) enhanced the expansion in extremely narrow ridges. The general sequence consisted in the gradual use of bone chisels, intermediary instruments and osteotomes. Implant's tapered design may help the expansion too. The resulting defect was filled with autogenous bone, bovine hydoxyapatite (Bio-Oss) or ß-tricalcium phosphate (Cerasorb). All the implants were submerged. Clinical and radiographical control post-op, and at 1, 3, 6 months, 1 and 3 years enabled us to analyze the bone loss.

Results: At second stage surgery, the mean values recorded for the horizontal augmentation in the 54 patients varied from 2 to 6 mm.

Conclusion: Bone expansion techniques are safe and predictable techniques if properly used allowing implant placement in

narrow ridges in one-stage approach instead of delayed placement. Advantages: one surgical site, reducing the treatment time and the capability to enhance both the horizontal and vertical components. We can extend the limits of the osteocompression up to 6 mm with an appropriate codification.

151 | Topic Guided Surgery

Computer-aided oral implant surgery (caois): a clinical and radiographic multicenter study on 25 patients

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Purpose: The purpose of this study was to evaluate in vivo the overall effectiveness and accuracy of a computer-aided and template-guided oral implant surgery, by comparing the three-dimensional positions of planned and placed implants.

Materials and methods: 25 adult patients in 2 private practices were subjected to computer-aided oral implant therapy using CAD-CAM stereolithographic templates fabricated according to a digital surgical planning (SurgiGuides®, Materialise n.v.). A second spiral Computed Tomography was taken after the surgery. Pre- and post-operative CT were pairs-wise aligned allowing for comparisons and accuracy measurement between planned and real implant positions. Eighty-nine implants were available for comparison and accuracy measurement. All operations were performed using the Mimics® software (Materialise n.v.).

Results: 100 out of 104 implants inserted with CAOIS have integrated giving at a mean follow-up time of 25 months a cumulative survival rate of 96%. There were no significant surgical complications. Prosthesis survival rate was 100%. With regard to accuracy mean lateral deviations at the coronal and apical ends of the fixtures were respectively 1.4 mm (range 0.2–6.5 mm) and 1.7 mm (range 0–6.9 mm). Mean depth deviation was 1 mm (range 0–4,2 mm) and mean angular deviation was 7.9° (range 0,7°–24,9°). There was a statistically significant correlation in accuracy between implants placed with the same guide. There were no statistically significant differences in accuracy between mucosa, bone, or teeth-supported guides. There was no difference between the 2 centres neither a learning curve could be demonstrated in this material.

Conclusions: CAOIS proved an effective technique with a mean acceptable accuracy.

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Pre-surgical CAD/CAM planning, designing and fabricating surgical guide and superstructure on dental implants

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Purpose: The primary purpose of this study is to investigate the accuracy of the digital processing of CT-images to 3-D models which will be used to design and fabricate the drilling guide and the final superstructure. This new treatment protocol is based on usage of diagnostic (mini-) implants and an immediate loading protocol for the restorative implants. Moreover the investigators tried to measure the possible misfit-induced strain on implant-supported superstructures, fabricated according to this protocol, and compared it with the superstructures which are fabricated in dental labs according to the traditional impression technique protocol.

This is a new concept in implant surgery. It is based on the processing of the Ct-scan images and computer segmentation in order to create a digital 3D model. Using mini implants as references to transfer the information from the computer to the patient with high precision this 3d virtual model can digitally plan a case, design and fabricate a surgical guide and eventually process the final superstructure which will be placed at the time of the surgery.

Materials and methods: A master cast of the edentulous mandible is fabricated with barium sulphate contained resin. After placement the mini-implants, specially designed and fabricated together with Straumann company, a digital cone-beam CT-scan is executed. After segmentation, the images are imported into especially designed planning software and 6 modified Straumann Standard implants are drawn into virtual model. The thus created planning data is imported into the CAD/CAM designing software where the surgical guide and superstructure are designed. The titanium base of the final superstructure is then fabricated by simultaneous 5 axes milling machinery. The implants are inserted using the fabricated surgical template which is connected on the 3 mini-implants. The fabricated superstructure is placed immediately after the implant insertion. The strain measurement is done using strain gauge devices and is recorded using computer software.

Clinical trial: 35 patients with an edentulous mandible and/or an edentulous maxilla were treated according this protocol from 01–2006.

Results: 1) The strain induced by misfit due to computer-assisted preoperative implant planning, CAD-CAM-designing and fabricating of the superstructures is at least comparable and in the most of cases less than the strain measurements in more traditional impression protocols.

2) The implant failure in these immediate loading cases does not seem to be different than the delayed loading data.

Conclusion: Using reference implants to transfer the information from patient to computer and visa versa seems to increase the precision of this data transfer considerably. Due to this level of precision we can reliably produce the final restoration prior to the actual implant insertion. This study indicates that the small amount of misfit of the superstructure does not per se lead to biological failure of immediately loaded implants. The (real time) immediate loaded implants seem to topographically adapt to the prosthesis, thereby minimizing the existing misfit.

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Loss of osseous graft height following lateral window sinus lift

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The objectives of this study were to analyze the loss of osseous graft height and implant success rate for lateral window sinus lifts after using bio-oss graft and beta – tricalcium phosphate (B-TCP).

Materials: patients receiving a lateral window sinus lifts in combination with implants either grafted with bio-oss granulates only or B-TCP only or a mixture of both materials. Graft height from the sinus floor and over the implant apex was measured using a periodontal probe during the sinus lift procedure and implant insertion. Adequate radiographs were available.

Results: lateral window sinus lift with bio-oss granulates were examined in 2 patients and 10 patients with B-TCP and the other 12 patients with mixed augmented material (bio-oss and B-TCP). Follow up study of 2 years showed a loss of osseous graft height with bio-oss according to adequate radiographs of 23%, 27% by patients with B-TCP and graft height loss of 25% by patients with combined grafted material bio-oss and B-TCP.

Conclusions: we believe that there are no serious differences between the used materials calculating the osseous graft height loss after lateral window sinus lift. Total loss of graft height from the sinus floor over the implant apex was approximately similar in the different groups.

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Guided surgery with transtomography: use of template and intraoperative control

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Transtomography is an evolution of conventional tomography. Digital images are taken with a panoramic machine (Promax-Planmeca Oy, Helsinki, Finland). With this technology, metallic pieces do not create any distortion of images.

A concept of preplanning using directly metallic drilling guides fixed on a template for preoperative transtomography is described: on cross sectional and longitudinal slices, we check the guides position relative to the ridge. If necessary, a newly developed corrective system is used to adjust the guides according to the angle or distance we have to correct, measured on the slices .

We conceived an operating room integrating when necessary this imagery to secure flapless procedures by intraoperative control. This operating room concept including Rx protection of the operators is described as well as the transport system of the panoramic machine for its transfer to the patient who remains seated on his surgical chair.

Surgical protocol is explained: after first limited drill through mucosa and bone, intraoperative transtomography is done with a custom made titanium guide inserted in the bone. Images show drilling axis in the three dimensions. This form of navigation (flexible protocol) allows rectifying drill axis. We explain how this protocol respects asepsis.

Clinical cases are showed using template method. Other cases show transtomographic navigation. Treatment of a narrow ridge case is described, using template method aided by navigation. In conclusion, the limits of this technique are explained followed by the future prospects with the new 3D cone beam computed tomography developed with the same panoramique machine.

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Mandibular biomodelling in the personalization of immediate loading in mandible

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Purpose: The proposition of a technique for the rehabilitation of edentulous mandibles with osseous integrated implants in immediate loading, using model prototypes in reverse planning, and the elaboration of the definitive fixed prostheses with rigid union of the implants on the same day.

Methods: a prospective study was performed on 14 patients with a total of 56 implants placed. Hence, the proposition of a technique for the rehabilitation of edentulous mandible with osseous integrated implants of immediate loading, using biomedical prototypes in reverse planning, and the elaboration of the definitive fixed prosthesis, with rigid union of the implants on the same day. The patients prototypes were divided in two groups. The first group consisted of patients with edentulous prototypes and those elaborated after exodontics procedures (Group 1). The other one (Group 2) consisted of patients of patients with teethed prototypes so as to allow an evaluation of the degree of difficult involved in surgery and prosthetics.

Results: the proposed technique using biomedical prototypes for the personalization of mandibles immediate loading was 100% successful in the case of prosthetics and 98,2% successful in the case of implants. The total procedure lasted from 7 to 10 h.

Conclusion: the proposed technique is feasible and can be performed on the same day including the finalization of the prosthetics structure.

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Accuracy of linear measuraments using a digital cone beam volumetric tomography

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Aim: evalutate the accuracy of measurement of distances on images from a cone beam volumetric tomography between anatomical structures in the jaw.

Materials and methods: a dried mandible was scanned twice -at first in horizontal position, then tilting it 45° referred to the horizontal plane- with a Planmeca Promax 3D radiographic apparatus. Ten linear measurements at different locations previously defined were taken on the tomographic images and on the dried mandible. The measures on the computer were recorded with the software Romexis®, while the measurements on the dried jaw were taken using a precision calliper. Three examiners took the measures twice for every experimental setting with a total of 120 measures. The error was estimated as the absolute difference between the X-ray measurements and the calliper measurements.

Results: The mean standard deviation for the measuraments was 0.22 for horizontal mandible, 0.21 for inclined mandible and 0.25 for the calliper measurements. The overall absolute mean measurements error was 0.3 mm (SD 0.3). In percentage the average measurements error was −0.7%. The error exceeded 1 mm in 3% of the cases. The inter-examiner reliability was tested with ANOVA no significant difference was found between the examiners. No significant difference was found between horizontal or 45° position.

Conclusion: results confirmed that the measurements taken on the computer images are adequately accurate for the purpose of implant planning. The positioning of the sample did not influence the measurement error, which can be interpreted as absence of spatial distortion in the scanned cylinder.

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Bone reaction to bovine hydroxyapatite in the mandibular defects of beagle dogs

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Purpose: The purpose of this study was to evaluate the bone reaction to new bovine hydroxyapatite grafted in surgically created mandibular defects of beagle dogs.

Materials and Methods: Four beagle dogs were used in this study. The 2nd/4th premolars on both sides of the mandible were carefully extracted. In the extraction sockets, the defects sized 8 mm × 6 mm × 5 mm were made and the flaps were closed.

After 4 weeks of healing, buccal-lingual full thickness flaps were elevated. The defect size was measured and the correction was done in case that the defect size was diminished.

Each defect was randomly assigned to 3 different group : 'Graft(G)' group, 'Graft + Membrane(GM)' group, 'Non-graft(NG)' group. Defects of 'G' group were grafted with OCS-B® and secured with interrupted sutures. Defects of 'GM' group were filled with OCS-B® and covered with Bio-Gide®. In 'NG' group, the flaps were replaced and sutured without any graft material or membrane.

The two dogs were sacrificed 4 and 6 weeks after graft procedure. Sections were prepared in the buccolingual plane and parallel with the long axis of the extraction socket. Histologic, Histomorphometric analysis was done under light microscope.

Results: The graft materials were in direct contact with the newly formed bone as well as with connective tissue. The osseous tissue around the grafted particles presented numerous osteocytes, typical to a woven bone pattern. At 6 week, the bridging of new bone tissue around graft particle was observed.

After 6 weeks, the grafted group regardless of the barrier membrane showed the good ridge morphology compared with the non-grafted group. The non-graft site revealed the severe bony defect. The recovered defect area of 'G' and 'GM' goup was significantly larger than that of 'NG' group. Average bone area fraction of 'G' and 'GM' group was also higher than that of 'NG' group and the difference was significant. But, no statistically significant difference was noted between 'G' group and 'GM' group in bone area fraction.

Conclusion: New bovine hydroxyapatite(OCS-B®) was demonstrated to have a biocompatibility and osteoconductivity in dog model. Further studies are necessary to verify its long term tissue reaction in human.

158 | Topic Guided Surgery

3D accuracy of a computer based guiding system: a pilot study

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Introduction: Recently, computer based guiding systems for implant placement were introduced and claim to provide safe,-fast,minimally invasive surgery combining the data from the future rehabilitation and the patients anatomy .However, little information exists about the accuracy of such systems.

The purpose of this research was to check the accuracy of a computer laboratory based guide system.

Materials and methods: The study was done on a sheep's mandible. Impression of the teeth and the edentulous ridge between the anterior and posterior teeth was taken with alginate.

The impression was poured with dental stone,and an acrylic guide was made .The guide was made from acrylic mixed with Barium Sulfate in a ratio of 1:5.

Two 0.5 m''m diameter led balls were placed on either sides of the guide and a Lego brick was placed on top of the guide.

A coned beam CT. study of the sheep's mandible was preformed with the guide affixed to the jaw and processed with a 3 D planning software(Med3D Heidelberg Germany). After determining the future location of the implants, a drill plan was processed and sent to the laboratory. In the drill plan, the exact location of each implant is represented by 18 values. According to this planning, 8 metal tubes were inserted in the guide using a positioning device. 8 implants,3.75 × 8 m''m (MIS Shlomi, Israel) were placed in the direction and depth determined by the tubes. A CT scan of the mandible was preformed again and, in the Med3D software, the implants diagrams were placed on the implants as appearing in the CT. A new drill plan was processed, and the values representing the implants locations of the original drill plan was compared to the values of the new one using the SPSS software.

Results: On everage, the position of the implants was within 0.3 m''m from the planned position.

Conclusion: Implants placed according to the Med3D laboratory guide based system seems to be located in the planned positions. Further research with more implants is needed.

159 | Topic Guided Surgery

Immediate or early loading on partial or single implant cases (prospective study)

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Purpose: The purpose of this study is to evaluate the immediate or early loading on partial or single implant cases with RFA measurements.

Materials and methods: Forty-four tapered designed implants (41 replace select®, 3 Tapered screw vent® implants) were placed in 10 patients of partial or single cases for immediate or early loading in all jaw lesions. The guidelines for early or immediate loading were the peak insertion torque more than 35 Ncm during implant insertion and RFA ISQ values more than 50 immediate after implant insertion.

Apart from clinical and radiographic examinations, the patients were followed with RFA at placement, measured again every 2 weeks until 6 months and measured at 12 months.

Statistical analyses were carried out to study the possible differences between the length, size of implants and also between jaws and jaw area.

Results: Three implants failed. Two of them seemed to be failed because of surgical technique mistake and one was a prosthesis failure of overloading due to provisional prosthesis fracture.

RFA values were pretty stable during all periods. There seemed to be no statistical difference between implant length and size. But there seemed to be significant between Maxillae v.s. mandible and initial v.s. final RFA values.

Conclusion: Within the limitations of this study, tapered designed implants with high initial stability can be used as immediate and early loading on various jaw regions.

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Clinical application of stereolithographic surgical guides for implant placement: preliminary results

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Background: The success of implant-supported restorations requires detailed treatment planning, which includes the construction of a surgical guide. Recently, computer-aided rapid prototyping has been developed to construct surgical guides in an attempt to improve the precision of implant placement. The aim of the present study was to evaluate the match between the positions and axes of the planned and placed implants when a stereolithographic surgical guide is employed.

Methods: Six surgical guides used in four patients (three women, one man; age from 23 to 65 years old) were included in the study and 21 implants were placed. A radiographic template was fabricated and computer-assisted tomography (CT) was performed. The virtual implants were placed in the resulting 3-dimensional image. Using a stereolithographic machine, liquid polymer was injected and laser-cured according to the CT image data with the planned implants, generating three surgical guides, with increasing tube diameters corresponding to each twist drill diameter (2.2, 3.2, and 4.0 mm), for each surgical area. During the implant operation, the surgical guide was placed on the jawbone and/or the teeth. After surgery, a new CT scan was taken. Software was used to fuse the images of planned and placed implants, and the locations and axes were compared.

Results: On average, the match between the planned and the placed implant axes was within $7.25^\circ \pm 2.67^\circ$; the differences in distance between the planned and placed positions at the implant shoulder were 1.45 ± 1.42 mm, and 2.99 ± 1.77 mm at the implant apex. In all patients, a greater distance was found between the planned and placed positions at the implant apex than at the implant head.

Conclusions: Clinical data suggest that computer-aided rapid prototyping of surgical guides may be useful in implant placement. However, the technique requires improvement to provide better stability of the guide during the surgery, in cases of unilateral bone-supported and non-tooth-supported guides. Further clinical studies, using greater number of patients, are necessary to evaluate the real impact of the stereolithographic surgical guide on implant therapy.

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Preoperative assessment of primary implant stability: in vitro validation using polyurethane foam bone

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Primary stability is a prerequisite for the success of osseointegration. For this reason, many procedures have been developped to measure this stability during the last decade. These methods provide useful information but can sometimes lead to inconsistent results. Moreover, being postoperative, they do not help finding the best position of the implant. Ideally the clinician should be able to evaluate the primary stability of an implant before the surgery in order to choose the optimal position.

We have developped a method to preoperatively assess the primary implant stability. The clinician first places the implant on a regular planning software. Once the position has been decided, information about the quality of the bone is extracted automatically from the CT scan and fed into a finite element analysis. It takes 10 s, once the implant has been placed in the planner, to get a patient-specific evaluation of the stability.

Experimental validation was conducted on polyurethane foam blocks for a more standardized evaluation (foam approved by ASTM for testing of orthopaedic devices). Removal torque was measured with a material testing machine. Blocks with layers of different densities and implants with different diameters and lengths were used. In total, 144 configurations were tested. The matching between the predicted and the experimental fracture torque was excellent ($r^2 = 0.97$) and will lead to further testing on porcine mandibles.

This method is a step towards a new generation of tools that will bring additional preoperative biomechanical information while still being perfectly integrated in the clinical workflow.

162 | Topic Guided Surgery

Pit holes of implant simulation systems based on CT data

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Objectives: Computer simulation systems using CT data became one of the most powerful tools for predictable, safe and successful implant treatment. Purpose of this study was to clarify the influence partial volume effects (PVE) in relation to the table speed, slice thickness in scanning, and the slice pitch in reconstruction.

Materials and methods: Industrial alumina-ceramic sphere with known diameters (3/32,1/8,5/32,3/8 inch) and a small toy figure were selected for the object for the scanning. CT data were obtained using the 16 DAS multi-slice CT machine (Light speed, GE Co.) as 4 DAS machine with different table speed, slice thickness. 3D reconstruction image with different slice pitch was obtained by the implant simulation software, iCAT (version2.0) (iCAT Co.).

Results and discussion: As the table speed increased form 3.75 to 15.0 mm/sec with the constant slice thickness, the distortion of the reconstructed ceramic sphere image (RCSI) as well as the reconstructed toy image (RTI) increased. When the slice thickness increased from 1.25 to 2.50 mm with the constant table speed (3.75 mm/sec), RCSI and RTI increased. The slice thickness, also largely influenced PVE and CT data density. The smoothing by 3D reconstruction software could be misleading in diagnosis when slice thickness and table speed (beam pitch) were large.

Conclusion: Our results suggested that CT scanning should be ordered with the minimum slice thickness (at least 0.5 mm) with the beam pitch of 0.75 (4DAS-3AP). They also suggested not perform quantitive measurement of the 3D reconstructed data under the actual CT slice level.

163 | Topic Guided Surgery

An accuracy of flapless-surgical-guides

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Background: From the viewpoint of the patient's benefits, flapless-implant-surgery is extremely powerful tool to reconstruct of occlusion. The success of flapless-implant-surgery requires precise surgical guides. The aim of the present clinical study was to evaluate the feasibility and accuracy of surgical guides supported maxillary mucosa derived from presurgical computer simulation.

Patients and methods: In 2 patients (two women 52 and 57 years old), 'Flapless All-on-6 Surgery' of maxilla were planned using computer simulation soft, and twelve stereolithographic surgical guides were fabricated with tube diameters corresponding to each twist drill diameter. During the implant operation, the surgical guides were supported on the plate or teeth. After surgery, immediate-function and full mouth reconstruction were performed in the same day. Two month after the operation, new CT scan was taken. On the software, the images of presurgical simulation and placed implant were fused, and the positions and axes were compared.

Result: The difference in distance between the presurgical computer simulation and placed position was 0.458 mm at the center of implant, and 0.229 mm at the neck of implant on average.

Conclusion: The present clinical study suggest that presurgical computer simulation and stereolithographic surgical guide might be useful in flapless implant surgery. However, several problems were become clear during guided-flapless-implant-surgery, for example, requirement of a certain degree of mouth opening to insert surgical guides.

164 | Topic Guided Surgery

Correlation between CT values of the bone and density types

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Aims: Assessment of correlation between bone mineral density values obtained by quantitative computerized tomography (CT), and 4 jaw bone density types and maximum screwing force at implant placement.

Patients and methods: In 6 females and 9 males, mean age 61 ± 7.3 years, 29 dental implants were placed with the assistance of CT scanning. Implant planning using SimPlant software was transferred by stereolithographic surgical guide to the patient's mouth. The software bone density inside and outside

the implant was measured using Hounsfield units (HU). The 4 bone quality for implants was defined according to Lekholm & Zarb (1985). The maximum force < 35 Ncm during implant screwing was recorded too. The correlation coefficient between computerized tomography values (HU) of the bone, and 4 bone qualities according to Lekholm & Zarb and maximum force during implant placement was assessed.

Results and conclusion: 1) The correlation coefficient between HU values inside the implant and bone density types is 0.75. 2) The correlation coefficient between HU values outside the implant and bone density types is 0.72. The correlations between HU values and bone density types are high. 3) The correlation coefficient between HU values outside the implant and maximum force (< 35 Ncm) during implant screwing is 0.3. In the limits of this study it seems that surgical technique for oral implant placement has more important role for primary stability then bone density.

165 | Topic Guided Surgery

Guided surgery and immediate function with cemented restoration for edentulous maxilla

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Background: In 2002, van Steenberghe et al.[1] presented a technique to transfer data from 3-dimensional planning software to the operative field for implants placement, which will become the "**NobelGuide**™" (NobelBiocare). This technique allows prefabricating definitive screw retained prosthesis before surgery: "Teeth-In-One-Hour-Concept" (NobelBiocare). On the other hand cemented restorations using prefabricated or CAD/CAM abutments have demonstrated high aesthetic performances[2,3,4,5].

Purpose: The aim of this work is to propose a prosthetic alternative to immediately load the implants by means of definitive abutments and cemented provisional bridge for edentulous jaws and to finalize the prosthetic treatment with a full arch cemented ceramic bridge.

Materials and methods: 3 patients presenting edentulous maxillas were treated with respectively 6, 8 and 10 implants (NobelSpeedy™ Replace; NobelBiocare) using the NobelGuide protocol. Before surgery, definitive abutments (prefabricated titanium or CAD/CAM design abutments: Procera® Abutment; NobelBiocare) and 12-units provisional bridges (metallic framework and acrylic teeth) were design on preoperative casts. The definitive abutments were place immediately after surgery. The provisional bridges were relined into the mouth and cemented with soft provisional cement. During the following weeks the aesthetic or functional patient's complaints were corrected by modifying the provisionals. After that, full arch cemented ceramic bridges were performed on the abutments.

Results: The implants success rate was 100%. All the patients showed high aesthetic satisfaction. The emergence profile was facilitated by the fact that cemented bridge allows planning perfectly the axes of the implants regarding anterior teeth: no room for screw access hole into the cingulum is needed. Furthermore flapless surgery and placement of definitive abutments allow high gingival quality only few days after surgery.

Conclusion: This technique allows immediately loading implants with an aesthetic restoration and gives the opportunity to modify some aesthetic or functional details by optimising the provisional prosthesis providing thus a final high patient's satisfaction rate.

166 | Topic Guided Surgery

Immediate loading utilizing guided surgery and implants anchored in the pterygo-maxillary region

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The efficacy of dental implant treatment is well documented. A number of protocols have been developed to simplify the procedures. Never the less, simpler treatment protocols are needed for the rehabilitation of the posterior maxilla, where insufficient residual bone volume, and poor bone density, often make implant placement difficult. The most obvious solution to this problem,-extending distal cantilevers for the positioning of posterior teeth- has been associated with biomechanical problems. Of the various options for implant rehabilitation of the posterior maxilla, sinus grafting is the most popular. However, a graftless approach for the rehabilitation of atrophied ridges, may avoid many of the inconveniences derived from surgical ridge augmentation for future implant instalation.

Placement of implants in the pterygomaxillary region has been documented with success, yet accuracy of implant placement in this region is not only difficult but potentially dangerous when done by the clinician free-hand.

A novel type of rehabilitation technique is presented. Utilizing three-dimensional implant planning software for CTscan data, and a flapless implant placement approach, implants anchored in the pterygomaxillary region, may be a safe and valuable treatment modality for the Immediate restoration of the athrophied maxilla in specific situations. Indications, advantages, clinical results, and comparison of this technique with other treatment options will be discussed.

167 | Topic Guided Surgery

CT based implant planning and guided implant placement

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Objectives: The aim of this study is to analyse the benfits and precision of CT based implant planning and guided implant placement.

Methods: After CT based implant planning with the SimPlant software (Materialise, Leuven/Belgium) Ankylos® (Friadent

GmbH, Mannheim/Germany) implants are placed with a SurgiGuide to drill exactly to the planned implant location. SurgiGuide converts the simulated implant's exact dimensions to a surgical guide. SurgiGuide drill guides are custom manufactured by a stereolithography process for each patient. During the operation, the SurgiGuide is placed on the jawbone. A provisional restoration is placed at the same day of surgery and after six to twelve weeks implants are restored with a permanent restoration. Periotest® measurements and periapical radiographs have been taken at baseline and 3, 6, 12 months postoperatively.

Results: Up to now 15 implants have been placed and immediately loaded. Complete information about the quality and quantity of the bone makes it possible to determine the ideal location for your implants. Knowledge of the exact location of important anatomy, such as the mandibular nerve and the maxillary sinus cavities, in combination with the SurgiGuide helps to insure that all implants are properly placed.

Conclusions: The probability for a successful operation with a CT based implaning and guided surgery seems to be increased. A SurgiGuide reduces implant complications during the operation due to a thorough knowledge of anatomyThe implant placement and function of the provisional restoration can be significantly enhanced by CT based implant planning and guided implant insertion.

168 | Topic Guided Surgery

Evaluation of the success of CAD CAM surgical stent based flapless implant surgery

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The protocol for a successful implant treatment is the one that demonstrates osseointegration, as well as optimal position of the implant for the fabrication of an esthetic and functional restoration. Preoperative prosthetic planning is a prerequisite for a successful treatment outcome.

The CT-based software programs that has been developed recently, can aid the surgery as well as the pre-surgical planning. Implant 3D (Media Lab Software, La Spezia, Italy) is such a software, that allows 3 dimensional investigation of the bone. By the help of a CT cross-sectional reformation, implant positions may virtually be decided.

56 dental implants were placed by the help of a serious of supramucosal surgical stents . Following the healing period, the stability of implants and osseointegration was confirmed with the use of an Osstell (Integration Diagnostics AB, Göteborg, Sweden) device. As the ISQ values were indicating a clear osseointegration, implant supported fixed partial dentures were made.

After 6 months, the second CT evaluation of the patients were done. The datas were imported into Implant 3-D software.

After the superpositions of preoperative treatment data and the postoperative position of implants data, the coordinates of apical and coronal points of the both implants were recorded to the data base. Then analytical calculations were performed to evaluate the angle deviations, apical and coronal location deviations and vertical deviations. Degree of association between variables was evaluated by Pearson's Correlation Coefficient.

The results indicated that the error resulting from transfer of CT-based implant planning guides is minimal and can be safely used.

169 | Topic Technical and Biological Complications

Characteristic morphology of the marginal bone resorption for different implant systems

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Hypothesis: Different construction principles of the crestal part of different implant systems result in characteristic bone resorption pattern.

Patients and Methods: In a retrospective study using post Op and follow up panoramic radiographs the following implants were included: 1) Implants with a clinical laoding time of 3 and 4 years. 2) Implants were used to restore a partial (shortened) arch with a fixed restauration. 3) No augmentation procedures, 4) healthy patients without bone disease or radiation therapy. Medial and distal values of the vertical and horizontal bone loss were measured. Mean values of the medial and distal values were calculated.

Results:

Implantat system		Median vertical bone loss [mm]	Mediane horizontal bone loss [mm]
Astra Micro Thread	n = 15	0.1	2.8
Camlog Root Line	N = 16	2	1.7
Straumann standard	N = 17	0.4	1.7
3 i Osseotite	N = 11	1.3	2
Branemark Mk III	N = 17	1.5	1.2

Conclusion: Even with the restrictions of the accuracy of panoramic radiographs some characteristic differences were seen: The horizontal bone resorption was similar for all systems. Implants with a rigid (conical) implant abutment connection and those with a transgingival neck showed little vertical bone loss resulting in a shallow bone resorption pattern. Implants with a ''tube in tube'' internal connection showed a steep resorption pattern comparable to two piece external hex implants.

170 | Topic Technical and Biological Complications

Finite element analysis of load transmission at bone-implant interface

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Objectives: Patterns of von Mises stress values surrounding tilted implants that support full fixed prostheses (FFP) in the edentulous mandible were evaluated using 3-dimensional finite element analysis.

Experimental methods: An edentulous jaw solid 3D model was created by a customized software. Four implants were virtually placed in the intraforamina area of the mandible. Distal implants were placed, taking care of the mental foramen, in four different inclinations: 0, 15, 30 and 45 degree. A FFP endowed with a metal framework, extended to the first molar, was connected to the implants. Vertical load was applied on the distal cantilever. Von Mises stress values and areas were evaluated.

Results: The first result is that tilted implants show a higher peri-implant bone stress if they are considered as a single unit. Different behaviours are instead observed when they are part of a rigid FFP. 30° and 45° degree configurations allow the use of longer implants giving a supporting polygonal frame reducing cantilever length and mechanical stress on the distal implants. Implant length plays a key role in load transmission especially in soft bone experimental model. As far as the bridge framework is concerned, the 45 degree configuration presents a stress 3 times lower than a 0° up-right configuration.

Conclusions: This finite element study supports the clinical use of mesiodistal-inclined implants in FFP. Tilted implants, reducing cantilevers length, permit to decrease peri-implant bone stress up to 50%.

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Prevention and risk factors in bronj: 19 cases

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Objectives: Bisphosphonates (BPs) are an important therapeutic drug in multiple myeloma and cancers with bone metastasis. Bisphosphonates Related Osteonecrosis of the Jaw (BRONJ) has been described as a potential side effect of last generation BPs (Zoledronate – Pamidronate – Alendronate). The authors studied risk factors, clinical features and timing surgery.

Methods: The authors retrospectively analyzed 19 patients in BPs endovenous treatment: 14 patients (73,8%) were treated with zoledronate, 1 (5,2%) with pamidronate and 4 (21%) with both drugs for breast cancer (47,4%), multiple mieloma (31,5%), prostatic cancer (15,8%) and colon cancer (5,3%).

Results: The lenght of therapy was 5-36 months before osteonecrosis was observed; in 15 (78,9%) patients BRONJ involved the mandible, in 2 (10,5%) maxilla and in 2 (10,5%) both jaws.

The trigger factors were tooth extractions, inadequate removable total denture, basic and advanced surgery, root canal treatment.

10 (52,6%) patients received non-surgical treatment, 7 (36,8%) patients minor surgical procedures and 2 (10,5%) patients a partial maxillectomy. Healing was achieved in all maxillary localization, and in only 1 mandibular localization with partial maxillectomy performed.

Conclusions: Prevention is the best important phase in the management of this patology. Risk factors are the type of bisphosphonate and the length of exposure, previous dental procedures are trigger factors. Conservative treatment seems to be the best way to control BRONJ, bone resection and soft tissue closure have to be performed when the lesion is refractory to conservative approach.

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Autologous PRGF-glue to repair sinus membrane perforations during sinus lift

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Maxillary sinus lift is a useful procedure to augment available bone volume in placing implants in the posterior maxilla of the atrophic edentulous patient.

One of the major complications of the procedure is the perforation of the Schneiderian membrane, which may inhibit the particulate graft placement and abort the whole procedure, with obvious discomfort for the patient. A number of techniques to close the perforation have so far been published, using either a reabsorbable barrier membrane, suture of the tear or combination of both. A new possibility to treat such a complication comes from a promising and simple technique to provide an autologous Platelet-Rich of Growth Factors gel, as described by Anitua (PRGF System, B.T.I. Biotechnology Institute, Vitoria, Spain). A membrane made of autologous fibrin enriched of platelet Growth Factors and clotted in a rounded shape into a sterile Petri glass is then used as a sticky tear-closure medium when such perforation occurs during the sinus augmentation procedure. This barrier, placed in multiple layers, restores the tenting function of the sinus membrane and completes the placement and the confinement of the graft material into the newly-formed cavity. All cases were successfully restored with an implant-supported restoration.

A case report with clinical, histological and radiographic control after up to3-years has recently been presented.

This simple method may help clinicians to solve this surgical complication, to avoid further surgeries and discomfort for the patient and to reduce the overall costs of the whole procedure.

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Influence of restoration type and prostheses misfit on stress distribution in bone around implants

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Purpose: The purpose of this study was to use photoelastic stress analysis to investigate the effects of restoration type, prostheses misfit, and various occlusal forces on the stress distribution of 3-implant supported FPDs.

Materials & methods: A photoelastic model of a partially edentulous left mandible with 3 ITI implants (4.1 × 10 mm) was fabricated using PL-2 resin. Three 3-unit gold FPDs were fabricated on 3 solid abutments for cement-retained restorations, and on 3 synOcta abutments for screw-retained restorations. After precise units were tested, variations of prostheses misfit were made by placing a 100-micron gap between 2nd and/or 3rd fixtures. The effects of load of 30 pounds on 5 different points were analyzed with a polariscope.

Results: Even in unloaded conditions, stresses were shown around the fixtures after screw fastening or cementing the restorations. Loading on anterior or posterior fixtures developed higher stresses than on the middle fixtures. Screw-retained restorations exhibited wider range of stresses on the coronal portion of adjacent fixtures than cement-retained restorations. But even with the cement-retained FPDs, severe prosthesis misfit caused deflection and increased stresses around fixtures.

Conclusion: Misfit prostheses increased stresses in the surrounding bone especially in the screw-retained restorations and cement-retained restorations cannot achieve the true passive fit to the fixtures.

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Surgical repair of sinus membrane perforations using stabilized collagen barrier membranes

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A review of the sinus augmentation literature of the past 25 years reveals the evolution of the sinus grafting technique, with subsequent prosthetic rehabilitation, into a highly predictable discipline.

The most frequent intra-operative complication with this type of surgery is the perforation of the Schneiderian membrane and the repair of perforations with bioabsorbable collagen barrier membranes has been previously documented.

New techniques are presented on 20 consecutive cases for the management of large perforations of the Schneiderian membrane that could occur during maxillary sinus elevation. A bioabsorbable collagen membrane (BioGide, Geistlich Pharma) is stabilized outside the antrostomy and then folded inward to create either a new superior wall that can obliterate a large perforation or a ''pouch'' that can completely contain the particulate graft material.

Based upon the clinical and radiographic outcomes of the cases presented in this report the following may be stated: 1) bioabsorbable membranes can be utilized to repair large perforations allowing for the completion of the surgical procedure; 2) histological evidence reveals that vital bone formation is not affected by the occurrence of and proper repair of a perforation; 3) radiographic evidence reveals that 100% graft containment can be achieved with a properly stabilized perforation repair; 4) clinical and radiographic examination revealed that normal sinus health was present following grafting of a repaired perforation; 5) limited short-term implant survival was not negatively affected by the presence of large perforations in the cases presented in this report; 6) further studies are needed to confirm the results achieved in this limited presentation of clinical cases.

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An alternative technique for removal of a fractured implant abutment screw: a clinical report

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Aim: The purpose of this study was to evaluate and resolve the prosthetic complications with implant-supported overdentures in the mandibula.

Methods: A 60-year- old man was referred to the clinic with the screw fracture of ball attachment of an implant supported mandibular overdenture. The patient history also revealed several previous screw fracture, loosening and relining of the mandibular overdenture. Although the female part inside the prosthesis seemed to be adequate, the prosthesis itself was needing a relining. Therefore it has been extrapolated that the cause of the ball attachment screw fracture was the excessive forces due to the poor tissue adaptation of the prosthesis. A notch was prepared on the fracture surface of screw remnant as a guide for the subsequent intervention. A hole was prepared in the fractured screw using a metric no 2 guide drill. Then a new ball attachment replaced and prosthesis was relined.

Results: Two-year follow up of the patient revealed neither screw loosening nor fracture although the patient have reported similar complications frequently occurring in his history.

Conclusions: This article describes a technique that allowed removal of the fractured screw and preparation of the inner configuration of the implant fixture for subsequent minute insertion of a new screw abutment assembly.

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Necrotizing sialometaplasia. Report of a case

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Introduction: Necrotizing Sialometaplasia is a self- limiting and benign inflammatory disease of the minor salivary glands. The aetiology is not clear. A lot of authors suggest that a physic-chemical or biological injury on the blood vessels would produce ischemic changes, leading to infarction of the gland tissues with necrosis, inflammation and intent of repairing. It subsequently induces metaplasia, changes in ducts and further scar tissue.

Case report: A 60-year-old man without previous disease, presented a bilateral ulcerated lesion in posterior hard palate of seven days duration. He noted very sharp pain in the areas. Clinical examination showed a bilateral ulcer with violet whitish moderately firm borders. There was no pain to palpation. Local anaesthesia with vasoconstrictor was previously administered for rehabilitation of upper jaw with implants. The patient was treated with antiseptic washes and systemic analgesics. Fifteen days later the patient had an important improvement with total resolution of the lesion in seven weeks.

Discussion: The aetiology of Necrotizing Sialometaplasia is still not fully resolved. It is widely accepted that an acute loss of blood supply to the minor salivary glands is the principal cause of this lesion. Histologic features are squamous metaplasia of ductus and acini and a pseudoepitheliomatous hyperplasia of the overlying mucosa. Differential diagnosis must be particularly done with malignant neoplasia. Clinicians and pathologist must be aware to avoid mistakes in the diagnosis and treatment, considering that it is a self-limiting disease.

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Clinical performance of short implants: 1 year study

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Background: The use of dental implants is a routine treatment modality. Local anatomical restrictions may constrain the placement of standart length implants without advanced surgical interventions.

Objective: The purpose of this study was to evaluate the outcome of short implants (8 mm) related with survival rates and bone level.

Materials and Methods: Totally 78 dental implants (Nobel Biocare / Replace, TiUnite surface) were placed in 28 patients. Grafted sites, medically compromised patients and smokers were excluded from the study. All short implants were splinted with each other by cemented prosthesis. Implants were loaded after 2–4 months healing period in mandible and maxilla respectively. Panoramic and periapical radiographs were taken right after the operation, prosthesis delivery and 6,12,18,24. months. Peri-implant index scores (plaque and gingival indexes) were also recorded at 12,18,24. months after the operation.

Results: The cumulative survival rate was % 94,9. 4 implants were lost all after loading; three in posterior maxilla and one in anterior mandible. Total mean bone loss was 0,08 $\pm$ 0,6 mm for all implants. Implants placed in mandible were slightly showed more bone loss than maxillary implants but not significantly. There were no significant differences in peri-implant index scores between maxillar and mandibular implants.

Conclusion: In contrary to advanced surgery interventions, the use of short implants can be a predictable and also an alternative treatment method. Nevertheless, there should be a careful prosthetic planning against extreme loadings on their use in posterior maxilla.

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Clinical evaluation of implant supported full ceramic screw retained prosthesis

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Background: The attachment of suprastructure to dental implant body is fixed with either screw retained or cemented. Screw retained prosthetic structures have their own advantages and indications versus cemented prosthesis. A wide range of zirconium material usage in dentistry has dramatically increased recently.

Objective: The purpose of this study was the clinical evaluation of implant supported zirconium full ceramic screw retained prosthesis related with peri-implant soft tissue health, bone level and prosthetic or implant complications.

Materials and Methods: In this study totally 48 implants (Nobel Biocare / Replace) were inserted in 35 patients.

All implants were placed in posterior part of upper and lower jaw.

48 zirconium all ceramic screw retained prosthesis were delivered after healing time (2 / 4 month for mandible and maxilla respectively). Cantilever or pontic units were not used for all prosthetic components. Plaque and gingival indexes were recorded at 6,12,18,24. months after the operation. For evaluation of bone level around dental implants, panoramic radiograhs were used right after insertion of implants, prosthesis delivery and 12.,18.,24. months.

Results: No implants were lost in this two year study. Three restorations were replaced after one year loading because of porcelaine breakage and recurrent screw loosing. Satisfactory peri-implant health scores were achieved in this study. Marginal bone resorption around the implants was low (0,8 mm).

Conclusion: The use of zirconium screw retained prosthesis is a predictable way to achieve excellent aesthetic appearance, functional reliability and healthy peri-implant soft-hard tissue condition.

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Consecutive low-intensity pulsed ultrasound promotes osteogenesis in vitro

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Studies have indicated that consecutive low-intensity pulsed ultrasound (LIPUS) accelerates fracture healing in animal models and in clinical studies. However, the mechanism by which LIPUS accelerates fracture healing remains unclear. Interestingly, no reports have investigated the effects of consecutive low-intensity ultrasound on bone augmentation during guided bone regeneration. In this study, we investigated the effect of consecutive LIPUS on osteogenesis by examining the rate of cell proliferation and osteogenesis-related gene expression in the rat osteosarcoma cell line ROS 17/2.8.

LIPUS was applied to cultured cells for 20 min daily for 14 consecutive days. The ultrasound signal consisted of 1.5 MHz at an intensity of 30 mW/cm^2. With LIPUS stimulation, cell proliferation was increased at days 5, 7, and 10 of the culture, and ALPase activity was increased at day 7 of the culture. Real-time PCR analysis indicated that LIPUS significantly increased the expression of the mRNA transcription factors Runx2, Msx2, and Osterix at day 7. This study demonstrates that LIPUS stimulation affects osteogenic cells directly. In clinical use, consecutive LIPUS likely has an important role in accelerating bone formation, and it may also provide an alternative noninvasive method to reduce the treatment period in bone augmentation.

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Three dimensional finite element analysis of stress distribution of implant with marginal bone loss

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Although initial bone loss around implant is considered as a common phenomenon in clinical cases but there has been little study about stress distribution in this condition. A three-dimensional finite element analysis was performed and the influence of marginal bone resorption shape on stress in the bone and implant was investigated. This study was performed with three conditions of bone loss patterns. 1. Horizontal bone loss and vertical bone loss, 2. Various bone loss patterns during biologic width formation, 3. Pathologic vertical bone loss with or without cortification. From the right second premolar to the right second molar of mandible was modeled according to the CT data of dentated patient. Teeth were removed and an implant (Ø 4.0 × 10.0 mm) was placed in first molar area. A total of twelve models with an implant were created. Axial, buccolingual and oblique force was applied independently to the center of implant crown. The Maximum von Mises stress value and stress contour was observed and von Mises stresses at the measuring points were recorded.

Within the study, the following conclusions were drawn.

1. Bone stress distributions were similar in the nonresorption and horizontal resorption models, but differed from those in the vertical resorption models. 2. Bone loss during biologic width formation does not seem to jeopardize bone for the stress distribution 3. In case of vertical bone resorption, contact of cortical bone to the implant may affect the stress distribution positively.

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Micro-organisms of peri-implant infections in patients after radiation therapy

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Objectives: Infections with staphylococci, enterics and candida are common in radiated patients and are known to be difficult to be treated. There is a avidance that they may play a role in peri-implant infections. The aim of the present study was to determine the associaton of these micro-organisms in patients with peri-implantitis and after radiation therapy.

Methods: 40 edentulous patients were divided into groups without(PI-)/with(PI+) peri-imlantitis and without(XPI-)/with(-XPI+) peri-implantitis after radiation therapy (>60 Gy). Patients with peri-implant infections showed positive plaque index, positive bleeding on probing and pocket depth >=5 mm. Microbiologic samples were taken from the deepest pocket of one implant and analysed for DNA of 11 peri-implantitis associated pathogens (micro-IDent® plus, HainLifesience). Additionally another sample were screened for candida(C), staphylococcus(S) and enterics (E) on selective agar.

Results:

group	C	S	E	A.a.	P.g.	B.f.	T.d.
PI- (n=14)	1	1	6	0	2	0	0
PI+ (n=13)	3	1	7	1	4	4	3
XPI- (n=7)	1	1	4	0	0	0	0
XPI+ (n=6)	3	1	3	0	1	0	0
group	P.i.	P.m.	F.n.	C.r.	E.n.	E.c.	C.s.
PI- (n=14)	0	3	6	1	0	5	4
PI+ (n=13)	3	7	12	2	1	6	4
XPI- (n=7)	0	1	2	1	1	1	1
XPI+ (n=6)	0	1	3	0	0	1	0

Conclusion: Periodontal pathogens are detected in peri-implantitis only, after radiation therapy only lower numbers are found. Enterics and candida were present in surprisinlgy high numbers.The role of enterics and candida in per-implantitis should be subject in further studies.

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Effect of prosthesis design on reverse torque of abutment screws

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Screw-retained telescopic implant prostheses(SRTP) have both advantages of screw -retained implant prostheses and cement-retained implant prostheses. One screw of the screw-retained telescopic prosthesis prevents accidental dislodgement of the whole prosthesis, but the long term screw stability is unknown.

Twenty seven implant prostheses were fabricated on fifty four Camlog Promote implants that were embedded in clear acrylic resin. Each prosthesis is a two-unit connected type IV gold alloy restoration. The implant prostheses were divided into three groups: group I(control: pure cement-retained prosthesis), group II(SRTP with chamfer margin), group III(SRTP with Konus margin). The specimens were cyclically loaded (30 ~ 120 N sinusoidal compressive/2 Hz/ 500,000cycles)in the special mounting jig after cementation and screw tightening. The postload reverse torque values were compared to the preload reverse torque values.

The mean postload reverse torque values of SRTP groups(Group II and III) were not significantly different compared to those of control group. The mean differences between preload reverse torque values and postload reverse torque values were not significantly different among three groups.

Within the limitations of this study, it can be concluded that the abutment screws of SRTP show similar stability against loosening to those of cement-retained implant prostheses under simulated chewing conditions.

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Treatment outcome following computer assisted virtual treatment planning

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Objective: The objective of this study was to evaluate the survival and failure following computer assisted virtual treatment planning and flapless fixture installation in immediate loading of edentulous jaws.

Material and methods: 29 consecutive patients (20 males, 9 females, age range 42–90 years, mean age 71.5 years) with edentulous maxilla, mandible or both were treated using the Nobel Guide™ and Teeth-in-an Hour™ concepts between 2003 and 2006. Patients were followed from 4 months to 3.5 years. A total number of 176 fixtures (Brånemark System MkIII with TiUnite™ surface) were installed in 31 edentulous jaws (124 fixtures in 21 maxillae and 52 fixtures in 10 mandibles). Clinical success and failure were evaluated at the follow-up.

Result: 19 out of 176 fixtures were lost between 2 and 18 months after fixture installation and immediate loading. Fixture survival rate at the end of the study period was 89%, 92% in the maxilla and 83% in the mandible. At the patient level, 6 out of 29 patients lost fixtures (21%). Out of these, 2 patients lost all fixtures.

Conclusions: The survival rate compared to a conventional treatment protocol was lower in this study. However, this method is still in an exploratory phase with limited long term data available. Further refinement of the technique may lead to more optimal results.

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Pitfalls related to the alveolar distraction osteogenesis

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For the successful placement of dental implant, adequate alveolar bone height and width are required. Alveolar distraction osteogenesis is an effecive method that enables to resolve the insufficient alveolar bone height for dental implant placement, so alveolar distraction has been applied to clinic and satisfactory results have been reported.

The advantages of alveolar distraction osteogenesis are these.

1) augmentation of alveolar bone height with new bone formation and simultaneous expasion of the soft tissues

2) no bone harvesting is necessary.

3) the technique has a lower morbidity rate compare with conventional techniques. But there are intraoperative and postoperative complications of alveolar distraction osteogenesis. The complications are these.

1) infection on operation site

2) incorrect direction of distraction

3) perforation of the mucosa and suture dehiscence

4) fracture of the infirmed basal bone

5) bone formation defects

6) limitation of distraction, and so on.

So, in the cases of alveolar distraction osteogenesis performed in our department, we would study intraoperative and postoperative complications and problems.

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Implant prognosis in periodontal patients: a comprehensive and critical review

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Objectives: The outcome of implant treatment in periodontally compromised partially edentulous patients has not been completely clarified. Therefore, the aim of the present study was to perform, applying a systematic methodology, a comprehensive

and critical review of the prospective studies published in English up to and including August 2006, regarding the short-term (<5 years) and long-term (>=5 years) prognosis of implants placed in periodontally compromised partially edentulous patients.

Material & methods: Data sources included Pubmed and Cochrane databases and several hand-searched journals. At the first phase of selection the titles and abstracts and at the second phase full papers were screened independently and in duplicate by all reviewers.

Results: The search provided 2987 potentially relevant titles and abstracts. Following the first phase of selection, 31 publications were retrieved for full text screening. After the second phase, 15 prospective studies (seven short-term and eight long-term) were selected.

Conclusions: No significant differences in both short-term and long-term implant survival exist between patients with a history of chronic periodontitis and periodontally healthy individuals. Patients with a history of chronic periodontitis may exhibit significantly greater long-term probing pocket depth, peri-implant marginal bone loss and incidence of peri-implantitis, compared to periodontally healthy subjects. The short-term implant prognosis for patients treated for aggressive periodontitis is acceptable; however, on a long-term basis the issue is open to question. Alterations in clinical parameters around implants and teeth in aggressive periodontitis patients may not follow the same pattern, in contrast to what has been reported for chronic periodontitis patients.

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Myositis ossificans as a complication of iliac crest bone harvesting

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Heterotopic ossification is defined as the formation of bone in sites where it does not normally exist. Myositis ossificans is classified as a type of heterotopic ossification where bone formation occurs following trauma. A case is presented of a 65-year old female patient diagnosed with maxillary and mandibular atrophy, in whom myositis ossificans developed secondary to iliac crest bone harvesting for preprosthetic augmentation prior to placement of maxillary and mandibular implants. Approximately three months following right anterior iliac crest bone harvesting, although there had been routine recovery from the bone grafting procedure, the patient developed persistent pain, described in her own words as ''incapacitating'', in the right lower quadrant of her abdomen. She was evaluated by a number of different specialists before a diagnosis of myositis ossificans was reached, based on magnetic resonance imaging. Management of the pain proved difficult and eventually the symptoms improved to the extent that there was minimal disruption to the patient's daily activities. Implant placement and prosthodontic treatment concluded to the patient's satisfaction. It may be advisable to include the possibility of occurrence of heterotopic ossification and resultant pain as a specific pre-operative warning when iliac crest bone harvesting is planned, in order to prepare patients for this potential complication and avoid litigation.

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3D-finite element analysis of stability and stress distribution on mandibular implant-retained overdenture

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Purpose: The aim of this study was to analyze the displacement and stress distribution of various mandibular implant-retained overdenture models supported by two implants in interforaminal region under the occlusion scheme load.

Materials and Methods: FEA models were made by the 3D scanning of the edentulous mandibular dentiform. The three models were named as Model M1, M2, and M3 according to the position of implants: M1, Lt. incisor area, M2, Canine area, and M3, 1st Premolar area. Inter-implant angulation model was named as M4. Conventional complete denture was named as M5 and used as a control group. Ball implant and Gold matrice were used as a retentive anchors. The occlusion type loads were applied horizontally over each tooth.

Results: 1. In mandibular implant retained overdenture Canine Protected Occlusion type load resulted in higher levels of stress to the implants and female matrices than other types of loads.

2. The overdenture model, M1, with implants in lateral incisor areas resulted in lower stress concentration to the implants and female matrices than other models.

3. In mandibular implant retained overdenture the stress of the implant and female matrice were lower in mesially inclined implant than that of parallel installed implant.

Conclusion: Lateral incisor ares could be the best site for the implants in mandibular implant-retained overdenture. The mandibular implant retained overdenture models mentioned above showed low stress to the implants and female matrices.

key word : FEA, Mandible, Overdenture, Implant Angulation.

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Clinical reactions to experimentally induced peri-implantitis in beagle dogs

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This study compares implant mobility and clinical reactions of peri-implant tissues to experimentally induced peri-implantitis in Beagle dogs, using sand-blasted/acid etched (SLA) implant and smooth surface (SS) implant. The right and left mandibular premolars were

extracted from 5 Beagle dogs, and 2 SS implants and 2 SLA implants were implanted in each animal. After 120 days, healing abutments were connected and replaced for prosthetic abutments fifteen days later, the hygiene regimen was suspended, and peri-implantitis was induced by cotton ligatures. At baseline and 30, 60, and 90 days later, clinical attachment level (CAL), probing depth (PD) and mobility (MO) were measured. Probing depth increased significantly in the SLA group alone on comparing baseline PD with the 30-, 60- and 90-day evaluations ($P < 0.05$). There were no significant differences between the two implant groups ($P > 0.05$). The loss in CAL was significant in both groups on comparing the baseline value with the 30-, 60- and 90-day evaluations ($P < 0.02$). Comparison between the two implant groups revealed a greater loss in CAL in the SLA group at the 90-day evaluation period ($P = 0.04$). There was a significant increase in mobility in both groups on comparing the baseline and 90-day evaluations ($P < 0.04$). However, there were no statistically significant differences between the two implant groups ($P > 0.05$). Experimentally induced peri-implantitis results in a greater loss in CAL in SLA implants than SS implants; however, there were no differences in mobility or probing depth between the two implant groups.

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Maxillary osteomyelitis caused by dental implants

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Introduction and objectives: Masticatory function rehabilitation with Osteointegrated implants (OI) has become very common in our practice. The growth in the number of treatments has brought also a great augmentation in the number of complications related with them. We reviewed all the OM cases related with previous dental implant's treatment.

Material and methods: Retrospective review which includes 8 cases treated of OM in the maxilofacial unit of our Hospital from 2001 to 2005 where we found a relation with previous treatment with dental implants. We reviewed the relation of this cases with the risk factors. All this patients underwent samples and antimicrobial susceptibility. The examinations performed in every patient were CT and OPG, and in selected cases a gammagrafic study was practiced.

Results: A total of 8 patients, 5 females and 3 males. The infection was polymicrobial in 5 out of 8 cases. Viridans streptococci were the most commonly isolated agents (6/8 cases). All patients requiered debridement and all implants had to be removed. The length of the treatment was of 2 to 12 months. Fluorquinolones asociated or no to clindamycin was the most extended treatment.

Conclusions: In this series 17% of the overall osteomyelitis of maxillary bones are associated with dental implants. We've noticed a high resistance among the streptococci viridans (the most common bacteria isolated) to clindamycin, and it seems to be related with previous therapy of this antibiotic or some macrolide. The resolution of the OM requires the early removal of the dental implants.

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Peri-implantitis in the aesthetic zone. Non surgical treatment with an innovative appliance: rationale and case report

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Treatment of peri-implantitis is traditionally based on ''combined'' therapies, as plaque removal, topic and/or systemic pharmacological therapy, surgical procedures. The presence of deep peri-implant pockets greatly reduces the success rates of the treatment. Moreover, as the pocket and the bacterial reservoir grows and the bone resorbtion increases, the indications to a surgical treatment increase. In front sectors, highly aesthetically demanding, the surgical modality induce a mucosal recession, with abutment or implant exposal.

Aim of the present work is to explain basic principles of surgical and non-surgical treatment and to show a case report of a severe peri-implantitis in the frontal sector.

Therapy was executed with the aim of antiseptic and antibiotic substances, by a pharmacological point of view, and with the aim of Teflon curettes and of a novel system of tip, composed of peek, connected to EMS ultrasound headpiece. Thanks to the correct execution of these procedures, authors show how it's possible to control and maintain in the medium period, severe peri-implantitis, without the need of invasive procedures.

Moreover, the showed technique and the use of the peek insert is an advantage for prevention of peri-implant pathologies and for the treatment of mucositis.

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FEA study during early healing of implant installation

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Objectives: To evaluate the biomechanical effects of loading during the early healing of implant installation.

Methods: Four finite element models with a single implant (Straumann® 4.1 × 10 mm) in position 3.6 (FDI) were obtained: II_1, II_2, III_1 and III_2; where II and III are bone type quality criteria (Lekholm and Zarb), represented here with a cortical bone thickness of 2 and 1 mm, respectively. Subscript 1 and 2 represent the distances (mm) from implant shoulder to marginal bone. Peri-implant bone was modelled with elastic properties of a bone still in healing and numerical Resonance Frequency Analysis (RFA) was made using ADINA software. Natural vibration frequencies obtained validate these models because they correspond to values above 70 Implant Stability Quotient (ISQ). Then a static numerical analysis of these models was carried out by applying a load of 118.2 N in a 75° angle with the occlusal plane.

Results:

	Model II_1	Model II_2	Model III_1	Model III_2
Maximum Displacement [μm]	11	14	16	21
Resonance Frequency Analysis [Hz (ISQ)]	8370 (88)	7092 (79)	7816 (84)	6547 (75)
Maximum Principal Strain [με]	+2703 (−2624)	+2568 (−2724)	+3830 (−3930)	+5092 (−4738)
Maximum Principal Stress [MPa]	+43 (−51)	+73 (−99)	+41 (−50)	+79 (−96)

Conclusions: High ISQ and low displacement values in healing bone may reflect good primary stability; RFA is less sensitive to differences between bone type II and III in comparison to marginal bone distance; higher microstrains (>3000 με) in type III will result in more marginal bone resorption.

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Tightness of proximal tooth contact on implant prostheses

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Purpose: The aim of this study was to evaluate the tightness of proximal tooth contact (TPTC) using a novel device at rest state on implant prostheses.

Materials and methods: The test group comprised sixteen patients (10 males and 6 females; mean age, 47 years; s.d., 9 years; age range, 37–60 years), restored with a total 16 single-implant crowns in the left maxillary and mandibular second molars for 8 single-implant crowns, respectively. All implants were 3i parallel walled implants of internal connection and were longer than 11.5 mm and had a diameter 4.0 mm. All abutments were screw-retained UCLA gold (hexed) abutments. All superstructures were gold-alloy full cast crowns. All subjects had a natural interproximal tooth surface between the left first molar and the implant prosthesis in both the maxilla and mandible. The TPTC between left first molar and the implant prosthesis in both the maxilla and mandible was measured by a novel device at rest state. Mann-Whitney U test was used to compare the values in the maxilla and mandible.

Results: The mean TPTC of the maxilla and mandible was 1.32 N (s.d. 0.2) and 1.18 N (s.d. 0.3), respectively. No significant association was found between the maxilla and the mandible.

Conclusion: The quantitative evaluation of the TPTC on implant prostheses was tried by a novel device. Further evaluation with a larger sample size is needed to get more reliable information.

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Changes in temperatures in dental implants during hot beverage intake: in-vivo measurements

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It is now recognized that mechanical and thermal damage to the bone during implant-site preparation should be minimal. Since titanium or titanium alloy are excellent thermal conductors, we hypothesized that intake of hot beverages may cause a rise in temperature along the implant which, in turn, might damage the surrounding tissues.

The aim: of this study was to measure the increase in temperature in dental implants during the intake of hot beverages *in vivo*.

Materials and Methods: Eight implants of seven subjects were examined. Each subject was asked to drink the same volume of hot beverage. While drinking, temperature changes were recorded via three embedded thermocouples placed (i) in the implant's internal space, (ii) at the implant-abutment interface, and (iii) at the abutment. All thermocouples were linked to a computer and analyzed with appropriate software.

Results: The maximum temperature at the abutment was 47.3°C, at the implant's internal space −45.6°C, and at the implant-abutment interface −44.6°C. The mean difference in temperature between the abutment and the interface and between the abutment and the internal space was about 2.5°C. A linear correlation was found between the temperatures measured (i) at the implant abutment and in the implant's internal space, and (ii) at the abutment and at the abutment-implant interface.

Conclusion: Further clinical studies are required to determine whether the habitual consumption of hot food and beverages may be considered a risk factor in the success of implant-supported prostheses.

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The risk factors associated with stability of two-part mini-implants

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Objective: Two component mini-implants have been introduced as intermaxillary fixation (IMF) screws in cases of periodontal problems with bone loss, severely damaged teeth, or short roots. The purpose of this research was to investigate the complications and the risk factors associated with failure of two-part mini implants for IMF cases and to show the possible indications compared to one-component mini-implants.

Study design: The study sample was composed of 46 randomly selected patients who had a total of 203 implants. Pearson

chi-square tests of independence were used to test for associations among categorical variables.

Results: 19 of the total 203 implants failed (9.3%). There was no significant difference in implant failure due to gender, age, oral hygiene and placement but there was significant difference due to soft tissue characteristics and root contact. And complications in IMF with mini implants are rare.

Conclusions: The two-component design of the mini implant is reliable for IMF. However, the factors influencing the few cases of implant failure were root damage and the condition of soft tissues.

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Removal effect on artificial plaque from RBM treated implant

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Purpose: This study was performed to evaluate the removal effect on artificial plaque from RBM treated implant surfaces that are exposed due to peri-implantitis.

Materials and method: Artificial plaque *Streptococcus mutans* and acquired pellicle adhered to RBM treated implant discs. Study materials divided into one control and six test groups. In test groups, physical and chemical methods used to remove plaques. Prophyflex, Professional Mechanical Tooth Cleaning (PMTC) and interdental brush as mechanical treatments and 0.1% Chlorhexidine, Citric acid, HCl tetracycline as a chemical treatment were used. To analyses the study, disc weight was measured for remaining plaque quantities and SEM (Scanning Electronic Microscope) findings was taken for evaluation of surfaces.

Results: In weight changes, there was significant difference between each treatment group and the control group ($P < 0.05$). Therefore all treatment methods using this study have good ability for remove plaques. In weight changes, there was no significant difference between mechanical and chemical group, and there were no significant differences between each groups ($P > 0.05$). SEM findings after mechanical treatment disclosed as follows; Prophyflex group looked like sound implant surface, and there were some paste on implant surface at PMTC group, and there were some artificial plaque at interdental brush group. SEM findings after chemical treatment disclosed as follows; there were some dark lesions which were supposed as the product from *Streptococcus mutans* at Chlorhexidine, Citric acid and HCl tetracycline groups.

Conclusion: These result suggest that all six methods using in this study have good ability to remove artificial plaque on RBM treated implant, and prophyflex is a superior method to remove dental plaque among test groups.

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A retrospective study of fractured implants

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Implant fracture is an uncommon complication in implant therapy, with significant clinical and financial consequences. The purpose of this retrospective study is to report the incidence and circumstances of implant fracture in a sample of 1763 consecutive Astra Tech® dental implants. In total, 14 (0.79%) implants in 8 patients were lost due to fracture, with a mean of 48 months (range 7–144 months) after loading. All patients but two were male. Similar number of 3.5 mm and 4.5 mm implants were found among fractured implants. Three patients lost two or more implants while one lost four. Most fractures occurred in the posterior areas of the maxilla. No significant bone loss was found around fractured implants. An E.M. analysis of four specimens showed excellent percentages of bone-implant contact. No clear reason could be identify to explain implant fracture in this sample, although overloading could be suspected in most cases.

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Giant intracranial arachnoid cyst–a case of implant-prosthodontic treatment

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Arachnoid cysts are intra-arachnoid collections of cerebrospinal fluid; congenital in origin, they account for about 1% of all atraumatic intracranial mass lesions. This case report describes implant-supported restorations in a 53 years old male patient with congenital giant arachnoid cyst. Enlargement of the cyst or complications such as intra-cystic bleeding or rupture of the cyst into the subdural space may be occasionally observed, and found to require neurosurgical treatment. Because of that, a multidisciplinary approach which included neurologist and anaesthesiologist was needed. According to CTs and neurological findings the cyst was located intracranially in right fronto-temporo-occipital region with size of 134 × 73 × 69 mm. The patient needed complex implant-supported restorations and fixed prosthodontic dentures, both in maxilla and mandible. After endodontic and conservative treatment of remaining maxillary and mandibulary teeth, OPGs and conventional implant therapy plan were made. During surgery under anaesthesiologist supervision, two implants were placed in region 22 and 23 and three implants were placed in region 35, 36 and 46. Period of 6 months has been recommended as healing time for osseointegrated implants in the mandible and maxilla, respectively, during which functional loading should be avoided. For that purpose, teeth-retained metal-supported veneered bridges were made as provisional prosthodontic treatment. Following the period

of osseointegration provisional veneered bridges were removed and definitive porcelain-fused-to-gold crowns and bridges were made. Regular 6 months follow up has shown excellent functional and esthetical result after one year.

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Risk factors in implantology

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Introduction: Nowadays the replacement of lost teeth by implants supposes a successful treatment. Nevertheless, there are some risk factors that we must evaluate in our treatments.

Aims:

- To analyze some risk factors of implantology failure nowadays.
- To evaluate the most important risk factors in osseointegration and their degree of influence.

Material and methods: We realize a literature review in Pub – med of articles related to these risk factors in a period from 2002 until 2007.

Results: We can say that the following factors: tobacco, disease periodontal previous, poor oral hygiene, diabetes mellitas previous periodontal bone loss, immediate load, type, length and diameter of implant and, in minor measure, the bruxism influence the appearance of problems as periimplantitis, mucositis or of stability the implants.

Conclusions: It is necessary to realize a patient's suitable clinical history to evaluate and check the previous health and risk factors before implant's treatment.

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The incidence of altered sensation after posterior mandibular implant placement

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Various imaging techniques are proposed for the assessment of available alveolar bone in the mandible and localization of the mandibular canal. The aim of this study is to determine the incidence of altered mental nerve sensation after implant placement in the posterior mandible using panoramic radiographs as the only preoperative imaging technique.

Preoperative bone height was evaluated on patients who had consecutively received posterior mandibular implants. Vertical linear measurements were recorded from the top of the alveolar crest to the superior border of the mandibular canal, with 2 mm subtracted as a safety margin. Prospective evaluation of sensory disturbance was conducted including the mental nerve function and subjective sensations such as pain. A total of 1230 patients received 982 implants in the premolar region and 1734 implants in the molar region. There were two cases of postoperative paresthesia, representing 0.07% of inserted implants. No permanent sensory disturbances were noted. A minor paresthesia of the lower lip lasted for 6 weeks in the first case, and the altered nerve sensation of the lower lip and the chin lasted for 3 weeks in the second case.

Panoramic radiography is simple, low-cost and low-dose preoperative diagnostic tool. It appears to be sufficient to evaluate the available bone height prior to insertion of posterior mandibular implants when a safety margin of 2 mm above the mandibular canal is respected. This presurgical evaluation procedure, combined with a clinical examination may ensure a very low incidence of altered mental nerve sensation after posterior mandible implant placement.

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Screw fracture when the Occlusal force is applied to dental implant – effect of tightening torque of screw

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The dental implant tightening torque of screw could be defined by preload which fixes a fixture to an abutment, and heat energy which is caused by friction. In general, the tightening torque of a screw would be set up by considering the measure of initial loosening torque and loss rate of the loosening torque followed by cycled load.

The purpose of this research is to analyze how the different setting of the tightening torque will affect screw and create fractures when retentive pressure works on the implant, and also, how the differences of the tightening torque affect the transmission of retentive force when the retentive force is delivered to alveolar bone through implant.

For the test, tighten the screws between fixtures and abutments with different torques and then, using tensile tester, pull out the fixtures and the abutments from opposite directions and measure the changes in the screws' preload, then compare preload and yield strength of the screws to analyze the aspects of fracture. Next, carrying out FEA using an implant model that is preloaded already from the initial tightening torque, compare stress distributions and characteristics of retentive force transmission of the screws.

Through this research, it is expected to achieve a new standard in setting up a tightening torque of a screw by clarifying the effect of the differences of tightening torque on screw fracture, and the effect of the differences of tightening torque on transmission of retentive force.

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The effect of various taper angles of the internal morse taper connection type dental implant fixture on their stress distribution by FEA Study

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Purpose: This FEA study aims to help in the choice of the internal connection type dental implant designs that are morse taper joint, based on the FE-Analysis the change of stress distribution in the implant and support tissue according to varying implant fixtures by researching how taper angle number of implants have effects on the stress distribution.

Material and methods: The Implant samples for FE-model which are 11.5 mm in length and 4 mm in the diameter were made and each sample had 0 ~ 15 degree in taper angle. They are designed by OSSTEM Co. Ltd., Korea. Alveolar bone models use by CT scanning three dimension data at fixture site model. The Analysing Software is used ANSYS Workbench v.10.

Result: Stress Distribution (Von-mises) significantly increase as the taper increase from 0 degree to 1degree to 3 degree but decreased in 5 degree taper. There is not difference between 1 degree and 3 degree.

Conclusion: The morse taper is designed that taper angle value is recommended 5 degree.

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Low-intensity pulsed ultrasound accelerates osteogenesis performing bone augmentation in vitro

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Low-intensity pulsed ultrasound (LIPUS) has been widely used intervention for accelerating osteogenesis in the region of orthopedics. However, there have been no studies investigating the effects of the mechanical stimulation provided by LIPUS treatment on bone augmentation performing guided bone regeneration (GBR). LIPUS is known to accelerate mineralization and bone regeneration, but the precise cellular mechanism is unclear. Here, we investigated the effect of LIPUS on osteogenesis by examining the effect of LIPUS stimulation on alkaline phosphatase (ALPase) activity, osteogenesis-related gene expression, and mineralized nodule formation in a rat osteosarcoma cell line. The cells were cultured in medium with or without the addition of LIPUS stimulation. The ultrasound signal consisted of 1.5 MHz at an intensity of 30 mW/cm^2 for 20 min for all cultures. ALPase activity was increased at day 7 of culture after LIPUS stimulation. Real-time PCR analysis indicated that LIPUS significantly increased the expression of mRNA for the transcription factors Runx2, Msx2, Dlx5, and osterix and for bone sialoprotein, whereas the mRNA expression of AJ18 was significantly reduced. The mineralized nodule formation and the calcium content in mineralized nodules were markedly increased on day 14 of culture after LIPUS stimulation. Our study demonstrates that LIPUS stimulation directly affects osteogenic cells, leading to mineralized nodule formation. In view of the widespread use of LIPUS for the clinical therapy of bone regeneration, it is likely that LIPUS has an important influence on key functional activities of osteoblasts in alveolar bone.

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Flap closure in grafted sockets

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The lost height and width of the alveolar ridge depends on the condition of the extracted tooth. Periodontal problems, large apical lesions, vertical root fracture or luxation of the tooth determine the defect and changes in the alveolar bone. To minimize this issue, Guided Bone Regeneration (GBR) simultaneous with the extraction of the tooth, is a predictable method to improve bone morphology so the fixture placement can be possible. One of the main problems related to GBR procedures simultaneous with teeth extractions is soft tissue coverage of the wound, which may lead to an undesired membrane exposure. Also, the absence of keratinized tissue around the extraction site is possible to cause mucogengival problems around the future fixture solution. This work describes a soft tissue closure method in two grafted sockets of canine teeth with a vertical fracture. The coverage of the exposed part of the membrane was achieved by a free gingival graft, harvested from the palate, placed over the membrane and stabilized with suture points to the adjacent soft tissue. The clinical parameters were followed up in the first week after the surgery, by the time of suture removal, 1, 3 and 6 months after surgery, at implant placement and 12 months after surgery. There were no signs of membrane exposure during healing period. The use of free gingival grafts eliminates the need of the periosteal releasing incision, avoiding an unpleasant postoperative, allows a complete closure of the soft tissues in the regenerated area and maintains the keratinized mucosa.

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Ridge preservation procedures after tooth extraction. A clinical and histomorphometric study

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Purpose: The aim of this randomized clinical study was to evaluate with a clinical and histological analysis whether ridge preservation procedure would prevent dimensional changes after tooth extraction.

Methods: Twenty-two patients, 16 female and 6 men ranging in age between 25 to 68 years, were included in the study to receive

extraction alone (control group) or ridge preservation (test group). After tooth extraction horizontal and vertical measurements were taken using a caliper and an acrylic stent. The test sites were grafted with a corticocancellous porcine bone and a collagen membrane. Seven months after surgery a bone biopsy were obtained with a trephine from all sites before implant placement.

Results: The mean ridge width decreased of 0.75 mm in the test group, while the mean ridge width decreased of 2.5 mm in the control group.The vertical ridge dimension changed of 0.2 mm in test group, versus a change of 1.5 mm in the test group. The sites which received porcine bone showed presence of vital bone and residual biomaterial. The particle were surrouded by newly formed bone. No inflammatory infiltrate and no tissue reactions were observed.

Conclusion: The ridge preservation procedures using a mixture of collagen and corticocancellous porcine bone were efficacy in reducing alveolar ridge changes after tooth extraction when compared to extraction alone. This technique contributed to maintain stable the alveolar bone dimension, after 7 months. The histologic analysis showed that the biomaterial is biocompatible and can be used for ridge preservation without interfering with the physiological reparative bone processes.

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Histological outcome of extraction sockets augmented with Straumann BoneCeramic®

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Objectives: BoneCeramic® (Straumann, Basel Switzerland) is a fully synthetic bone-graft substitute (hydroxyapatite + tricalcium phosphate) designed for augmenting bone to support dental implant procedures (launched May 2006). Bone regeneration in healing sockets was analyzed both clinically and histologically in a first-wave patient sample.

Material and methods: Eight patients (mean age 63, range 55–81), presenting for multiple extractions due to periodontal disease and selected for later implant placement, were included in the study. Extraction sockets with intact buccal and palatal bone plate were filled with BoneCeramic® mixed with own blood. One socket was randomly selected for normal healing. Bone cores from 12 substituted and 8 naturally healed sockets were sampled for histological analysis at the time of implant surgery. In 2 patients bone substitution of the graft (after 8 & 21 weeks of healing) was totally ineffective and sampling was impossible due to complete lack of mineralisation. Average healing time of the 6 remaining patients was 11 weeks (range 10–16). Samples were randomly assigned to 2 experimental groups to be processed either as decalcified or ground sections. Demineralized sections were stained with haematoxylin and eosin by Masson's trichrome method and immunostained for Cbfa1, a marker of early osteoblast differentiation. Ground sections were immunostained for osteocalcin, a marker of late osteoblast differentiation. The sections were blinded and examined by transmitted light microscope.

Results: Bone in substituted sockets was significantly softer than in controls and often initial stability was difficult to obtain in the experimental graft material, leading to the use of wider implants. Preliminary histological findings included the presence of large amounts of non-resorbed biomaterial in 60%, poor formation of new bone as compared to controls in 80% and chronic inflammation in 70%. Cbfa1 en osteocalcin reactivity were significantly weaker in the experimental samples, indicating poor osteoblast differentiation.

Conclusions: The present preliminary findings are indicative of a poor resorption/substitution of BoneCeramic® in human alveolar bone augmenting procedures after tooth extraction. Further research is needed to analyze both the biological mechanisms and the long-term clinical benefits of this procedure.

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Evaluation of different clinical variables in the determination of resonance frequency values at implant insertion

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The immediate implant loading technique requires a high primary stability. Resonance Frequency Analysis has been proposed to assess this stability with a quantitative method.

The aim of the present study was to evaluate the importance of different clinical variables in the determination of Resonance Frequency values at implant insertion. In 14 patients, 80 XiVE and 12 Frialit Synchro (DENTSPLY-Friadent, Mannheim, Germany) 2 screw implants were inserted. Sixty-five implants were inserted in a site previously treated with a sinus augmentation procedure, 11 implants were inserted in a healed site and 16 in a post-extraction site. For each implant, diameter, length, bone density, insertion torque, RFA value and percentage of implant fixed to non-grafted bone were recorded. A statistically significant positive correlation was found between Resonance Frequency values (RFA) and implant diameter ($P = 0.008$), implant length ($P = 0.02$), XiVE implants ($P = 0.008$), diameter of the last bur used ($P = 0.01$). No statistically significant correlation between RFA values and all the other variables considered was found. Very few variables seem to influence RFA values. In particular the length and the diameter of the implants, together with the geometry of the implant used are important to obtain a good primary stability.

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Regenaform vs. autograft: comparative clinical and histological randomized prospective study

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Objectives: The aim of this study is to compare the efficacy of allograft Regenaform® (Exactech, Florida) to the autogenous bone graft. in vertical augmentation by means of reinforced e-ptfe membranes.

Methods: Five partially edentulous patients with bilateral vertical jawbone defect (first Kennedy class) were selected. All patients were treated with a split-mouth design approach: at first surgery each side was randomly assigned to the test group consisting in titanium reinforced e-PTFE membrane and Regenaform® or to the control group consisting in titanium reinforced e-PTFE membrane and autogenous bone graft. Twenty-five Branemark implants were inserted (13 test group, 12 control group). The Screw head – Bone Distance (DSB) and Implant head – Bone distance (DIB) were recorded at implant placement and at healing abutment connection.

Results: All membranes remained uncovered except one. All the 25 implant were clinically stable at abutment connection. In the test group the average bone gain was 4.7 mm (SD ± 0.48 mm) while in the control group was 4.10 mm (SD ± 0.88 mm). The test's group dib variation was 1.26 mm (SD ± 1.18 mm), while in the control group was 0.84 mm (SD ± 0.92 mm). The histological analysis revealed a bone to implant contact of 32.80% (test group) and of 25.25% (control group) and bone regeneration with woven bone surrounding the cortical cancellous grafted bone chips.

Conclusions: Histological and clinical findings support the use of Regenaform® as a predictable allograft, even though further studies have to evaluate the long-term performances.

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Evaluation of sinus augmentation using a composite bone graft mixture

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Performance of implant surgery in posterior segments of an atrophic maxilla often poses a challenge due to insufficient bone available. Procedures for sinus lifting were developed to overcome this problem. It is the aim of this study to describe and evaluate, clinically and histologically, a novel sinus augmentation technique using a bone graft mixture.

Materials and Methods: Seventy patients, who required a sinus augmentation technique to receive implants in the posterior maxilla, were recruited for this study. All sites (98 sinuses) were treated with a composite graft consisting of harvested cortical autogenous bone, bovine bone (Bio-Oss®) and PRP. A total of 263 implants (171 Astra Tech™ and 92 Microdent™) were placed. All sites were clinically and radiographically evaluated 24 months after their prosthetic loading. Biopsy samples were taken from 16 delayed implant placement sites, 6 months after grafting, for histomorphometric analysis.

Results: A 100% of implant survival rate was found after 24 months of functioning. Only two implants failed before being loaded, this translates to 99% of overall implant survival rate. No statistically significant differences for implant survival were found between simultaneous and delayed implant placement. Histomorphometric analysis revealed that bovine bone was incorporated into newly formed bone in absence of inflammation. However, mean proportions for vital bone (34% ± 6.34), xenograft remaining particle (16.4% ± 3.23) and non-mineralized tissue (49.6% ± 6.04) showed that bovine bone has a low resorption rate.

Conclusion: A composite graft that utilizes cortical autogenous bone, bovine bone and PRP mixture can be an adequate choice for sinus augmentation.

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Autogenous bone versus beta-tricalcium phosphate graft for bilateral sinus elevation

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Aim: Two different graft materials, Beta-tricalcium phosphate (Cerasorb®) and autogenous bone, were used in the same patient. The aim of this study was to determine whether donor site morbidity could be avoided by using pure-phase Beta-tricalcium phosphate (Cerasorb®).

Materials and methods: Bilateral sinus grafting was performed on 20 selected patients; Cerasorb® was used on the experimental side, and autogenous bone was used on the control side. In each patient, one side was randomly designated the experimental side. Implants were placed 6 months after the procedure. In addition to routine panoramic radiographs, 2- and 3-dimensional computerized tomographic examinations were performed pre- and postoperatively and after implantation. Eighty bone biopsy specimens were taken at the time of implant placement.

Results: Histologically and histomorphometrically, there was no significant difference between the experimental and control grafts in terms of the quantity and rate of ossification. For each histologic sample, the total surface area, the surface area that consisted of bone, and the surface area that consisted of graft material were measured in mm^2, and bone and graft material

were analyzed as percentages of the total. The mean percentage bone areas were 36.47% ± 6.9% and 38.34% ± 7.4%, respectively; the difference was not significant ($P = .25$).

Conclusion: Comparisons with other studies reveal that Beta-tricalcium phosphate (Cerasorb®) is a satisfactory graft material, even without autogeneous bone.

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Influence of implant microdesign on healing outcome in grafted bone: A 36-months Preliminary Report of 1794 consecutively inserted implants

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Recent clinical studies indicate that an implant with a roughened surface may enhance osseointegration and improve clinical appearance. The presentation reports the results of a study evaluating the clinical performance of dental implants with a porous microstructured grit blasted/acid etched/neutralized surface in graftred bone.

1794 XiVE® (Dentsply Friadent, Mannheim, Germany) screw-type implants were consecutively placed between 2003 and March 2006 in the maxilla and mandible either with concomitant bone grafting procedures and sinus floor elevation respectively in bony ridges that had previously been augmented. 1020 implants were placed in the maxilla and 774 in the mandible. Irrespective of the augmentative treatment and localization of the implant second stage surgery occurred after 4 months in the maxilla and 3 months in the mandible. All implants were functionally loaded when restored. Standardized radiographic assessment was made at baseline, implant exposure and every 6 months after implant prosthetic incorporation. Plaque index, bleeding index and probing depth measurement started 6 month after prosthetic rehabilitation and was measured consecutively every 6 months.

After a follow-up of 12 to 36 months (average 31.7 months) four implants failed. One of them in the lateral grafted mandible and the other in the lateral grafted maxilla. The third implant failed in the augmented sinus and the fourth implant after immediate loading in the maxilla. Radiographic as well as clinical examination confirmed osseointegration of all other implants with a survival rate of 99.8%. Standardized radiographs demonstrated 0.95 mm mean marginal bone loss and 1.9 mm mean probing depth at 12 months after implant prosthetic treatment. Peri-implant probing depth and bone loss showed no significant difference between implants placed in different augmented sites.

The data and the experience described of this 3-year analysis indicate a predictable treatment using the presented implant in grafted bone with little marginal bone loss. The clinical and radiographic parameters showed no significant difference between implants placed in different augmented sites. The specific surface roughness on the endosseous section of the implant seems to enhance the regeneration potential at the interface, thus improving clinical performance and implant osseointegration in grafted bone. Despite the short follow-up, preliminary results have shown very promising results.

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Minimizing resorption of iliac corticocancellous bone grafts for maxillary augmentation

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The use of autogenous bone from the iliac crest for augmentation in the maxilla has been a well established technique in oral and maxillofacial surgery for many years. Resorption of the transplant is still a matter of discussion. Within this study a modified harvesting technique from the anterior iliac crest and the resorption rate of the mainly cortical bone transplant was investigated. Between 2001 and 2006 30 edentulous patients (21 female, 9 male) with extreme atrophy of the maxilla underwent augmentation of implant sites by corticocancellous bone from the anterior ilium. Harvesting was performed in all cases by splitting the iliac rim in the middle of the crest and cutting down on the internal blade. Thus a rounded and cortically surfaced substitute for the alveolar crest could be established similar to natural conditions. A questionnaire for all patients included pain scores, gait disturbance and changes in contour. After a 3-months healing period, at implant placement, bone biopsy samples were taken with a trephine bur and evaluated histomorphometrically and the resorption rate was measured at the miniscrews using an individual digital caliper.

Bone biopsy specimens were analyzed showing new bone formation of 45% and gave evidence of a resorption rate of 1.7 mm after 3 months. All planned implants were inserted. There were no major complications at the harvesting site.

Thus allowing the conclusion that the described grafting technique allows predictable results with minimal resorption rates and a sufficient amount of new bone formation after a 3-months healing period.

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In vivo micro-CT evaluation of GBA

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If clear computed tomography (CT) images could be taken of a living experimental animal then it would be possible to obtain data on the same animal continuously throughout a study. Consequently, fewer experimental animals would be needed, which would reduce costs. This study investigated the efficacy of a micro-computed tomography system, micro-CT (R_mCT, Rigaku, Tokyo Japan), for evaluating bone augmentation in the same living rabbit.

In vivo micro-CT with a high-speed two-dimensional flat panel detector was developed. The micro-CT equipment consists of a

micro-focus X-ray tube and a detector, both of which rotate around the object stage. In two rabbits, the calvarium was exposed and the guided bone augmentation (GBA) procedure was performed using a standard hemispherical titanium cap. After GBA, the same two animals underwent repeated micro-CT from 1 to 12 weeks post-operatively. The reconstruction and images were displayed using commercial visualization software (i-VIEW-r, Rigaku). The series of micro-CT images was assessed using subtraction images, between just after the operation and each week, to distinguish augmented bone under the caps.

The exposure time was 17 s, and the reconstruction time was 150 s. The augmented bone within the caps was observed clearly at less than 30-microm voxels.

The process of new bone generation under the caps could be followed continuously in the same rabbit throughout the study, for the 12-week GBA procedure. This enables longitudinal studies to examine changes in bone structure without considering individual differences, and should reduce costs.

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Dimensional stability of autogenous block grafts in the anterior maxilla

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Introduction: Traumatic tooth loss affects mostly young adults, resulting in bone deficiency of anterior maxilla. The aim of the study was to analyse predictability of horizontal ridge augmentation of this region, using mandibular cortical bone grafts.

Material and method: This pilot study was conducted with 5 patients who had suffered the traumatic loss of central incisors. Bone grafts had been taken from retromolar area and fixed with ossteosynthesis screws for recipient site. Bone graft was surrounded with anorganic bovine bone material (Bio-Oss, Geistlich AG Switzerland). Collagen membrane hasn't been used. A width of alveolar ridge was measured prior and after the augmentation in two levels (at 5 mm and 10 mm from cemento–enamel junction (CEJ) of the neighboring teeth). After 6-month-period the sites were re-entered and ridge width was re-assessed prior to implant placement. The width was measured by ossteometer.

Results: Average width of the ridge before the treatment at 5 mm from CEJ was 3.5 mm (min 2.8, max 4.0) and at 10 mm from CEJ was 5.9 mm (4.2–7.3). After the augmentation the measurements were respectively 6.9 mm (5.5–8.0) and 9.4 mm (7.7–11.0). Average graft width was 3.4 mm (2.7–4.2 mm). At the re- entry, at 5 mm from CEJ the width was averagely 6.8 mm (5.3–7.8) and at 10 mm from CEJ was 9.2 mm (7.5–10.7). Only minor surface resorption of 0.2 mm on the both measuring points was observed from augmentation to re-entry.

Conclusion: These results indicate that mandibular cortical grafts are predictable method of augmentation in esthetic zone of anterior maxilla.

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Placement of non-submerged implants and simultaneous sinus augmentation with bovine HA: a -2 to -7 year follow-up study

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Objectives: The presence of pneumatized sinuses in the posterior maxilla often impairs implant placement. A sinus lifting procedure can reliably augment the bone height, highest success rates having been reported if 2-stage implants are placed 6–9 months later. Our aim was to evaluate the long-term clinical reliability of a shortened approach where 1-stage, non-submerged implants were placed simultaneously with the sinus augmentation procedure.

Experimental methods: A sample of 41 consecutive patients (14 men and 27 women, 40–82 years old), with an insufficient residual bone height under the sinuses (from 3 to 8 mm), were treated from 1999 to 2004. A total of 108 implants were placed and simultaneously 53 sinuses were augmented: an oval window (about 8/10 mm) was created on the buccal bone wall using a diamond bur and the Schneiderian membrane was reflected inward. Bovine HA (Bio-Oss®), hydrated with a solution of 100 µg to 1 mg/ml of doxycycline, was used as space filler. A resorbable membrane (Biogide®) was placed on the buccal window before suturing. Healing or final abutments were immediately placed and implants were loaded 0 to 10 months later. The outcomes were evaluated 2 to 7 years after loading.

Results: Two implants had to be submerged because of a lack of primary stability. No sinusitis was noted. Only two implants were lost before loading due to excessive pressure of a provisional complete denture. One patient was dropped out and no implant failed since final rehabilitations were placed, leading to a 98.2% implant survival rate and 100% prosthetic survival rate after a follow up period of 2 to 7 years. The more common complications were gingival recession and ceramic chipping.

Conclusions: Sub-antral bone regeneration with bovine hydroxyapatite as a space filler is a highly effective and safe procedure allowing high and long term success rates of implants placed in the posterior maxilla. If the amount of remaining bone is sufficient to ensure primary stability, implant placement can be performed simultaneously with sinus lifting, and even in a non-submerged fashion. This allows to significantly reduce the number of surgeries and the delay before prosthetic rehabilitation.

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3-D guided bone regeneration using autogenous bone block as space maintainer for bone augmentation in the anterior maxilla

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Objectives: This clinical study aims at assessing the outcome of 3-D bone regeneration using autogenous bone block(s) as space

maintainer for horizontal and/or vertical bone deficiencies at the edentulous anterior maxilla.

Materials and methods: Guided bone regeneration was performed at 23 sites in 18 consecutive patients using autogenous bone blocks as space maintainers and a mix of bovine hydroxyapatite/autogenous bone chips (50/50) as space filler. All patients were no smoker and presented a crestal bone deficiency at the anterior maxilla, which did not allow correct implant placement. Crestal and buccal releasing incisions were made, and a full thickness flap was raised on the recipient site. Cortical bone plates were harvested from the chin and positioned away from the crest in order to create a 3-D regeneration chamber underneath. This space was filled with a mixture of bovine hydroxyapatite (Bio-Oss®) and autogenous bone chips (50/50). The augmented sites were covered with a collagen membrane (Bio-Gide®), and tension-free sutured. A CT-scan was performed five months after the bone augmentation procedures and the implants were placed subsequently.

Results: All sites allowed the placement of the 33 implants initially planned. 32 implants survived after a follow-up period varying from 6 to 30 months and 1 implant failed immediately after placement. Limited bone exposures appeared on 2 sites (2 patients) and were managed with either local tetracycline application or connective tissue graft and did not impair bone regeneration. According to the measurements on the 5-month CT-scans, the mean gain in bone thickness was 5 mm (varying from 4 to 7 mm); the grafted cortical plates proved to be partially resorbed whereas the bone created in the regeneration chamber remained stable. The histological analysis showed newly formed bone as well as residual hydroxyapatite particles in the regenerated areas.

Conclusion: The present study demonstrated successful ridge augmentations and subsequent implants placement. Even with minor contacts between the bone plate and the crest, bone regeneration was successfully achieved and the 3-D construction enabled a high bone gain. The mix of bovine hydroxyapatite/autogenous bone chips (50/50) as space-filler seems to be a suitable combination to prevent resorption and to promote bone formation in the created chamber.

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Anorganic bovine bone in the sinus lift procedure: a 40 months follow-up

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Aim: A clinical and radiologic follow up of anorganic bovine use in the sinus elevation procedure were evaluated for up to 9 years after grafting procedure and implant placement.

Materials and methods: 39 sinus lift procedures using anorganic bovine bone were performed from October 1997 to September 2006, with a mean follow-up of 40 months. 91 implants had been placed. Clinical and radiological evaluations were carried out to analize implant survival rate and intrasinusal graft vertical resorption.

All panoracs were made by the same radiographic machine (Orthopos® Siemens Erlangen, Germany) and dimensional distortion was solved by using a software (Autodesk, Autocad® 2004).

X-rays examinations were performed before sinus lift procedure, immediately post-op (base line) and after each 12 months analizing the distance between the top of the graft and the original sinus floor.

Results: none implant failure and success rate was 100% after 72 months. Mean graft resorption was 1.34 mm with a range from 0.20 to 7.85 mm.

Discussion: osteointegrated implants are a reliable treatment option for restoring the posterior maxilla and final predictability was not influenced by their placement in augmented areas after sinus elevation with bone substitutes.

The stability of graft volume is an important parameter to evaluate the success of grafting procedures.

Conclusions: the survival rate obtained with this study is similar to that expected for implants placed in native bone.

According to the results obtained, it can be stated that anorganic bovine bone is reliable for bone regeneration in subantral cavities.

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Prospective study comparing 3 different crestal sinus grafting techniques: 2-year results

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The aim of this prospective study was to compare 3 different crestal sinus grafting techniques as a predictable solution to vertical bone defects situations in the maxilla.

All clinical cases were treated using delayed implant placement. 7 months after sinus grafting, 89 implants (Zimmer dental) were placed in 41 patients, divided in 3 groups related to the grafting technique: a 1rst group (A: 50 implants) using particles of deproteinized bovine bone grafting material with a resorbable membrane, a 2nd group (B: 18 implants) using Block bovine grafting material associated with particles and membrane, and a 3rd group (C: 39 implants) with a new innovative crestal bone reflecting trap (CBRT) technique associated with bone particles. The decision criteria depend on residual ridge morphology. Radiographic control the same day, 3, 7, 12 and 24 months later enabled us to analyze the bone loss Crestal and apical bone remodeling, and implant survival rate were evaluated.

2 years later, no statistically significant difference in the 3 groups (cumulative implant survival rate 97.75%): peri-implant and apical bone loss from the group A and C (14.6%) were similar and less for the group B (5.9%), despite a significant difference concerning bone graft success rate: A = 96%, B = 87.5%, C = 100%.

Crestal approach gives evidence of a high success solution to different bone deficiency situations. The CBRT technique (group C) presents many advantages: preserving the crestal cortical bone, playing the role of a biological membrane and protecting the biomaterial inside the sinus cavity.

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Radiographic observation of autogenous bone after osteotome sinus floor elevation

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Implant restoration of the posterior maxilla poses significant challenges to the clinician. In an effort to increase the apical occlusal dimensions of available bone for implant placement, a number of sinus augmentation approaches have been suggested. In 1994, Summers systematized sinus floor elevation using an osteotome. This method uses an osteotome to tent the sinus membrane, and a bone graft is placed through the osteotomy site. We used limited cone beam computed tomography (Ortho-CT) to observe the change in grafted augmentation material after osteotome sinus floor elevation. This paper presents the radiological findings of a short-term (6 months) Ortho-CT follow-up study of 1-stage maxillary sinus floor elevation. The study examined 34 patients with a crestal bone height of less than 8 mm in the posterior maxilla. Fifty-one implants were subsequently placed in regenerated bone following osteotome sinus floor elevation. Autogenous bone was used as the augmentation material. Ortho-CT was performed before the first implant operation, just after the first implant operation, and at the second implant operation. In all cases, the grafted augmentation material tended to be absorbed, but at least 2 mm of grafted augmentation material was recognized around the implant fixtures in the Ortho-CT at the second implant operation. The border between the grafted augmentation material and the existing bone was indistinct. The results indicate that sufficient grafted augmentation material changed into bone to support an implant. Therefore, autogenous bone is useful for osteotome sinus floor elevation for implant placement. Long-term radiographic and clinical observations may be necessary.

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The effect of periosteum on healing process of the block bone graft

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Purpose: Bone graft is necessary for the reconstruction of the alveolar defect. However, major disadvantages of autogenous bone graft are the donor site morbidity and high resorption rate of the graft bones. This study was aimed to evaluate the effect of periosteum on the healing of block bone graft in the rabbit calvaria.

Methods: Twenty one mature male rabbits were used in this experiment. Lt. side iliac block bone 8(L) X 8(W) X 5(T) was harvested and fixed on the left side calvalium. In Rt side, periosteum attached iliac block bone was harvested and fixed on the same side. Biopsy specimens were taken at 1st, 4th, and 8th week.

Results: At 1st week, in the periosteum attached group, early revasculization between periosteum grafted bone and calvaria periosteum was observed. At 4th week, new bone formation was occurred more than that of the control group. At 8th week almost of the grafted bone in control group was resorbed. However, in experimental group, bone was relatively stable. But bone was slightly decreased in thickness to original. This results indicate that grafted bone with periosteum allows to resume the blood supply earlier than that of the control group and reduce the bone resorption by preventing direct contact between grafted bone and recipient periosteum.

Conclusion: Clinically, this technique could be effective to decrease the resorption of block bone graft in the alveolar defect. However, further longitudinal experiment and clinical evaluation of results are required.

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Bone regeneration in femur defects in rabbits treated with an e-PTFE and a new VBR titanium membrane

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Abstract: The aim of this work was an histological study of the bone healing of femoral defects in rabbits treated with an e-PTFE titanium reinforced membrane (W. L. Gore & Associates, Flagstaff, AZ, USA) and a new titanium membrane (VBR – Valve Bone Regeneration, Oralplant, Cordenons, Italy). Twelve New Zealand rabbits, weighing about 2.5 Kg were used in this study. One defect (6 mm × 6 mm) was created in each femur. Twelve defects were covered with e-PTFE membranes (control defects) and the other 12 defects were covered with the titanium membrane (test defects). The rabbits were killed after 8 weeks, with an intravenous injection of Tanax, and the block sections, containing the bone defects, were retrieved. A total of 24 defects were retrieved and the specimens were processed to obtain thin ground sections. All the defects of both groups were completely filled by mature, lamellar bone. Newly formed bone was in close, direct contact with both membranes and no gaps were present. Both membranes adhered closely to the bone defects. The e-PTFE membrane appeared to be compressed, in a few areas, by the overlying soft tissues. No inflammatory cell infiltrate was present. No multinucleated giant cells were present. No differences were found in the quantity of the bone regeneration using these two types of membranes, and both membranes have shown a high degree of biocompatibility, and did not induce any untoward effects.

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Distraction osteogenesis of the alveolar ridge: a systematic review

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This literature review was performed to analyse the outcomes of clinical studies of alveolar distraction osteogenesis listed by PUBMED between January 1996 and December 2006. A PUBMED search identified 128 articles on alveolar distraction. Twenty articles covering 209 cases were included in the review and analysed considering location, device and procedural parameters, rate of augmentation, aspects of final implants placement and follow-up. The most frequent location was anterior maxilla, and device an intra-ossous distractor. The mean of applied latency period was 7.26 ± 2.31 days, distraction rate 0.71 ± 0.27 mm/day, augmentation rate 6.88 ± 2.52 mm and consolidation period 12.81 ± 5.10 weeks. Complications arose in 33.5% of distractions. The overall success rate of treatment considering implant placement was 96.2%. A total of 469 implants placed were followed up to 52.8 months (mean 14.19 ± 11.03), with a survival rate of 97.0%. There was statistically significant difference in implant survival rate associated with rate of augmentation ($P = .03$) and duration of consolidation period ($P = .02$). Stabile peri-implant bone level was maintained in 95.0% of implants (data for 317 implants).

In view of the results of the present review distraction osteogenesis seems to be a promising treatment for vertical augmentation of atrophic alveolar bone. Complications in alveolar DO are rather frequent, but rarely cause severe problems, treatment failure or clinical decline. The results obtained in terms of the implant survival/success rate have been encouraging, but there is a clear need for further clinical studies based on long-term follow-up.

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GBR using a biphasic calcium phosphate or a collagen coated xenograft

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Objectives: The aim of the present study was to immunohistochemically investigate bone regeneration following application of either HA + beta-TCP (BCG) or a collagen coated natural bone mineral (BOC) in combination with a collagen membrane at dehiscence-type defects in dogs.

Materials and methods: Standardized buccal dehiscence defects were surgically created following implant bed preparation in six beagle dogs. Defects were randomly filled with either BOC, or BCG, according to a split-mouth design, and covered with a native porcine derived collagen membrane. After 1, 4, and 9 weeks of submerged healing, dissected blocks were processed for immunohistochemical (osteocalcin – OC) and histomorphometrical analysis (*e.g.* residual defect length – RDL, BIC, area of new bone fill – BF, percentage of osseointegrated bone graft particles).

Results: Both groups revealed significant decreases of mean RDL values, as well as increases of mean BIC, BF, and OP values after 4 and 9 weeks of healing. Remaining BCG and BOC granules were completely integrated into a secondly formed network of spongiosa. However, there was no osteoclastic activity at the surface of both bone graft particles.

Conclusions: Within the limits of the present study, it was concluded that both BCG and BOC may provide an equivalent osteoconductive scaffold to support GBR procedures at dehiscence-type defects.

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Porous titanium granules for implant stability and bone regeneration – a case followed for 12 years

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The clinical and radiological results are presented in a case followed for 12 years after implant treatment in combination with porous titanium granules for an augmentation of the alveolar ridge in a severely resorbed maxilla.

Methods: A patient (born in 1922) received in 1995 nine fixtures ad modum Brånemark in her maxilla. At surgery a split crest procedure was performed in region 17–14 and 21–27 because of a narrow bone ridge. Porous titanium granules (Natix®, Tigran Technologies AB, Malmö, Sweden) mixed with autogenous blood and bone-chips were gently packed around the fixtures. Nine months later, 9 abutments were placed and a temporary bridge was connected and adjusted to correct occlusal scheme. The temporary bridge was duplicated after three months into a permanent fixed-bridge-work in gold and acrylic resin denture teeth.

Essential results: After 12 years there was a loss of marginal bone height in average of less than 2 mm compared to the baseline 1996. The fixture stability was excellent for each of the nine fixtures individually tested. She had no infections or inflammations despite insufficient oral hygiene the last years and she was pleased with reliability, function and aesthetics.

Conclusion: Through a split crest procedure in combination with the porous titanium granules, sufficient initial stability was achieved for cross arch bridge installation in a case of a severely resorbed maxillary dento-alveolar ridge. The procedure was less time-consuming than bone-grafting and allowed for bone regeneration and the stability was maintained after 12 years.

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Platelet-Rich fibrin and xenogeneic bone graft for sinus elevation

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Aim: The aim of the present work was to evaluate the potential effect of Platelet-Rich Fibrin (PRF) in combination with anorganic bovine bone (Bioss®) to enhance bone regeneration in sinus augmentation procedure, by means of histologic and histomorphometric examinations of bone biopsies.

Methods and material: This study involved a total of 8 sinus floor elevations being carried out on 4 patients. In 4 sites of study group PRF was associated to anorganic bovine bone Bioss®. In the other 4 sites (control group) was used only Bioss®. The PRF has been obtained with the aid of a centrifuge (Hettich Zentrifugen® D-78532). After an average healing phase of 4.2 months, for the study group and 6.7 months for the control group bone specimens were harvested from the elevated sinus, during implant placement.

Results: Radiographic, histologic and histomorphometric evaluations showed a newly formed bone by a similar quantity in both study and control groups.

Conclusions: Platelet-Rich-Fibrin associated to Bioss® during sinus elevation reduced the healing time before implant insertion.

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Membrane micro-motion effect during bone regeneration procedures. A histological study

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Membrane micro-motion may compromise new bone formation during guided bone regeneration procedures. This investigation aims to evaluate the outcome of new bone regeneration using a controlled membrane micro-motion device.

On each buccal mandibular area of 54 New Zealand rabbits, a custom-made membrane resembling a semi-spherical metallic chamber with lateral stabilization rings of different internal diameters was secured using bone screws. The combination of bone screws and stabilization rings allowed for membrane micro-motions of 0.25 mm and 0.5 mm horizontally and vertically. 24 samples were assigned to group A (physiological micro-motion) and subdivided into 4 groups of six samples in each (group A1 and A2: 0.25 mm and 0.5 mm horizontal micro-motion, and A3 and A4: 0.25 mm and 0.5 mm combined horizontal and vertical micro-motion respectively). For 24 samples (group B), a membrane micro-motion was induced by the mastication movements using orthodontic wire, springs and bone screws to connect the metallic chambers with the anterior buccal area of the maxilla. They were sub-divided into 4 groups (B1 to B4) as previously. Six membranes with no micro-motion were used as control (group C).

The histometric analysis of the control group C showed statistically higher mean values of new bone formation (mean: 1.44 mm^2) than the ''physiological micro-movement'' groups A1–A4 (means: 0.81, 0.60, 0.14 and 0.11 mm^2 respectively) while slender bone formation was found in the ''induced micro-motion'' groups B1–B4.

In the ''physiological micro-motion'' group A, membranes did not always exhibit actual micro-motion during their function resulting in minor new bone regeneration. The induction of actual membrane micro-motion (group B), regardless size and direction, was inhibitory for new bone regeneration.

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Free microvascular transfer of segmental cortico-cancellous femur for alveolar ridge reconstruction

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Purposes: Poor transplant bed conditions are often seen in patients after tumour surgery or severe atrophy of the maxilla or mandible. In these cases microvascular transplants are often chosen to correct combined soft and hard tissue defects. For defect coverage an individually shaped bone transplant with a thin soft tissue layer is the aim.

The microvascular osteoperiosteal flap from the distal femur is a cortico-cancellous bone flap to be used for individual defect coverage of segmental defects of the jaws. In this study the surgical technique of ridge reconstruction using this type of microvascular bone transplant is described and initial clinical results are reported.

Methods: In seven patients with alveolar ridge deficiency of the maxilla or mandible after tumour surgery (3), trauma (2) or atrophy (2), defect coverage was carried out with the help of this femur transplant, designed according to the defect. The defects to be corrected measured from 3 cm to 10 cm in length and 1.5 cm to 4 cm in width. The height to be augmented was between 1 cm and 2.5 cm.The length of the microvascular pedicle was between 4 cm and 10 cm.The arterial anastomosis was performed between the descending genicular artery and the facial or labial superior artery as end-to-end or end-to-side anastomosis. The venous anastomosis was performed between the accompanying veins of the descending genicular artery and the facial vein or angular vein as end-to-side anastomosis.

Results: There were no severe complications or transplant loss. In all patients the defect coverage was performed in the correct size and design. All patients were treated with dental implants (24) 6 months after ridge reconstruction successfully.

Conclusions: The microvascular osteoperiosteal femur graft can be used successfully in individual reconstruction of alveolar ridge defects of up to 10 cm in length. The transplant can be individually shaped according to the defect and can be used for placement of dental implants later on. Long-term success is being followed up.

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Injectable calcium phosphate cement around peri-implant dehiscence defects

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Introduction: Peri-implant dehiscence defects occur frequently during implant surgery. Various graft materials and techniques are proposed for treatment. An injectable calcium phosphate cement (iCaP) applied in peri-implant defects is investigated in this study.
Material and methods: Standardized buccal dehiscence defects (height: 5.8 mm, width: 3.8 mm) were surgically created following implant site preparation in left proximal tibae of five beagle dogs. Fifteen stepped cylinder implants (3.8 × 13 mm) were inserted and iCaP was injected into the dehiscences. Postsurgically each dog received double staining of two fluorescent labels for estimation of bone cell activity at baseline and during 11 weeks of healing The animals were sacrificed after 12 weeks. Dissected blocks were processed for non-demineralised histologic, histomorphometrical and fluorescence microscopy analysis: percent of bone-to-implant contact (BIC) and percent linear bone height (LBH). Student t-test and Mann Whitney-U test were used for the statistical analysis ($P < 0.05$).
Results: Healing was uneventfull in all dogs. iCaP showed good space maintaining and osteoconductive properties with no foreign body reaction. BIC were 34.42 and 37.00% ($P = 0.907$) and LBH were 84.09 and 96.10% ($P = 0.000525$) for test and control sites respectively.
Conclusion: Within the limits of this study, it was concluded that iCaP may be used for the treatment of acute type buccal dehiscence defects at dental implants.

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The correlation between the density of augmented and existing bone

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Objective: This study compared the density of newly formed bone augmented using guided bone augmentation and existing bone in rabbit parietal bones.
Methods: The parietal bones of 18 adult male Japanese white rabbits were exposed. The cortical bone was penetrated, and a custom-made standardized hemispherical titanium cap was placed on the bone. Six animals each were euthanized after 1, 3, and 6 months of healing, and the experimental area was prepared for histological investigation. The percentage area of augmented bone in the central sagittal section was calculated relative to the space created by the titanium cap and existing bone. In addition, the percentage areas of mineralized bone in the augmented (density of augmented bone) and existing (density of existing bone) bone were calculated.
Results: With increased time of healing, there was a significant increase in the area of augmented bone between 1 and 6 months (62.7 ± 21.6% versus 93.4 ± 3.9%). By contrast, there were no significant differences in the density of augmented and existing bone based on the time of healing. Furthermore, there was a significant positive correlation between the density of augmented and existing bone in the regression analysis, and the correlation increased with the length of healing ($R^2 = 0.97$).
Conclusion: These results suggest that augmented bone increases significantly and fills in the occlusive space with time, and the density of augmented bone depends on the density of existing bone.

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Periosteal expansion osteogenesis using beta-tricalcium phosphate (B-TCP) block

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The aim of this study is to evaluate new bone formation under the periosteal expansion using beta-tricalcium phosphate (B-TCP) block in a dog model. The experiment was done on three, mature male beagle dogs. After preparation of atrophic alveolar region, B-TCP block was inserted under the mucoperisteal flap and put on the buccal cortex. Activation titanium screws were inserted transmucosally from lingual side. The tip of screw was touched with medial aspect of the block. After 7 days latency period, during which primary wound healing occurred, the lingual expansion screws were activated about 0.5 mm/day for 6 days, so that the B-TCP block were pushed and dislocated buccally. All dogs were sacrificed on the 60th days of consolidation period. Infection into the B-TCP was not occurred in all animals and no material problem was observed during this experiment. New bone formation was observed in the gap between original bone and B-TCP block, and also was on the lateral surface of the B-TCP block. Moreover, the replacement of large parts of the B-TCP with newly formed bone was observed in the B-TCP block area. These results indicate that bone tissue newly formed by periosteal expansion, so this method might be applicable for augmentation before implantation.

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Crestal sinus grafting technique with delayed implant placement: 5-year results

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The aim of this prospective study was to evaluate bone integration of the grafted sinuses submitted to crestal grafting technique with delayed implant placement.

51 patients presenting vertical bone defects in the posterior maxilla (1 to 4 mm) underwent 67 crestal grafting techniques combining burs, osteotomes and or bone chisels depending on the importance of the defect. Bovine hydroxyapatite (Bio-Oss, Geistlich) was used in all the cases. 3 different sub-categories:

Gr. A: we used only osteotomes (single edentulous)

B: trephine bur + osteotomes (larger edentulous area)

C: bone chisels followed by osteotomes (Crestal bone reflected window trap: CBRT): larger edentulous area, minimal vertical height. Radiographic analysis for up to 5 years (Panoramic) enabled us to evaluate the amount of bone volume resorption. Histological analysis was also done to evaluate the rate of newly formed bone and residual grafted material at 6 months since the first bur used during implant placement (Zimmer dental) was a trephine retrieving a biopsy from the grafted area.

At 6 months, the amount of bone resorption was M = 12 ± 0.7%). At 1 year: M = 14 ± 0.3%. After the first year, bone loss was statistically insignificant. All 106 implants were osseointegrated except one in the group A. The histological findings revealed 54.1 ± 12.6% of nonmineralized tissue, followed by 21.2 ± 24.5% of lamellar bone, 14.5 ± 10.3% of BH particles, and 10.2 ± 13.4% of woven bone.

Crestal sinus grafting approach is highly predictable, minimally invasive and could resolve various sinus grafting situations.

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Crestal vs. lateral sinus grafting technique associated with delayed implant placement: 5-year prospective study

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Background: The aim of this prospective study was to compare lateral and crestal sinus grafting techniques (both used with delayed implant placement) regarding bone quality and quantity.

Material and methods: 126 patients presenting 1 to 4 mm vertical residual bone height under the sinus were grafted using bovine hydroxyapatite (Bio-Oss, Geistlich).

Group A: 67 sinuses using crestal approach: burs, osteotomes, bone chisels.

Group B: 59 sinuses using conventional lateral approach (Caldwell-Luc) Radiographic analysis up to 5 years: Panoramic evaluated graft bone volume resorption.

Histological analysis at 6 months, the day of implant placement (Zimmer dental): a trephine bur collected a bone biopsy: formalin fixing, decalcifying and paraffin embedding. 5 µ sections, hematoxilin-eosine and Masson's trichrome staining.

Results: Radiographic evaluation: gr. A bone resorption of: Mean = 12 ± 0.7%; at 6 months and then limited to 14 ± 0.3% 6 month after implant placement; no more significant bone loss till 5 years. Group B: 15 ± 0.8% at 6 months, 18.5% at 1 year, then stable until 5 years.

Histological results: non mineralized tissue A: 54.1 ± 12.6%, B: 57.3 ± 41%; lamellar bone: A: 21.2 ± 24.5%; B: 18 ± 31.3%; residual BH particles A: 14.5 ± 10.3%, B: 16.4 ± 18.9%; woven bone A: 10.2 ± 13.4%, B: 8.7 ± 15.6%.

Conclusion: Crestal approach revealed a higher rate of newly formed bone. This could be explained by the osteocompression process (autogenous bone expansion) when pushing the residual crestal bone towards the sinus. Radiographical follow-up revealed no statistical significant difference regarding graft bone resorption.

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Rehabilitation of the atrophic posterior maxilla with sinus grafting and oral implants: clinical outcome and a proposal of defect classification

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Objectives: to present a classification of maxillary defects necessitating sinus grafting with two objectives: a) to propose a standardization of surgical procedures according to initial type of atrophy; and b) to allow the evaluation of success/survival rates of implants placed in the grafted areas according to the initial situation.

Materials and methods: 952 consecutive reconstructive procedures were performed on 692 patients. Initial defects were classified according to a new classification, which considered not only residual bone height, but also the width of the alveolar crest and intermaxillary relationship. Sinuses were grafted with autogenous bone: 579 procedures were associated with vertical and/or horizontal onlay grafts to correct concomitant alveolar ridge defects. A total of 2037 implants were inserted in the grafted sinuses either immediately or 4 to 6 months later. Three to 6 months afterwards, implants were loaded. Mean follow-up was 59 months (range: 12–144).

Results: Success rate of the reconstructive procedures varied between 93.2% and 100%, according to class of atrophy; overall survival and success rates of implants were 95.8% and 92.5%, respectively, whereas survival and success rate according to class of atrophy varied between 90% and 97.6%, and between 85.4% and 95.5%, respectively.

Conclusion: Results demonstrated that sinus grafting, alone or in association with reconstructive procedures with autogenous bone blocks, is a reliable procedure to allow implant placement in atrophic maxillae, irrespective to the initial clinical situation. However, it must be underlined that success rates of reconstructive procedures and implants are lower in classes presenting with more severe atrophy.

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Accelerated implant stability after light emitting diode photobiomodulation treatment

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The biostimulatory effect of laser photobiomodulation on implant integration has been shown in a number of in vitro and animal studies. The effect of light emitting diode (LED) photobiomodulation on implant stability, as assessed by resonance frequency analysis (RFA), has not been studied to date.

In this controlled human clinical study, the OsseoPulse device (Biolux Research Ltd, Canada) was utilized. The device has an integrated alignment system that allows for repeatable positioning over the surgical site.

Nobel Biocare Replace Select implants were placed following manufacturer's guidelines. Treated patients performed the photobiomodulation on a daily basis of 20 mW/cm² for 20 min at a wavelength of 618 nm for 21 days.

The implants were tested for primary stability with an Osstell Mentor RFA device at the time of implant placement and at 14, 30, and 60 days.

The LED treated implants demonstrated a mean Implant Stability Quotient (ISQ) change (compared to Day 0) + 3.8% at Day 14, − 2.6% at Day 30, − 5.7% at Day 60.

The untreated control implants demonstrated a mean ISQ change (compared to Day 0) − 28.3% at Day 14, − 17% at Day 30, − 9.9% at Day 60.

The control implants from Day 14 to 30 presented a typical marked loss of stability, however the treated group did not experience this loss at Day 14 and only a slight loss at Day 30.

The accelerated implant stability in the the LED photobiomodulation treated implants compared to the non-treated controls, may allow for faster loading of implants than under conventional treatment regimens.

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Distraction and implants insertion after gianto-cell granuloma – a case report

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Central giant–cell granuloma usually affected the mandible. Radiographically is a well-defined radiolucency with occasional resorption of associated teeth. Histologically there are large numbers of osteoclast-like cells in a vascular stroma. Case report demonstrates treatment options using distraction osteogenesis of the frontal mandibular segment and dental implants insertion.

A 9-year-old boy was sent to the Pediatric clinic with suspected follicular cyst of impacted and dystopic tooth 33. The tissue was extirpated and tooth 33 was surgically extracted.

Bioceramic material (BAS-0) was implanted into the defect of the frontal part of the mandible. Histological examination demonstrated a giant-cell reparative granuloma.

After two years the new surgical intervention was necessary. A segmental resection of the mandible was performed, the continuity of mandible was not disrupted and the teeth 42, 41, 31, 32, 34 were extracted. Healing of the wound was without any complications, but the patient refused to use the partial denture. At the age of 17 without any signs of recidivating, the patient agreed with the following treatment plan:

1. Vertical distraction of the mandibular defect within the range of teeth 42–34.

The activation was 0.5 mm/12 h; the range of distraction was 10 mm (TRACK 1.5 mm Distractor, Martin).

2. six weeks after finishing the distraction three dental implants STIO-BIO were placed (Lasak, length 18 mm), and the distractor was removed.

3. one year later the patient was rehabilitated with partial removable titanium construction.

At present, i.e. 3 years after reconstruction, the patient is very satisfied with the functional and aesthetical results.

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Simultaneous implant placement and bone regeneration using tissue-engineered bone

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The objectives of the investigation: The purpose of this study was undertaken to evaluate the use of tissue-engineered bone as grafting material for alveolar augmentation with simultaneous implant placement.

Methods used: After one month following the teeth extraction in the mandible region of hybrid dogs, bone defects on both sides of the mandible were induced. Dog mesenchymal stem cells (dMSCs) were obtained via iliac bone biopsy and cultured for 4 weeks before implantation. After installing the dental implants, the defects were simultaneously implanted with the following graft materials: (i) fibrin, (ii) dMSCs and fibrin (dMSCs/fibrin), (iii) dMSCs, platelet-rich plasma (PRP) and fibrin (dMSCs/PRP/fibrin) and (iv) control (defect only). Two, 4 and 8 weeks after implantation, the implants were assessed by histological and histomorphometric analysis.

Results: The implants exhibited various degrees of bone-implant contact (BIC). The BIC was 17, 19 and 29% (control), 20, 22 and 25% (fibrin), 22, 32 and 42% (dMSCs/fibrin), and 25, 49 and 53% (dMSCs/PRP/fibrin) after 2, 4 and 8 weeks respectively.

Conclusions: The findings of this study indicate that tissue-engineered bone may be of sufficient quality for enhancement of bone regeneration around dental implants when used simultaneously with implant placement.

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A novel statin delivery system to improve the bone quality

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Objectives: Hydroxymethylglutaryl coenzyme A reductase inhibitors, so-called statins, have been widely used for hyperlipidemic patients, and their osteogenic effect was recently reported. In the present study, to achieve the improvement of bone quality, we examined the effect of fluvastatin delivered by a novel drug delivery system on the promotion of osteogenesis.
Method: Ten-week-old female Wistar rats were used. In the present study, we developed a composite consisted of alpha-TCP and collagen gel as a statin delivery system. Under systemic anesthesia, above-mentioned composite with (experimental groups) or without (control group) fluvastatin was percutaneously injected into the parietal region. In experimental groups, composite contained 0.5 or 1.0 weight % of fluvastatin. One, 2, and 4 weeks after the surgery, animals were sacrificed and then undecalcified ground sections were prepared. Finally, both histological and histomorphometrical analyses were performed.
Results: In all groups, composite remained adjacent to the parietal bone surface, however, direct bone-to-composite contact was not observed. In experimental groups, parietal bone thickness was thicker than control group. Despite the application of the composite, the outline of the parietal bone was not irregular in control group. On the contrary, irregular outline of the parietal bone was indicated in the experimental groups.
Conclusion: It is concluded that this composite was a potential material for the local delivery of statin and it may possess the ability for the improvement of the bone quality.

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Stem cells from dental pulp

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Investigations on alveolar bone reconstruction for implant dentistry were advanced through years. Recently, the considerable therapeutic potential of human multipotent mesenchymal stromal cells (MSC) has generated markedly increasing interest in this discipline. And studies about various resources of MSC were published such as bone marrow, cord blood, adipose tissue, etc.

Objectives: The present study was performed to verify possibility of mensenchymal stem cell MSC culture from the adult human dental pulp.
Materials and methods: Dental pulp was obtained from normal human impacted third molars. The tissues were digested in collagenase/dispase to generate single cell suspensions. Cells were cultured in low glucose DMEM supplemented with fetal bovine serum, L-glutamine and antibiotics. After expansion, the phenotypes were analyzed by flow cytometry.
Results: The cells were plastic-adherent in this culture condition. Also expressed CD105, CD73 and CD90, but showed lack expression of CD45, CD34 and HLA-DR surface molecules.
Conclusion: These data revealed the presence of MSC population in adult human dental pulp and suggest the potential of these cells to regenerate defect of alveolar bone.

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Dental implants inserted in the newly formed mandible using rhBMP-7

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Bone morphogenetic protein is one of the most promising osteoinductive substances and has been expected to be applied clinically for bone reconstruction. BMP-7 has demonstrated the ability to stimulate bone regeneration in multiple skeletal sites, including the craniofacial complex.

Several animal studies confirmed that the application of bone morphogenetic proteins caused a more rapid and enhanced osseointegration of simultaneously placed implants when compared to the bone substitute alone.

To our knowledge, only two case reports presented clinical use of BMP-7 in maxillofacial surgery (maxillary sinus floor elevation; Le Fort I osteotomy and advancement).We present patient with recurrent ameloblastoma treated by segmental osteotomy of the mandible. The bone defect (6 cm length) was reconstructed by autogenous iliac crest bone grafts using BMP-7. Radiographic evidence of new bone formation was seen at 9 months, postoperatively. A biopsy was taken at 9 months demonstrated viable new bone formation. A year after the reconstruction we have inserted three dental implants (Ankylos, Friadent). One implant failed, and two years after the insertion we have loaded two implants with ceramic bridge. Follow-up period is two years.

To our knowledge, this is the first described case of dental implants inserted in resected mandible reconstructed by bone graft using bone morphogenetic protein. The problem of BMP-7 dosage

and overgrowth of the graft should be discussed. Although this case has shown encouraging results, long-term results and the predictability of nthis type of reconstruction in humans are still unknown.

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Peri-implant osteogenesis is promoted by the local application of statin

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Objectives: HMG-CoA reductase inhibitors (''statins'') are widely used for hyperlipidemia. Recent in vivo and in vitro studies demonstrate that statins induce osteoblast activity and lead to bone formation. The purpose of this study was to examine if the local application of statin enhances the osteogenesis around the titanium implant.

Methods: Ten-week-old Wistar rats received pure titanium rods in both tibiae with or without fluvastatin (FS). Propylene glycol alginate (PGA) was used as a carrier. Rats were divided into 6 groups: implant only group, implant + PGA group, low-dose (implant + 3 μg of FS) group, medium-dose (implant + 15 μg of FS) group, high-dose (implant + 75 μg of FS) group, and ultra-high-dose (implant + 300 μg of FS) group. The animals were sacrificed at one and two weeks after implantation. Peri-implant bone formation was assessed using histomorphometric procedures by measuring bone-implant contact (BIC), peri-implant osteoid volume (OV) and mineralized bone volume (MBV). Mechanical push-out test was also done to evaluate implant fixation strength. Statistical differences among groups were determined by ANOVA and $P < 0.05$ was considered significant.

Results: In ultra-high-dose group at week 1, OV was significantly higher than others ($P < 0.05$) and MBV was significantly lower than others ($P < 0.05$). At week 2, both BIC and MBV in high-dose group were significantly higher than non-fluvastatin groups ($P < 0.05$). In addition, the data showed good correlation between MBV and push-out strength.

Conclusion: Local application of fluvastatin promoted mineralized bone around implant and it was suggested that the improvement of osseointegration may attribute to calcification of peri-implant bone.

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Application of simvastatin to tooth socket of rats for bone augmentation

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Objectives: Decrease of alveolar ridge after tooth extraction caused difficulties in prosthodontic treatment, especially in implant supported prosthesis. Statins, inhibitors of cholesterol synthesis and therapeutic drugs for hypercholestemia, stimulates BMP-2 expression in osteoblasts. The objective of the present study is to examine how local application of simvastatin, one of the statins, to the tooth socket after tooth extraction affect alveolar bone.

Materials and methods: The mixture of lactic acid/glycolic acid copolymer (PLGA), α-tricalcium phosphate (TCP), calcium carbonate was prepared as carrier for simvastatin. One hundred fourteen male Wistar rats, 10 weeks old, were used. After right mandibular incisor extraction, 96 rats were divided into eight groups and tooth sockets were treated differently: no treatment (control), PLGA carrier only, PLGA containing 0.1, 0.25, 0.5, 1.0, 2.0, and 4.0 mg simvastatin, respectively. They were sacrificed at 4 and 8 weeks. Bone mineral content (BMC) of alveolar ridge was measured with Dual-energy x-ray absorptiometry and histological analyses were performed. Other 18 rats were divided into 2 groups and tooth sockets were treated differently: no treatment and PLGA carrier containing 1.0 mg simvastatin. They were sacrificed at 2, 4 and 6 weeks. RNA from the alveolar ridge was extracted then RT-PCR analyses were performed.

Results: All groups treated with simvastatin showed higher BMC compared to the control group and PLGA carrier group at 4 and 8 weeks. Histological analyses revealed the thickness of cortical bone of statin group increased compared to the control group at 4 and 8 weeks; however, newly-formed bone in the tooth socket of statin group was less than the ones of the control group and PLGA carrier group. RT-PCR analyses demonstrated that simvastatin application to the socket enhanced expression of alkaline phosphatase and BMP-2 two and three-seven fold, respectively.

Conclusions: Local application of simvastatin would be potential to enhance bone formation and preserve alveolar ridge after tooth extraction.

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VEGF and bone remodeling

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The objective of this research was to evaluate the response of osteoblast and osteoclast to vascular endothelial growth factor (VEGF) for future clinical application to implant or periodontal surgery.

Rat bone marrow cells (RBMCs) were separated from tibiae. RBMCs were seeded in 24-well or 96-well plates for proliferation or differentiation into osteoblast-like cells or osteoclast-like cells. For the proliferation assay, the cells were cultured for 24 and 48 h in the presence or absence of VEGF. For the differentiation assay for osteoblasts, the cells were cultured for 4 ~ 16 days after confluent culture. The culture medium was collected to assess the amount of osteocalcin (OCN), one of the osteoblast differentiation markers, by ELISA. For the osteoclast formation assay, RBMCs were cultured with 1alpha, 25-dihydroxyvitamin D3 in the presence or absence of

VEGF for 4 days. Osteoclast formation was measured by counting the number of TRAP positive multinucleated cells more than three nuclei (TRAP(+)MNCs) using histochemical staining.

Although VEGF did not enhance the proliferation of RBMCs intensively, OCN secretion was stimulated by the addition of VEGF. On the other hand, VEGF stimulated the formation of TRAP(+)MNCs.

These data provide evidence for a direct role of VEGF on bone cells (osteoblasts and osteoclasts) at a cellular level and suggest that VEGF stimulates osteoblast and ostraoclast activities. This study implies that VEGF can enhance the bone remodeling and it may contribute to the improvement of bone quantity and quality.

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Magnetic fields stimulate bone formation in vitro

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Purpose: Shortening the healing period is one of the patient's demanding in the implant treatment. In stimulation of bone healing around implants, magnetic exposure could be employed, however, little is known about threshold of magnetic effects and its biological mechanism. A purpose of this study was to evaluate a promotional effect of static magnetic field and an extremely low frequency magnetic field on bone formation *in vitro*.

Methods: Static magnetic field (250mT, Neodymium disc magnet) and time varying magnetic field (electro-magnetic power unit) were applied on MC3T3-E1 osteoblastic cell culture. In changing the magnetic field, 400mT maximum intensities and frequency of 0.8 Hz were applied to the culture. Cell proliferation and differentiation were assessed by WST-8 method and measuring alkaline phosphatase (ALP) activity. Effect in mineralization was evaluated by measuring amounts of mineralized nodule formation.

Results: After 4weeks of the culture, mineralized nodule formation was significantly increased in both static and changing magnetic filed exposure. Cell proliferation was increased after one to twenty four hours exposure of the changing fields, however decreased in the exposure of the static magnetic filed. There were no significant differences in ALP activities.

Conclusion: Based on these results, both static and electromagnetic fields stimulate mineralization *in vitro*. The stimulation of osteoblastic cell proliferation might be responsible for the promotional effect in the changing magnetic filed, but not in the static magnetic field. Further studies are needed for clinical application of magnetic fields in stimulation of osseointegtation.

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Bioguided Tissue Engineering: Synergy between Bone and Soft Tissues for Implant Placement

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Background: Bioguided tissue engineering is a nobel concept of intelligent principles and methods toward the development of biological dynamic cellular and molecular delivery that can restore, maintain or improve biomimetic processes for dental implant placement.

Purpose: To evaluate the potential of autologous growth factors and fibrin matrices (GFFM) combined with particulate (DFDBA) and/or autogenous (AB) bone grafts to enhance complex bone architecture and soft tissue healing. At 6 months, re-entry procedure was performed to evaluate bone and soft tissue gain.

Methods: Thirty eight patients (28 maxillary/11 mandibullary ridge defects) were treated utilizing GFFM combined with particulate and/or autogenous grafts. Soft and bone tissue gain was measured at surgical, 3, and 6 months postoperatively. Re-entry procedure was performed prior to dental implant placement and bone tissue gain was assessed.

Results: At 1 month postoperatively soft tissue width gain was 4.71 mm ($P = 0.001$ CI 95% (3.40 ± 4.71 mm), and height gain was 3.87 mm (CI 95% 3.40 ± 4.71 mm). Soft tissue volume increase and complete wound closure was observed. At 3 months, soft tissue width gain decreased to 3.12 mm ($P = 0.001$, CI 95%- 2.57 ± 3.80 mm), and height gain to 2.87 (CI 95%- 2.40 ± 3.71 mm). At 6 months these values remained unchanged. At re-entry procedure, bone tissue width gain was 4.80 mm, and height gain was 3.90 mm for AB + GFFM ($P = 0.001$). Bone tissue width gain was 3.08 mm, and height gain was 3.04 mm for DFDBA + GFFM ($P = 0.001$).

Conclusions: Bioguided tissues engineering utilizing GFFM + DFDBA and/or AB translate to significantly bone gain and improve esthetic results and implant success in tissue augmented sites. Further studies with a larger sample are needed to enhance the statistical significance of our clinical findings.

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Glucuronic Acid and Phosphoserin act as Mineralisation Mediators of Collagen I Based Biomimetic Substrates with Calcium Phosphate Phases Using Electrochemically Assisted Deposition

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In this work, model molecules carrying acidic functional groups were used to mimic effects of native biomolecules and influence the mineralisation behaviour of collagen I. These molecules were glucuronic acid (GA) and phosphoserine (PS) as models for glycosaminoglycans (GAGs) and phosphoproteins, respectively. Electrochemically assisted deposition (ECAD) was used for the

mineralisation of collagen substrates. Deposition was performed in a ($Ca^{2+}/H_xPO_4^{(3-x)-}$) electrolyte with pH and temperature close to physiological conditions. Collagen substrates modified with GA showed a stable interaction between GA and collagen fibrils, and during mineralisation of collagen-GA matrices, amorphous calcium phosphate (ACP) clusters shifted earlier into crystalline hydroxyapatite (HAP) needles with increasing GA content of the collagen matrix. We propose that the activation energy necessary for the phase change is reduced as a consequence of the presence of GA. The addition of PS to the electrolyte, on the other hand, succeeded in inhibiting the phase transformation from ACP to HAP. The lower density of the resulting mineralisation and the appearance of coalesced aggregates at a certain PS concentration suggest an interaction between calcium and PS involving the formation of complexes. The combination of GA-modified collagen and PS-modified electrolyte showed dose-dependent cooperative effects.

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Novel aesthetic regeneration treatment by injectable tissue-engineered bone and papilla

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The objectives: Now we are confronted by an aged world, and people hope youthful happy life improved in quality of life (QOL). So we applied tissue engineering and regenerative medicine (TERM). The aim of this study was to clinically evaluate the improvement of function and aesthetic, and the success of dental implants, interdental papilla regeneration for black triangle and the stability of the regenerated bone after functional loading.

Methods used: It applied in conjunction with an injectable tissue-engineered bone (TEB) or papilla (TEP), along with mesenchymal stem cells (MSCs) and platelet-rich plasma (PRP) or extracellular matrix. We applied injectable TEB for sinus floor augmentation, vertical and horizontal alveolar ridge augmentation of the severe bone resorption with stimultaneous implant placement, and TEP for interdental papilla regeneration, and investigated the regenerative bone volume and the stability of the regenerated bone on a long term basis.

Results: The mixture of TEB or TEP is safety and useful as a regenerative substitute as for dental implant or interdental papilla regeneration clinically. And the height of regenerated mineralized tissue for dental implants showed the mean increases of 8.1 ± 2.3 mm compared to preoperative values. In addition, black triangle improved by TEP.

Conclusions: This injectable tissue-engineered technology would stably predict the success of bone formation, reduce patient burden, and provide minimally invasive cell therapy. In addition the future for TERM to dentistry would be one with potential, capable of bringing advances in treatment for our patients and improvement in QOL in an advanced age world.

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Effects of electromagnetic fields on bone healing: evaluate the histopatholgic and biochemical study in rats

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The purpose of this study was to evaluate the effects of electromagnetic fields on bone healing. Wistar Albino adult male rats were used for the experiment.

We performed a tibial osteotomy and we applied 100 Hz and 3Gauss electromagnetic field for 12 h per day. We evaluate the histopatholgic effects of electromagnetic fields on days 15 and 45. We also investigate the serum Ca^{+2} and ALP levels on days 0, 7, 15, 21 and 45.

Our results suggest that electromagnetic stimulation does not improve bone healing on day 15 but increase new bone formation on day 45. But these results were not statistically significant ($P = 0.133$, $P = 0.094$). Electromagnetic fields stimulation group demonstrated significant lower serum Ca^{+2} levels ($P = 0.011$) compared with control group on day 15. On the other time periods, statistically significant difference were not observed in serum Ca^{+2} and ALP levels, between groups.

In our study,the use of electromagnetic fields to bone defects showed us the stimuleting effects to the bone healing with higher concentration of Ca^{+2} levels and blood vessels without any negative effects to the bone healing during long time.

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Histopathological effects of two cryogen agents liquid nitrogen and carbon dioxide on the healing of experimental bone defects

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We aimed to evaluate the histopathological effects of liquid nitrogen and carbon dioxide on the healing of experimental bone defects in our study.

126 Wistar–Albino male rats, weighing 240 g $\pm$ 20 g were used in this study. Rats were equally divided into two main groups and into 7 sub groups due to the scarification dates respectively 3, 7, 14, 21, 28, 45 and 60 days. 5 mm long and 3 mm wide cortico-cancellous bone defects in both left and right tibia of each rat are done. Liquid nitrogen was applied on the left tibia and carbondioxide on the right side. The other main group is the control group. We evaluated the histopathological effects on the bone at the 3rd, 7th, 14th, 21st, 28th, 45th and 60th days according to the scarification times.

According to the statistically evaluated data from the histopathological findings, there are aseptic necrosis fields in both liquid

nitrogen and carbondioxide group and these are significantly much more than the control group. Due to the necrosis amount the healing of bone in each group is significantly delayed in contrast to the control group.

Regarding to this findings we suggest that the use of cryotherapy in the maxillofacial region where especially locally aggressive lesions are usually seen can be safely done to avoid the generally seen residives and this study may provide a baseline for further clinical and experimental research.

248 | Topic Long-Term Studies

8 years follow-up of 6 MM wide-diameter implants

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The rationale for introducing wide diameter implants into the clinical practice is based on a larger bone-to-implant interface and increased prosthetic-base surface area. These characteristics facilitate the primary stability of the implants and improve the distribution of the occlusal forces and the stability of the prostheses.

A search of the English scientific literature reveals several articles regarding 5 mm diameter implants with conflicting results of the survival rates. The numbers of studies including 6 mm diameter implants is negligible.

The presentation will report retrospectively on 8 years clinical success rate of 45 tapered HA-coated 6 mm diameter implants. All implants supported a fixed prosthesis at the posterior areas. For the majority of the patients (35), it was a single-tooth fixed prosthesis and the mean loading time is 59 months. The overall survival rate is 100%.

The presentation will discuss the anatomic considerations for inserting wide diameter implants at the posterior areas, the augmentation techniques occasionally needed to achieve the bone dimension required for 6 mm wide implants. The presentation will also consider the usage of 6 mm diameter implants as a single tooth replacement at the first molar areas.

The presentation includes clinical demonstrations.

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Survival analysis of implant in maxillary and mandibular molar regions; A 4 ~ 5 years report

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Purpose: This study was performed to evaluate the 4 ~ 5 years' cumulative survival rate and the causes of implant failure in different locations for maxillary and mandibular molars.

Materials and Methods: Among the endosseous implants placed in Gwangju Mir Dental Hospital from Jan. 2001 to Jun. 2002, 473 implants from 166 patients (M:75, F:88) were evaluated retrospectively. By location, 205 maxillary and 268 mandibular posterior implants were included. Analysis on implant failure and survival was performed by various factors on patient, fixture, bone and prosthetic type using chi-square test and Kaplan-Meier cumulative analysis during 4 ~ 5 year follow-up periods.

Results: The overall failure rate at 5 years was 10.2% (subject level) and 5.5% (implant level). The cumulative overall survival rate was 94.5%. The survival rates were 91.3% in maxillary 1st molar, 91.1% in maxillary 2nd molar, 99.2% in mandibular 1st molar and 94.8% in mandibular 2nd molar regions ($P < 0.05$). The survival rates were not significantly affected by gender, baseline periodontal status, surgery type, bone augmentation, fixture length, and single or splinted implant crowns. The survival rate for wider diameter fixture (wider than 5.75 mm) was also lower ($P < 0.01$) in mandibular 2nd molar region. Among 5 surface types (acid etched, SLA, TPS, RBM, and HA), none of SLA implants failed during the follow-up periods. The failure rate of HA implants was the highest after loading. Out of 26 failed implants, 20 implants were removed before loading and 6 implants were failed after loading .

Conclusion: Implant survival rates were different in various locations. The fixture diameter as well as the surface type was the significant factor for implant survival.

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Immediate loading of implants with a provisional fixed prosthesis in the edentulous maxilla

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Background: Interest in long time follow-up after use of one-stage surgery and immediate loading of implants in the edentulous maxilla has lately been increasing.

Purpose: To prospectively evaluate the success rate of immediately loaded Straumann sand-blasted, large-grit, acid-etched (SLA) solid-screw dental implants in the edentulous maxilla in a long time follow-up.

Materials and Methods: Twenty-eight patients (mean age 63 yr) with edentulous upper jaws each received six implants and one implant-supported fixed provisional prosthesis within 24 h after surgery. After a mean healing time of 15 weeks, the patient received a permanent, screw-retained implant-supported fixed prosthesis (ISFP). A total of 168 implants were placed. Clinical and radiological examinations and assessments were made at implant placement and after 8, 20, 32, 44 months and 5 years of loading. All ISFP's were removed at the 32 months follow-up, the implant stability was checked with a torque device and the Implant Stability Quotient was measured with Resonance Frequency Analysis

Results: The mean marginal bone loss between 8 and 20 months after loading was 0.41 mm (SD 0.63, $P = 0.001$) and from 20 to 32 months 0.08 mm (SD 0.49, $P = 0.039$). The cumulative success rate after 32 months was 98.2% and after 5 years 96.8%.

Conclusion: Solid-screw SLA implants–immediately loaded within 24 h after placement with a provisional fixed prosthesis–showed in

a long time follow-up, a similar success rate as compared with conventional loaded implants. Immediate loading of implants in the edentulous maxilla was found to be a viable treatment alternative.

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Comparison of results of implant treatment among different age groups

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Aging is a compromising factor in skeletal bone loss. Placing implants in older patients may be more complicated and more bone resorption around implants can be seen. The purpose of this study was to compare the survival rates and crestal bone loss around implants among different age groups. Study group consisted of 71 patients. First group presents the younger adults consisting of 31 patients, younger than 30 years (mean age 28.7). Second group presents adults, aged between 31 and 64 consisting of 20 patients (mean age: 51.5). Third group presents older adults consisting of 20 patients, older than 65 years (mean age 67.3). 203 implants were placed totally (59, 81, 63 implants respectively). Mean follow up was 36.4 months. Implant survival rate, crestal bone loss, type of prosthesis have been compared. Patient satisfaction has also been evaluated. No significant differences were found among groups regarding to survival rate and crestal bone loss. However, types of prosthesis were different among groups. In young patients single tooth implant was primary indication however, fixed partial prosthesis was the main treatment in other two groups. Overdenture was one of the other treatment option mostly used in third group. Older patients were more satisfied from outcomes of treatment since they were able to chew as they could before losing their teeth. Results of this study showed that older patients can be treated by implants as the young and middle aged ones and implant survival rate and the crestal bone loss does not change with age.

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Implant-supported single tooth restorations. A 6 year clincal propective study

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Purpose: To evaluate prospectively the 6-year outcome of implant-supported single-tooth prosthetic restorations.

Material and methods: Forty four patients (mean age 45 years), 26 males and 18 females, who required single-tooth implant for a missing tooth were recruited. A total of 48 osseotite implants (Biomet 3i, USA) 42 in the maxilla and six in the mandible,were installed in a two-stage procedure. Abutment connection was performed 3–6 months after implant installation. Clinical and radiographic examinations were performed after prosthetic treatment and once a year during a 6-year follow-up period. The analysis of peri-implant bone level alteration was performed on subject and implant levels.

Results: Four patients were lost during the 6 years of follow-up. Two implants were lost after 1.2 years in function and four implants could not be accounted for at the 6-year follow-up evaluation. The overall failure rate at 6 years was 2.3% (implant level). The mean loss of marginal bone at the implants during the first year in function was 0.03 mm (0.65) on the implant level. During the subsequent 5 years the annual change in peri-implant bone level amounted to 0.03 mm at implant levels. The mean total bone level change over the 6-year interval was 0.15 mm. The frequency of implants with a 6-year bone loss of $\geq$ 1 mm was 13%. The 87% of the implants demonstrated no bone loss.

Conclusion: The clinical trial on single-tooth replacements with Osseotite implants demonstrated that the bone loss during the first year of function as well as annually thereafter was small.

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Patient consciousness, experience of, and satisfaction with implant supported restorations

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Recent investigations have focused on patients' subjective assesment of implant treatment. The aim of this study was to determine the patients' knowledge about implant dentistry, as well as experience of surgical and prosthetic procedures. Forty-five patients were requested to answer first part of the questionnaire to obtain how much they know about dental implants before surgery. Then patients were treated with implants for fixed dentures. Second part of the questionnaire was completed after delivery of the restoration. Most of patients had very little information about implants. Patients were very positive about aesthetics, phonetics, eating comfort, however approximately 25% of them experienced unpleasentness in prosthetic procedures, mostly impression making was cause. Nevertheless, 6/45 patients would not undergo the same treatment again, yet all of them would recommend it to others. Even the patients were unknowing about treatment at the beginning, highly satisfied with the outcome of the treatment and experienced it to be without significant unpleasantness irrespective of the treatment concept.

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Immediate implants loading in resorbed edentulous mandibles: 68 months report

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Objectives: The aim of this prospective study is to report the results of the rehabilitation of patients presenting very much resorbed mandibles, with short titanium implants immediately loaded by a complete prosthesis.

Methods: From June 2000 to February 2006, 112 of the 670 patients treated with an immediately loaded implant-supported overdenture in our clinic received 4 short implants in the interforamina region. Clinical and panoramic evaluations were performed after 4 and 12 months.

Results: At the end of the observation period, all the 448 short implants were clinically stables and asymptomatics, showing normal peri-implant status, resulting in a survival rate of 100%. Mean marginal bone loss after 4 months is 0.1 mm. Mean loading time is 24 months (4 to 68 months).

Conclusions: These results shows that immediate loading of mandibular short implants with overdentures is a safe protocol, as long as the implants are installed in normal density bone of at least 8 mm height and of sufficient width to receive a normal diameter implant, and as long as a good primary stability is achieved. Care must be exercise to avoid overtorquing of the implants to prevent mandibular fracture. It is interesting to note that 50 narrow (3.5 mm diameter) short implants installed in very resorbed and narrow jaws healed uneventfully under immediate loading.

Avoidance of invasive grafting, rapid stabilisation of the implants and prosthesis with a permanent structure, controlled initial loading, immediate function and better treatment acceptance by the patients are the main advantages of this protocol.

255 | Topic Long-Term Studies

Mini-screws in orthodontics: a literature review

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Aim: Review of patient-, implant- and surgery related effects on the stability of mini screws.

Materials and Methods: Investigations published until March 2007 and designated as human clinical trials were considered if 30 implants were used at least. Parameters were patient gender, age, location, procedure of implantation, implant length, diameter, time, amount of loading, and clinical complications.

Results: Eleven clinical trials covered 342 patients and 933 implants. The mean overall success rate was 83 ± 11%. Neither patient gender nor age showed significant differences. Miyawaki (2003) reported success rates of small screws (∅ 1 mm, length 6 mm) as significantly lower than larger implants (0% vs. 84% and 85%). Chen (2006) reported similar findings for 6 mm- vs. 8 mm-screws (72% vs. 90%). Miyawaki (2003) and Kuroda (2007) were more successful using a flapless method (85% vs. 75% with flap, 88% vs. 81%); Herman (2006) used a flap yielding 100% vs. 49% without flap. Two studies showed significantly higher success rates for maxillary than mandibular screws (Cheng 2004, Park 2006). Load related factors played no significant role in the screws' success rates. Immediate loading and 4 weeks healing periods, and loading of up to 400cN proved to be adequate.

Conclusions: In all papers analyzed success rates were sufficient for orthodontic treatment. Small screw design should be avoided. Although it minimizes the risk of root damage, diminished stability and life-span are expected. Implantation protocols varied markedly. Time and amount of loading (≤ 400cN) showed no significant influence on screw stability.

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Evaluation of two retention systems for implant supported mandibular overdenture

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The objective of the investigation is to compare, in a randomized clinical study, two types of stress-breaking retention for mandibular overdentures with the use of Straumann Dental Implant System.

Material and methods: 46 patients, fully mandibular edentulous were enrolled. Each patient received 2 × 10 mm or 12 mm screw-type Straumann implants with SLA surface, in the canine region of the mandible. After 6 weeks healing period implants were loaded and the patients were randomly assigned to one of two groups (23 patients each): retentive (ball) anchors (B) and magnets (M). New mandibular overdenture with metal reinforcement was made.

Data collection performed at baseline (1 week after insertion of the implant overdenture) (T0) and every 6-month (T1–T6): gingivascor, plaque-score, calculus, bleeding-score, probing pocket depth, standardized intra-oral radiographs, denture retention, mechanical complications of the attachment components. Implant stability was measured at the time of surgery (Mc), at abutment insertion (Mo) and every 6 month (M1–M6) using Osstell Mentor.

Results: 4 implants failed (95.6% success rate). Mean scores on indices of gingiva, plaque, calculus, bleeding and pocket depth were low at all evaluation period. No loss of implants stability. Bone resorption 0.7 (±0.15) at booth groups. Lower denture stability measured for magnet group.

Conclusions: No significant difference between the two retention systems after 36 month. The two-implants-retained overdenture reduces stress on patients and tissues minimize denture movements and represents reliable treatment options in atrophic edentulous mandible.

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Implant-supported mandibular overdenture: maintenance and patient satisfaction

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The purpose of our investigation is to compare in a prospective study the satisfaction level and masticatory capacity of mandibular edentulous individuals, applying questionnaires adapted from the indexes oral health-related quality of life (OHIP) and its short form OHIP-EDENT during the phases of rehabilitation treatment with a two-implants supported overdenture and the use of Straumann Implant System.

Material and methods: 46 patients fully mandibular edentulous with severe alveolar ridge atrophy and instability of the existing lower denture were enrolled in the study.

Each patient received two screw-type implants in the interforaminal region of the mandible. After 6 weeks healing period a new denture was made and the patients randomly assigned to one of the following equal groups: retentive anchors(B) and magnets(M).

All patients rated with the aid of questionnaires their general satisfaction as well as other features of their dentures (comfort, stability, ability of chewing, speech, esthetic and cleaning ability) prior to the treatment and at 6, 12, 18, 24, 30 and 36 months.

Results: Both groups had less oral health related quality of life problems than before treatment. Ball group gave higher rating on comfort, stability and ability to chew, also higher rating on maintenance requirement comparing to magnet group.

Conclusions: Although the retention force of the magnet attachment is smaller, patient satisfaction is high at both groups. Rehabilitation with implants produces a significant improvement in the satisfaction level and the masticatory capacity.

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Success of osseointegrared implants in maxillo mandibular complex

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Purpose: Determination of the success rate achieved in 140 osseointegrated implants and its relation to bone density and remainder.

Material and method: 140 implants performed with drill technique (Adell), 24 through bone expansion technique (Summers) and 16 by drill membrane conjugated technique (Zitzman). The maxilla implants 64 were reopened 6 months later and those in mandible 76 4 months after the procedure, considering as successful the fixed elements. As statistical methods K Square and Fisher Test ($P < 0.05$).

Results: for mandible implants fixed implants were observed in 74 (97.3%) and for maxilla in 59 (92.1%). The success rate achieved with the drill technique was 99.0%, being 79.2% with bone expansion technique and 93.8% with guided tissue regeneration. Losses were more frequent in the maxilla 8.9% in contrast to 1.3% in the mandible.

Conclusion: the best results happened in cases of bone density D2 (Lekholm and Zarb criteria) and bone reminder A and B (Misch criteria) with increased success index for mandible implants.

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Long-term follow-up of immediately loaded implants in completely edentulous jaws

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Aim: To evaluate up to 4 years implant survival, radiographical bone-to-implant contact level and prosthetic complications of immediately functionally loaded implants restored with provisional prostheses.

Material and methods: Full medical records including dental radiographs of in total 798 implants (Osseotite implants Biomet 3i, Palm Beach, Fl, USA) installed in 83 patients were retrospectively examined. All patients were restored with semi-permanent provisional acrylic restorations within 3 days of surgery. Bone-to-implant contact, implant losses and prosthetic complications were registered.

Results: In total 42 implants were sleeping and not included in the bone-to-implant evaluation. In the maxilla implant failure was 11/343 (3.2%) and mean bone loss was after 1, 2, 3, 4 years resp. 1.4 mm, 1.6 mm, 1.7 mm, 1.9 mm. In the mandible implant failure is 5/414 (1.2%) and mean bone loss was after 1, 2, 3, 4 years resp. 1.2, 1.5, 1.4, 1.5 mm. Wilcoxon signed rank test, performed on implant level, indicated statistically significant bone loss until 4 years after loading in both jaws. On 25% of the implants prosthetic material damage, fractures and regular technical repairs were needed but this did not affect implant survival.

Conclusion: The implants functioned very well under immediate loading as reflected by failure rates below 3% in both jaws. Acceptable mean bone values were scored according to the success criteria described by Albrektsson and Isidor (1994). The excessive rate of prosthetic complications are probably due to the fact that the provisional prosthesis was kept unchanged for reasons of cost reduction. The acrylic material is more prone to damage and a cost-benefit analysis on long-term is needed before this prosthetic protocol can be advocated for general use.

3-years results of immediately loaded TiOblast implants in the maxilla

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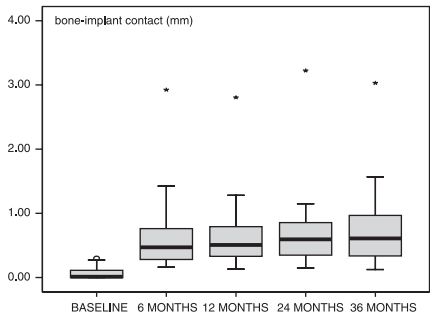
Aim: To evaluated prospectively the 3 years implant survival and radiographical bone-to-implant contact level of immediately loaded TiOblast implants (Astra Tech Dental, Gothenburg, Sweden) supporting complete maxillary fixed bridges.

Material and methods: 25 patients (13 men-12 women; 8 smokers-17 non-smokers; 12 with a previous history of periodontal disease) were consecutively treated and received each 7–9 implants in the edentulous maxilla. They were restored with a provisional glassfiber or metal reinforced 12 unit acrylic restorations within 1 days of surgery. After 6 months the final prosthesis was constructed. Bone-to-implant contact was measured on apical radiographs at time 0, 6, 12, 24, 36 months.

Results: In total 195 implants were installed; the 3 years survival rate is 100%. Mean bone loss of 0.57 ± 0.60 mm was measured during the initial 6 months healing. Wilcoxon signed rank test, performed with the patient as a unit, did not reveal further statistically significant bone loss up to 3 years of functional loading.

Conclusion: With 100% implant survival and 97% implant success, immediate functional loading on 8 TiOblast dental implants has shown to be a feasible treatment option for rehabilitation of the completely edentulous maxilla.



Boxplot showing bone-implant contact value measured during 3 years in 22 patients with all radiographs readable at the various examination time points.

Single immediate functional loaded implants. 4 Years follow-up

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Conventional single-tooth replacement with fixed partial dentures (FPDs) exposes abutment teeth and reconstruction to biological and technical risks. A single crown on an implant might be the treatment of choice, even if the patients have to accept a surgical intervention. Osseointegrated single-tooth implants have been found to result in a high longterm success rate.

Numerous studies have also reported on immediate implant insertion into extraction sockets with predictable results. A shortening of the healing period for single-tooth implants and immediate loading has become a necessity for the aesthetic zone in the maxilla.

The aim of this clinical study was to determine the effectiveness of immediate loading procedures on preserving crestal bone height and improving peri-implant bone density around maxillary implants restored with single crowns by an accurate longitudinal radiographic assessment technique.

185 patients have been treated with immediate functional loading with single implant with follow up to 48 months. All patients came at our observation with a missing or losing tooth.

All the provisional crown have been positioned and loaded at the surgical time. It has been used six differents kind of implants during this study and all implant have been positioned following the manufacturer protocols (Seven and Mistral (MIS Implants), Xive (Dentsply–Friadent), Premium and Khono (Sweden & Martina), TBRIde@ (TBR Implants).

The mean coronal bone level changes (CBD) at 12, 24, 36 and 48 months were 0.45, 0.53, 0.66 and 0.75 mm.

The overall success rate was ranging from 100% to 96.12% relating to different implants.

Immediate loading with overdenture in edentulous jaws

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Aim: To evaluate clinical efficacy of simplified technique for immediate loading in edentulous jaws with overdenture.

Methods: A total of 336 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were placed in 39 edentulous mandibles and in 45 edentulous maxilla (four implants in each jaw) and immediately loaded.

76 patients (mean age 61 years) were monitored in this study. Eight patients received the same treatment in both jaws. Following surgery all implants were connected with prefabricated conical abutments, that are manufactured with a precise fit to secondary

conical copings. These prefabricated copings are polymerised into denture base directly in the mouth of the patients as described by May & Romanos, 2001. Panoramic radiographs, mSBI, mPlI, technical complications and patient satisfaction in different time intervals were recorded.

Results: 2 implants in the mandible and 4 implants in the maxilla were removed during observation period and could be successful replaced but are not included in our statistics that lead to an implants cumulative survival rate of 98.2% (mandible 98.7%, maxilla 97.8%), the prosthesis survival rate was 100%. After a total observation period of 28.5 months (range 12–60 months) all other implants presented healthy peri-implant hard and soft tissue conditions (mSBI > 1; mPlI = 1). Radiographic examination showed an excellent bone healing and stable bone level. Five patients were not satisfied with aesthetic; all other appreciated function, aesthetic and retention of the restoration.

Conclusions: Basing on the present data it was concluded that four implants with high primary stability, may support immediate loading in edentulous mandible as well as in edentulous maxilla.

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Implants supporting Maxillary Full-Arch Prostheses: 3-year data

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Purpose: The aim of this study was to report the biological and technical outcomes and patient satisfaction after three years of function of dental implants supporting maxillary full-arch bridges.

Methods: Between February-01 to April-04 a total of 67 Ankylos implants were placed according to the standard protocol in 11 patients (6 male, 5 female) with edentulous maxilla. The mean age was 63 years (range 49–72 years).

The implants/patient distributions was: 5implants/4patients; 6implants/4patients; 7implants/2patients; 9implants/1patient. 11 implants (16.4%) were placed consecutive to tooth extraction, 26 (38.8%) within 3 months and 30 (44.8%) after 3 months or more. The length of implants ranged from 9.5 mm to 14 mm. After 6 months of submerged healing the implants were loaded with cemented metal-ceramic full-arch prostheses. The total number of units replaced was 128. After prosthetic treatment, all patients were submitted to a quarterly control. In different time intervals PlI, SBI, GI, standardized peri-apical radiographs, technical complications, patients satisfaction were recorded.

Results: After submerged healing time all implants became osseointegrated. During a total observation period of 3.2 years (range 2–5 years), none implant was lost.

Biological complications (bone loss>2 mm; GI +, SBI +) occured in 7.4% of the implants. All other implants presented healty soft and hard tissues conditions. 6 patients presented a total of 13 ceramic fractures. 2 patients were not satisfied with aesthetic of the rehabilitation. 1 patient refered fonetic difficulty.

Conclusions: Favourable clinical conditions were found at implants abutments after 3.2 years of function. Bruxism as well as extensions were associated with more technical failures.

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Survival rate of first molar replecement with implants

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Purpose: The present multicenter-study reports on the clinical results of implant-prosthetic treatment of first molar.

Methods: between October-99 and September-04, 207 patients (118 female, 89 male) had been treated with 233 Ankylos implants to replace first molar. Age at implants placement ranged between 22 and 71 years (mean 49.9 years). Implants in the mandible and in the maxilla were 58.3% and 41.7% respectively. None implant were placed consecutive to tooth extraction, 64 (30.9%) within 3 months and 143 (69.1%) after 3 months or more. Implant length ranged from 9.5 mm to 14 mm. The implant diameter distribution was: 42% of ∅ 3.5 mm, 49.2% of ∅ 4.5 mm and 8.8% of ∅ 5.5 mm.

After prosthetic treatment, all patients were submitted to maintenance therapy every six months. In different time intervals PlI, BOP, standardized periapical radiographs, technical complications and patients satisfaction were recorded.

Results: After 3–6 months of submerged healing, all implants were osseointegrated. 41 implants received final restoration using Auro Galvan Crowns veneered with ceramic, 152 with metal-ceramic crowns, the remaining 14 implants with zirconia-ceramic crown. All crowns were cemented.Four patients with four implants were lost to follow-up**.** After 37.4 months of function (range 26–58 months) two implants in mandible failed. Cumulative survival rate was 98.5%. The majority part of implants presented healthy peri-implant soft tissue conditions (PlI < 1, BOP < 1). Marginal bone resorption ranging from 0.36 to 1.52 mm. During observation period, one case of abutment screw loosening occurred. Eleven prostheses (11 patients/11 crowns) had a porcelain fracture.

Conclusion: the implant-prosthetic replecement of first molar has proved to be a predictable treatment.

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Immediate Implant-supported overdenture in edentulous maxilla

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Aim: to present the clinical results of immediate loading in edentulous maxilla with removable denture.

Methods: In 45 patients (18 females, 27 males) with edentulous maxilla a total of 180 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were placed (4 implants in each maxilla).

At the implant placement, patient mean age was 60 years (rang 43–76 years). 59 implants were placed consecutive to tooth extraction, 36 within three months and 85 after six months or more. Autogenus bone graft, without barrier membrane, was used to fill the peri-implant defect.

Following surgery all implants were connected with prefabricated conical abutments, that are manufactured with a precise fit to secondary conical copings. These prefabricated copings are polymerised into denture base directly in the mouth of the patients as described in the edentulous mandible by May & Romanos 2001.

Panoramic radiographs, mSBI, mPlI, technical complications and patient satisfaction in different time intervals were recorded.

Results: During a total observation period of 26.7 months (range 12–54 months) 4 implants were removed, all other implants presented healthy peri-implant soft tissue conditions showing low value of clinical parameters (mSBI > 1; mPlI = 1). Cumulative survival rate was 97.8%. Swelling or suppuration were not observed. Radiographic examination showed an excellent bone healing and stable crestal bone level. 3 patients were not satisfied with aesthetic of rehabilitation; all other appreciated function, aesthetic and retention of the restoration.

Conclusions: Basing on the present data it was concluded that four implants with high primary stability, may support immediate loading in edentulous maxilla, with relevant satisfaction for the patients.

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Five-year follow-up of fixed prostheses implants-supported in maintenance therapy

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Aim: To evaluate the peri-implant tissues of 174 implants supporting fixed prostheses, in maintenance therapy.

Methods: Between February-2000 and March-2001, 174 Ankylos implants (Dentsply, Friadent, Mannheim, Germany) were inserted in 56 partially edentulous patients and in 6 patients with edentulous maxilla. After prosthetic treatment and in different time intervals mPlI, mSBI, standardized peri-apical radiographs, technical complications and patient satisfaction were recorded.

Results: After conventional submerged healing period all implants were osseointegrated. 38 implants were loaded with single crowns, 93 implants with 38 bridgework and 43 implants to support 6 full arch bridges. The length of implants ranged from 8 mm to 14 mm.The total number of units replaced was 128. During a total loading period of 56.4 months (range 49–60 months), no implant was lost. Biological complications (bone loss >2 mm; SBI+) occured in 7.4% of the implants The majority of implants presented healthy peri-implant soft tissue conditions (mPlI = 1, mSBI>1). Radiografic mean bone loss evaluating both interproximal surfaces was 0.88 mm.

During the observation period no patient reported swelling or suppuration., 6 patients reported ceramic fractures. No complications related to implant components occured.7 patients were not satisfied with aesthetic result.

Conclusions: It is concluded that a correct oral hygiene, the presence of keratinized mucosa and microgap design, could influence the stability of peri-implant tissues and the longevity of implants. The characteristic design of the implant-abutment connection produces a not relevant microgap and significantly influence the peri-implant soft tissue and bone level stability.

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Design and development of dental implants based on mechanical engineering processes

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Dental implants have to withstand the chewing forces over the entire life and have to avoid mechanical overloading of the crestal bone to reduce bone resorption. These items can be considered in the design and development process of dental implants using virtual prototyping methods derived from mechanical engineering processes.

Structural design optimisation of local geometry of the implant based on finite element calculations is used to achieve an optimised design of the implant. The design validation is done in two steps. In the first place a rotating bending test gives results for the lifetime of the implant within one week. In the second step the fatigue test according to ISO 14801 which takes about two month is carried out. The increase of the lifetime of implants and reduced risk of implant fractures and screw loosening following this consistent process is shown. Additional requirements to improve the design validation by the ISO 14801 are discussed.

The influence of mechanical overloading on bone resorption can be studied by finite element analysis coupled with bone remodelling algorithms. This virtual prototyping process allows to study the long term behaviour of the surrounding bone of osseointegrated dental implants. The influence of the stress distribution caused by the implant design is shown. The effect on the long term integration of the implant by bone remodelling is explained.

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Early loaded conical Brånemark dental implants in the edentulous mandible

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Purpose: The aim of the study was to evaluate the treatment of patients with a new type of implants with a 2-stage design but here placed according to a 1-stage surgical procedure. Fixed complete-arch restorations were made and early loaded.

Materials and methods: 24 patients were treated between 1999 and 2001. Each patient was provided with 4 conical machined-surface MK II or MK III Brånemark System implants in the mandible. The implants were early loaded with fixed complete-arch restorations. The frameworks were fabricated in titanium and produced according to the Cresco Ti Precision method. Clinical examinations were performed and case records were scrutinized.

Results: Of originally 24 patients 16 (67%) participated in the study. In 5 of these 16 patients 13 implants were lost after a mean follow-up period of 59 months (range 48–70 months). The survival rate of the implants was 80% and of the suprastructures 80%.

Conclusion: It is not recommended to treat mandibular edentulous patients with four conical machined-surface Brånemark System implants when placed according to a 1-stage protocol as in this study and early loaded with a fixed complete-arch restoration, as other methods have shown more successful.

Keywords: dental implants

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Radiographic assessment of autotransplanted teeth after 5 years

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Aim: to evaluate the radiographic status of autotransplanted teeth after 5 years.

Material and methods: The investigation of the patients took place at least 5 years after surgical treatment. In each patient, the contralateral teeth were investigated as control group. Radiographs of 81autotransplanted teeth (TX) and 81 control teeth (TC), were taken for investigation.

Caries was evaluated (0 = no, 1 = yes). The width of dental fillings was investigated (Fo = no filling, F1 = one surface, F2 = two surfaces, F3 = three surfaces).

Results: Caries was investigated in 20% (TX) and in 23.08% (TC) of the cases. No caries was detected in 80% of TX and in 76.92% of TC. Dental fillings were found in 30.77% (TX) and in 80% (TC) of the cases [TX Fo = 69.23%, F1 = 18.46%, F2 = 7.69%, F3 = 4.62%/TC Fo = 20%, F1 = 12.31%, F2 = 18.46%, F3 = 49.32%).

Conclusion: In this present study, no significant differences were found between the autotransplanted teeth and their contralateral teeth regarding caries by radiographic examination. The autotransplanted teeth showed even less dental fillings then their contralateral control teeth. This study confirms the value of Autotransplantation as a successful treatment option.

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Early loading of implants in irradiated bone: a pilot study

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Rehabilitation of patients with oral cancer usually involves radical tumor surgery and radiotherapy. Irradiation causes alteration in vascular supply of structures and decrease in osteoblastic and osteoclastic activity in surrounding bone, which causes difficulty in oral rehabilitation of the patients with osseointegrated implants. The present report aimed to evaluate the early loading of implants in irradiated bone. Five oral cancer patients (38 to 60 years, 1 woman, 4 men) received postoperative adjuvant radiotherapy with varying doses of 40 Gy to 120 Gy in areas that included future implant sides. Implants were placed after a period of 18 months. Seven ITI SLActive Straumann Implants were inserted in maxilla, three in mandible. The stability of the implants was measured with Resonance Frequency Analyzer/Osstell™ Mentor at implant placement, one week later and at the end of the third week. The measurements were high enough for an abutment connection at the end of the 3rd week. Two implants were lost in maxilla in healing period as a result of osseointegration failure (The overall success rate was 80%) After a follow-up period of 10–16 months, all of the remaining implants are still stable. Although the survival rate of implants was slightly lower than standard conditions, from the results of this pilot study, it may be concluded that osseointegrated implants can be early loaded in irradiated bones, unless a careful patient selection and treatment planning is performed.

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Early loading and bone training of implants inserted by postdocs

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In a prospective study we are investigating the reduction of the previously stated healing periods for implants. The new time schedule was fixed for six weeks submerged healing and for six weeks bone training. The study was performed by surgeons with less then three years surgical experience with the Ankylos-Implant-System (Dentsply-Friadent, Germany).

Since 2002, 353 implants have been inserted in 187 patients. According to the protocol the second stage was six weeks after. The implants were then supplied with provisional prosthodontics on standard abutments. For six weeks the patients hold on a soft diet. The Periotest-values were raised at the time of second stage as well as at the end of the conditioning phase. The final treatment was usually on balance abutments.

The average period for implants with final restoration is 29.7 months. 131 implants were in the upper and 222 in the lower jaw. During the bone training phase, the Periotest values changed from -2.00 to -3.00. A distinct differentiation was observed between upper and lower jaw. (UJ from -0.78 to -1.76 LJ from -2.73 to -3.25). According to the T-test, the difference is highly significant. From 353 implants, seven failed (1.98%). Six in the lower jaw one in the upper jaw. Two suffered periimplantitis. The success rate was therefore 97.5%.

Due to the high success rate, even with low experience, the possibility of an early treatment of rough structured conical implants with progressive thread (Ankylos, Dentsply, Germany) after a healing period of six weeks and further six weeks subliminal loading can be considerated as a safe and reliable treatment.

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Resonance frequency analysis of xive implant stability during osseointegration period

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Introduction: Implant stability monitoring by using resonance frequency analysis made possible to measure implant stability in implant stability quotient units at any time during osseointegration period.

Purpose: The purpose of present study was to evaluate clinical stability of XİVE implant placed in both jaw using one-stage surgical procedure.

Materials and methods: Seventeen patient(11 female and 6 male, mean age of 49.9 years) were included into this study. Total 64 implants were placed using standard surgical protocol. ISQ reading were obtained for each implant at the time of surgery before flap closure, 3 weeks, 6 weeks postoperatively, and at the time of loading (3 or 6 months after the surgery). None of implants were immediately or early loaded. Data were analyzed for different time, various anatomical locations and implant lengths and types.

Results: One implant failed during healing. Implant stability was higher on mandible compared to maxilla for each implant (Mann-Whitney test, $P=0.001$). ISQ readings decreased significantly was noted from surgery to the 6-week postoperative period (Wilcoxon tests, $P=0.001$). A recovery to the initial ISQ level was noted at the time of implant loading. There was no correlation between implant length and ISQ readings, different anatomical location, and different healing periods for XİVE implant system (Spearman correlation coefficients, $r<0.5$, $P>0.01$).

Conclusions: Implant stability is weakest at 3 to 6 week in one-stage non loaded. Further studies are needed to compare the early changes seen in immediately loaded implant to determine whether there is any time in which the total recovery in ISQ levels may occur.

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Retrospective study on short (≤8 mm) Straumann implants

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Recently, dental implants show a fairly high success rate and are used universally to replace lost tooth. However, when there is vertical bone loss in the alveolar bone clinicians face with various difficulties in treating implants and many clinicians have reported a high failure rate for ≤ 8 mm implants. The purpose of this study is to investigate ≤ 8 mm Straumann implant survival rate and radiologic success rate along with their relationship with various factors. Data of 172 patients who had Straumann implants inserted at the Oral-Maxillofacial surgery department of the Kyunghee University Dental Hospital from 1996 to 2006 were collected. Out of 172 patients, there were 106 patients who were followed-up after prosthetic rehabilitation. Clinical changes were evaluated based on patient charts and radiographs. The longest follow-up period was 119 months and the average follow-up period was 34 months. Out of 173 implants, only 3 Implants were lost before prosthetic rehabilitation, and no implants were removed after prosthetic rehabilitation. This shows a very high survival rate of 98.27%. Also this study will be evaluating the implant survival rate and radiologic success rate according to patient's gender, age, type of prosthesis, implanted sight, bone quality, ratio of crown length and root length, systemic disease, implant type and etc.

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Narrow-diameter implants placed in limited alveolar spaces- A 3-year follow-up

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Introduction: Use of narrow-diameter implants (NDI) is indicated in limited alveolar spaces or in patients, who are not willing for augmentation procedures and alveolar bone has insufficient bucco-palatal width for standard-size implants. It is generally considered, that NDI are an acceptable and reliable tool. On the other hand, current literature offers insufficient knowledge, whether the buccal and interproximal bone crest can be maintained in extremely narrow implantation sites after using NDI.

Materials and methods: In a retrospective case-control study, 38 single-tooth-NDI were placed in 17 patients and followed annually up to three years. The implant survival rate, clinical success according to Karoussis and others (2003), and radiological findings were collected. The alveolar spaces at the mesial and

distal sites of each implant were measured from the study casts and radiograms and compared to marginal bone responses. The safety margin to adjacent tooth to avoid clinical risk of resorption was set at the level of 1.75 mm. According to this estimation, the implants were divided in two subgroups; gap size < 6.8 mm (group A) vs. gap size > 6.8 mm (Group B).

Results:

	NDI cumulative survival rate n/%	NDI clinical success rate n/%	Bone loss after 3 years Mean/CI-95%
NDI Group A gap < 6.8 mm	14/100	14/100	0.40/0.27–0.53
NDI Group B gap > 6.8 mm	24/100	24/95,8	0.23/0.16–0.38

The mean distance to adjacent tooth (DAT) at the implantation site was 1.49 mm (SD; 0.18) in Group A and 2.78 mm (SD; 1.01) in Group B. The radiological findings indicate, that the risk for bone resorption will arise, if the DAT is less than 2 mm.

Conclusions: Narrow-diameter implants are an acceptable alternative for limited alveolar spaces, if an adequate clinical safety margin, at least two millimetres, to adjacent teeth can be confirmed. From a clinical point of view, this favours an edentulous gap over 6.8 mm, when using 3.3-diameter implants.

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Immediate occlusal function in full-arch rehabilitations. A 3-year retrospective analysis

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It has been demonstrated that an immediate functional load can be tolerated by the bone-to-implant interface, without jeopardizing the process of osseointegration. Yet one of the questions that subsist is how many implants are necessary for predictable cross-arch stabilization of a full-arch rehabilitation using an immediate loading protocol.

The aim of this retrospective study is to compare success rates (mandible and maxilla) between immediately loaded, full-arch cases on 4, 5 and 6 or more implants. A 3-year follow-up analysis was performed in 150 consecutive cases of immediate loading with screw-retained interim prostheses in the edentulous upper and/or lower jaw. A total of 122 patients, 74 women and 48 men with an average age of 56.3 years were considered in this study; 746 implants were placed, 468 in the mandible and 278 in the maxilla.

Our results show that in the mandible there is no statistically significant difference between success rates when placing 4, 5 or 6 implants to support a full-arch rehabilitation using an immediate loading protocol (98.6%, 99.7% and 100%, respectively). However in the maxilla, immediately loaded full-arch rehabilitations on 4 implants have significantly lower success rates (85%) when compared to cases where 6 or more fixtures were installed (96%).

In conclusion, in this study population immediate loading of full-arch cases in the mandible is predictable whether over 4, 5 or 6 implants. However, in the maxilla we recommend the installation of at least 6 fixtures as to maintain predictable success rates when compared to conventional two-stage protocols.

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Implants as strategic abutments to improve removable partial dentures function

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Patients with an (extreme) reduced dentition often suffer from a reduced stability of a removable partial denture (RPD), especially when canines and/or molars are lost. Using implants in strategic positions improves the function and the retention of a RPD considerably–and the above mentioned (mostly elderly) patients benefit from easy surgical implant procedures and often from keeping the existing RPD.

The background of the ''concept of strategical implants'' is to improve the number and distribution of supporting abutments and to lower load transfer to existing teeth.

Our presentation will focus on the outcome of a group of 73 once a year recalled patients, where implants of different companies were under risk at least 2 years (maximum 9, median 4.3 years). Attached to 120 implants these patients received 36 RPDs in the upper and 51 RPDs in the lower jaw, of which 53 were renewed existing prostheses.

In our presentation special emphasis will be put on the number of implants per case, the type of abutment, the outcome concerning ongoing loss of teeth, underlining of the RPD, wear resp. activation of the retention mechanism, and prosthesis repair. Up to now only 6 implants were lost after prosthetic loading.

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A descriptive and time based analysis of the success rate in using ITI dental implant system over a period of ten years (1995–2005)

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Introduction: The aim of this article is to analyze the rate of success in using ITI Implants over a period of 10 yrs.

Methods and Materials: The present study is a descriptive, time based analysis of all the files of patients that have been treated using Dental Implants over a period of 10 yrs. commencing from 21/03/1995 to 21/05/2005 at two different dental offices in Tehran. General information such as Age, Sex, Number of Implants in each jaw, Type of Implant surface, Type of edentulous area, Time span of Prosthodontic therapy and the endurance of Implants, were gathered from patient files and recorded on specially designed information forms.

Results: In this study 3050 Implants of ITI system were operated in 1050 stages on 1000 patients of whom 54.4% of the patients were males and 44.6% were females.

The average age of these patients was 49/5 ± 12/8 yrs. 47.7% of the Implants were in the maxilla and 52.3% were in the mandible.

Most of the Implants were of 12 mm Length and 4.1 mm Width.

Regarding the surface of the Implants, 83% had SLA surface and the remaining were TPS.

Out of the 1000 study cases, incidence of failure was as low as 2% corresponding to 21 cases and the number of Implant failures was 23 out of the 3050 Implants, which comprises only 0.7% of the total.

These failures were seen in 13 Implants in the upper jaw of 12 patients and 10 Implants in the lower jaw of 9 patients.

In other words comprehensive success was seen in 98% of the patients and 99.3% of the Implants.

Conclusion: The use of Dental Implants in treatment of missing teeth is possible regardless of the subject's age, sex and type of the edentulous area with high sucses rate.

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Denture stabilisation mini implants versus conventionnal implants (6 years follow up)

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A comparative study. Older patients wearing total denture often complained of lack of retention of their lower denture. The use of implants to stabilize denture is good and well accepted technique.The aim of the present clinical study was to compare two different approachs: 4 mini implants and immediate loading to 2 normal implants and delayed loading. All the patients (20) selected were fully edentulous and wearing a total denture since many years and the main complain was the lack of stability. After clinical and radiological examination, patients (8) with some health complications were selected for mini implants and immediate loading, the others (12) were treated with conventionnal implants. In the mini implants group, 4 mini implants were placed between the mandibular foramen, the surgical approach was flapless when the bone crest was large and in some cases a small incision was use only to see and discover the thin crest. Immediately following the implantation, 4 metal caps with internal plastic o-ring were inserted in the denture with cold acrylic. Complications were: a fractured drill, a fractured mini implant when it was screwed with ratchet. Once placed a patient presented a mobility of one mini implant which was removed without impairing the stabilisation of his denture (still 3 mini implants remained).

No further complications occured. Gingiva remain stable around implant without inflamation even with poor oral hygiene. In the conventionnal group two implants were placed between the mandibular foramen, the surgical approach was slightly more aggressive, a flap reflection vestibular and lingual was used, it was often necessary to flatten the thin bone crest in order to get a larger crest. After two months, two ball attachments were screwed in the implants and two gold caps were inserted in the denture. Complications were none in this sample, during the healing phase the main complain was the mobility of the denture and sometimes the gingival inflammation around the implants. In some cases recurrent perimplant inflammation was present, because of of thin or lack of attached gingiva. It appears that mini implants present some interesting advantages:

Less aggressive surgical approach. Immediate loading. If losing one implant, the work is not compromised. Less time is necessary for the overall treatment, so less fees. Implants material is also less expensive. To our experience 4 mini implants and immediate loading is the therapy of choice for old patient with removable denture.

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Maxillary overdenture supported by splinted implants: a retrospective study up to 20years

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Background: The survival rate for implants supporting an overdenture in the maxilla seems lower than for the mandible. The purpose of this study was to assess cumulative success rates (CSR) of implants supporting overdentures in the maxilla.

Methods: During a 20-years period (1987 to 2007), a total of 138 implants were placed in 32 patients to supported an overdenture in the maxilla. The surgery was done in the Department of Periodontology while the prosthetic rehabilitation was completed at the Department of Prosthetic Dentistry. Patients ranged in age from 26 to 69 years (mean 54.2 years). The overdenture was retained via a rigid Bar-attachment system on 4 to 6 implants (Brånemark system®, Nobel Biocare AB, Göteborg, Sweden). Soft tissue complication such us mucositis and gingival hyperplasia were also assessed.

Results: Implant survival rate was 99.2% (1 implant was lost), and the 20-years cumulative survival rate (CSR) was 99.3%. Hyperplasia (mainly under the bar) was frequently observed (14/32 patients), while only 3 patients presented stomatitis.

Conclusion: An overdenture therapy on rigidly splinted implants is a successful treatment option for the maxilla.

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Success criteria for immediate restored implants in the posterior region

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Introduction: Immediate restoration of Implants with a provisional brings a high comfort to the patient. In addition there is an advantage in using the provisional for bone training and soft tissue management. It is already known that a high primary stability is a prerequisite for the osseointegration of immediate restored implants. Most articles recommend a primary stability higher than 25

Ncm. The aim of the study was to show if this criteria is sufficient to reach a success even in the posterior region.

Methods: 176 immediate restored implants where examined. All patients matched the following inclusion criteria: Immediate restored Implants in the posterior region, primary stability >25 Ncm, immediate reconstruction with a provisional restoration. Immediate restored implants in the anterior region where used as control group. The X-Rays where measured to find out if there where any significant correlations between the implant parameters and the peri-implant bone loss.

Results: 2 implants did not match the success criteria due to a high bone loss, 1 implant was lost. The overall success rate was 98%. The statistics showed a significant correlation between an implant length <13 mm and a higher peri-implant bone loss. The implant region had no influence on the result.

Conclusion: The immediate restoration of implants should be strict indication oriented. Provided that the case matches all the criteria of the protocol, immediate restored implants in the posterior region should be considered as a save treatment option for the patient.

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The use of fibula grafts for the resorbed mandible

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7 patients with edentulous mandibles of less than 10 mm vertical height were treated with fibula grafts and screw retained fixed bridges (Toronto bridge) on 4 or 5 Astra Tech implants (∅ 3.5 and 4.0 m). Over all 30 implants were placed between the foramina mentalia after a healing period of 3 months after the grafting with an extraoral access. The delivery of the bridges (precious metal/acrylic) took place after 12–14 weeks. All patients were followed up for 5 years with annual x-ray controls using orthopantomograms with standard magnification of 1:1.25.

Results: 1 implants could not be used due to mobility after the healing period. 29 implants had a stable marginal bone level after 5 years with a medium vertical bone loss of 0.5 mm. There was no radiological sign of relevant vertical resorption of the grafted bone within the period after implant placement and 5 year control. After 4 years, there were 2 patients with a localized mucositis, which could successfully be treated. For the extremely resorbed mandible the fibula graft in combination with a fixed implant supported bridge seems to be a predictable treament option.

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Ten to fifteen-year follow-up of implant treatment

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Objectives: The aim of the present study was to evaluate the long-term results of implant therapy using implant survival and implant success as outcome variables.

Material and methods: 54 patients had received implant therapy (117 ITI system implants) during the years 1990–1996 at the Department of Periodontology, Dental Faculty, Strasbourg, France. The patients were recalled to the department 10 to 15 years after implant placement for a complete clinical and radiographic examination followed by a questionnaire of satisfaction. Success was defined as being free of all complications over the entire observation period. The prevalence of biological and technical complications has been carefully analysed. Associate factors related to peri-implant lesions were analysed on patient and implant basis.

Results: The long-term implant survival rate was 85.13%. The prevalence of biological complications was 20.28% and the prevalence of technical complications was 24.33%. The summary estimate of the cumulative complication rate after an observation period of 10 to 15 years was 44.61% which meant that substantial amounts of chair time was needed following implant placement. The majority of implant losses and biological complications were concentrated in a relative small number of patients.

Conclusions: Despite a relatively high long-term survival rate,- biological and technical complications were frequent. Patients with a history of periodontitis may have lower implant survival and were more prone to biological complications such as peri-implant mucositis.

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Challenging edentulism with immediate loading in severely atrophic edentulous maxillae

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Aim: To prospectively investigate the long-term results of immediately loaded dental implants provisionally restored with fixed prostheses in atrophic maxillae without previous augmentation.

Methods: Two centers (Chicago, USA and Uppsala, Sweden) enrolled 50 patients with severely atrophic edentulous maxillae (Lekholm & Zarb class III or IV and quantity C, D or E) and placed 300 implants (Osseospeed™, Astra Tech AB, Mölndal, Sweden). The six implants in each patient were restored within 24 h with screw-retained fixed prostheses.

Following clinical follow-up at 2 and 4 weeks the provisional restorations were removed at 12 weeks and implants evaluated regarding stability. Definite restorations were thereafter inserted (20–24 weeks) and will be followed up to 5 years. Radiological follow-up at implant placement, 20–24 weeks and at 1–5 year visits. Oral health impact profile questionnaire (OHIP) has been registered by patients.

Results: Status by March 2007 reveals 40 definitive restorations placed in mostly class C (61%) and type 3 (58%) bone. 12 implants in 5 patients have been lost (96% success rate) with 47 patients successfully wearing their permanent prostheses (94%) at 6 month control.

Marginal bone level change over the first 6 months for 203 implants was −0.4 mm (SD 0.8). OHIP:s indicates rising satisfaction level among patients with maxillary fixed prostheses.

Conclusion: The initial year of this study reveals that careful selection and planning by the restorative team enables comparably successful treatment of patients presenting severely resorbed edentulous maxillae with immediate loading of implants including provisional fixed restorations without additional bone augmentation.

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Selection of autotransplants for increasing alveolar branch of the upper jaw

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The main biological goal in plastics of autological tissue in the optimization of surgical area, developed in our clinic is the differential way of choosing a transplant with the necessary biological qualities. The goal of our research is to realize the use of the lower jaw as the root of autogennal marrow transplants in plastics of the alveolar branch of the upper jaw. Carried out is the utilization method of cultivating a patient's bone marrow stem cells (colony forming unit of fibroblasts–CFUf) through *in-vitro* fertilization. Particular attention has been focused on the study of alkaline phosphate (AP), as the marking ferment of osteoblasts. Our research has shown that: VI type of colony is characteristic for the cell culture, in the centre of which form large deposits of calcium salt, its periphery consists of up to 76.25% cells with high AP activity. Resulting data gives evidence of high differential osteogennal cell qualities in bone marrow of the lower jaw. Carried out was a study by comparison, of the quantity of osteogennal cells in different areas of the human skeletal structure. Presence of CFUf in the bones studied can be classified in the following increasing order–metatarsal bones, upper jaw, proximal metaphase of the tibia, rib, spongiosis of the proximal sector femoral bone, lower jaw, iliac bone sector, vertebra body, and breastbone. Therefore, the high osteogennal activity of bone marrow cells in the lower jaw serves as the foundation for it being the optimal donor bone.

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Clinical outcome of dental implants placed in vascularized iliac bone grafts

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Objectives: The study aimed to evaluate the clinical status and the survival rates of dental implants inserted in vascularized iliac bone grafts used for the reconstruction of mandibular defects following ablation for tumors.

Material and methods: We conducted a clinical follow-up study based on 42 patients after oral tumor surgery, who received vascularized iliac bone grafts and endosseous implants (121 implants) for functional mandibilar reconstruction between 1995 and 2004. Clinical records of the patients were reviewed retrospectively. Clinical parameters of horizontal and peri-implant bone loss, plaque index, probing pocket depth, and bleeding on probing were assessed.

Results: The mean follow-up after implant insertion was 51 months (range: 24–97 months). The cumulative survival rate of vascularized iliac bone grafts was 97.6% (Out of 42 vascularized iliac bone grafts, one failed and had to be removed). The cumulative implant survival rates of implants were 96.1% using the Kaplan–Meier method. Horizontal bone loss reached a steady state around 0.5 ~ 1.5 mm after an observation time of 2 years.

Conclusion: Vascularized iliac bone grafts provide a firm basis for placement of dental implants in mandible reconstruction. Implants placed in vascularized iliac bone grafts were demonstrated to integrate normally. Implant brand, length or diameter and gender of patients had no statistically significant influence on implant survival.

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Metaanalytic evaluation of long-term survival rates of immediately loaded implants

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Objectives: In recent years, various papers evaluating survival rates of immediatly loaded implants were published. Most of these studies describe a high survival rate after a short observation period of one ot two years out of rather small follow-up numbers. It is aim of this meta-analytic study to evaluate the state-of-the-art knowledge base of immediate loading concepts.

Materials and methods: By means of electronic databank research and manual literature research 660 publications have been identified. Based on the criteria defined by Sutton et al. (1998) according to the 10 studies have been selected for the meta-analysis.

Results: The survival rate of immediatly loaded implants in edentulous maxilla averages after one year 97.42%. In edentulous mandibles the survival rate is 98.64% after one year and 97.82% after two years. Without exception all authors described a minimum torque of at least 30 Ncm as basic requirement for immediate loading.

Conclusion: Based on the selected studies it can be concluded that immediate loading in mandibles is well documented and successful on a rather short observation period of maximum two years. The majority of the evaluated studies of the upper jaw, however, lack detailed information about materials and methods, precise information concerning failure causes. Furthermore evidence based data of follow-up periods longer than one year is scarce for immediatly loaded implants in the maxilla.

Literature. Sutton AJ, Abrams KR, Jones DR, Sheldon TA: Systematic reviews of trials and other studies. Health Technology Assessment 1998; 2(19).

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Time-related decrease of titanium osteoconductivity and rejuvenation using light treatment

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Objectives: This study examined the effect of time-related changes in the hydrophilic properties of titanium surface and the effect of surface treatment with ultra-violet light (UV) on *in vitro* osteoblastic response and *in vivo* osseointegration capacity.
Materials and methods: Commercially pure titanium disks were acid-etched with sulfuric acid and stored in dark for certain periods of time. Rat bone marrow stem cell-derived osteoblasts were seeded onto the fresh (newly acid-etched), 28-day old and UV-light treated 28-day old acid-etched surfaces. Hydrophilic status of titanium was measured by contact angle of water. The cell proliferation and differentiation were evaluated by hematocytometer and reverse transcription-polymerase chain reaction (RT-PCR), respectively. Acid-etched cylindrical implants with different ages were placed into rat femurs. *In vivo* osteoconductive capacity of titanium was evaluated by biomechanical push-in test.
Results: The contact angles for the fresh, 28-day old and UV-treated 28-day old titanium surfaces were 0 degree, 70 degree and 0 degree, respectively. Fresh and light-treated 28-day old surfaces, respectively, showed 57% ($P < 0.001$) and 76% ($P < 0.001$) increase in cell number than the 28-day old surface. The expression level of osteogenic genes was maintained among different groups throughout the culture period (days 7 and 14). The *in vivo* retention of implants measured by push-in test at day 14 post-implantation showed significantly greater values for the fresh implants and for the light-treated 28-day old implants than for the 28-day old implants ($P < 0.0001$).
Conclusions: The osteoconductive capacity of titanium surface decreases over time and UV-light treatment can restore this time-related decrease.

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Clinical evaluation of mini screws (Aarhus System®) for orthodontic anchorage

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Anchorage is one of the most important aspects of tooth movement during orthodontic treatment. Maintaining the planned anchorage is sometimes difficult, particularly in patients with reduced desmal potential. Therefore anchorage devices such as intraoral, extraoral or enossal devices are used additionally. Mini screws are an enossal systems, which consist of a self tapping screw with a modified head for orthodontics.
Purpose: Due to the lack of data the aim of this study was to examine the success rate of Aarhus System® prospectively.
Subject, material and methods: 21 Patients (8 male and 13 female, mean age 25.9 years) years got 34 mini screws due to orthodontic treatment planning. After insertion under local anaesthesia, the miniscrews were loaded immediately with up to 300 cN. During orthodontic treatment the devices have been observed till the time of their remove.
Results: 6 out of 34 screws got lost during orthodontic treatment in the time 2 to 5 month after insertion. (i.e.17.6%). Four screws became loose without any obvious reason and could not serve as absolute anchorage. Around one miniscrew inflammation of the surrounding mucosa was detected and the device had to be removed consecutively. Another device had been inserted into the root of a molar and was extracted during the remove of that tooth.
Conclusion: Mini screws are a valuable tool for absolute anchorage in orthodontic treatment. Literature demonstrate a loss rate from 11% (*Cheng, 2004*) up to 30% (*Fritz, 2004*), which could be achieved with the tested system.

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Properties of pulsed laser deposited zirconia/hydroxyapatite on titanium

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Coating dental implants with hydroxyapatite (HA) may give certain advantages such as active encouragement to new bone growth, a lower rejection rate and an improved long-term prosthesis fixation. This study examined the mechanical and biological properties of titanium alloy implant cores with an interlayer of zirconia and a coating of HA created using pulsed layer deposition (PLD). The thickness of the zirconia layer was 50–100 nm and the HA layer ~ 600 nm. The crystallinity, morphology, wettability and Ca/P ratio of the HA layer were investigated by electron microscopy, X-ray diffraction, goniometric measurement of contact angle and wavelength dispersive X-ray analysis. The physical tests indicated adequate mechanical properties and a satisfactory adhesion to a titanium core modified with zirconia and HA. Cell proliferation and metabolic activity of human embryonal lung fibroblasts were determined using counting of harvested cells and providing a MTT assay. It demonstrated that none of the samples were cytotoxic and their surfaces promoted cell colonization. PLD was found to be a promising method of applying coatings to a metal

core for dental implants and the in vitro biological tests suggest that the crystalline HA coating can improve the biological properties of titanium covered with zirconia.

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Short-term comparative study of 4 different implant surfaces in dogs

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The effect of dental implant surfaces modified by various mechanisms, using both human and animal models, have been reported to enhance osseointegration of the implants. Nevertheless, an assessment of the evolution over different time frames and the comparison with a wide range of commercially available implants is hard to find.

This study compares, after a one month healing period in the mandible of Beagle dogs, ion implantation of CO as a surface treatment with commercially treated implants, among them double acid-etching, anodizing and sandblasting and acid etching, completing a previous study with similar implants for healing periods of three and six months. Histologic evaluation of each sample was performed by conventional transmission microscopy and ESEM.

The histological results obtained by conventional transmission microscopy demonstrated a % BIC for implants treated with CO ion implantation of 77%, with 60% for double acid-etched, 59% for sandblasted and acid etched, 54% for anodized. Evaluation by ESEM produced lower but similar results to conventional transmission microscopy.

Conclusions: The findings of this study showed that %BIC values were higher in implants treated with CO ion implantation and differences were statistically highly significant ($P < 0.01$) when compared to each of the commercially treated implants.

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Effect of abutment surface configuration and luting agents on the retention of implant supported crowns

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Objectives: The purpose of this study was to determine the effect of abutment surface configuration, total surface area and type of luting agent on the retention of the prosthetic crowns which were fabricated on the implant abutments.

Methods: Sixty castings were fabricated on Esthetic Abutment™ and Easy Abutments™. The cements used for the test were zinc-phosphate (Adhesor), glass ionomer (Meron) and eugenol-free zinc oxide (Provicol). After cementation, implant- abutment-casting assemblies were thermocycled between 5–60°C for 24 h. The samples were subjected to a pull out test using a Lloyd testing machine at a cross head speed of 0.5 cm/min until cement failure occured. The mean uniaxial force (Newtons) and the load (MPa) required to dislodge the castings from the abutment was determined and data were analysed statistically using Kruskall Wallis and Mann Whitney tests with Bonferroni correction ($P < 0.05$).

Results: Uniaxial resistance forces ranged between 13 and 299 N for Easy Abutments™, 14 and 350 N for Esthetic Abutments™ where loads ranged between 0.14 and 3.32 MPa for Easy Abutments™, 0.28 and 7.24 MPa Esthetic Abutments™. The luting agent influenced the retention of casting on implant abutments ($P < 0.0001$) where different surface configurations and total surface area of the two evaluated abutments did not influence the uniaxial resistance forces ($P > 0.05$).

Conclusions: Among the cements tested Adhesor exhibited higher values followed by Meron and Provicol. The increase in surface area provided by the Easy Abutment™ did not result in improved in retention.

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The ability of osseotite surface. Histologic and histomorphometric study in rabbits

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Purpose: To evaluate the percentage of bone to implant contact (BIC) around non submerged expanded platform implants with osseotite surface.

Materials and methods: Four new designed expanded platform implant (4 mm diameter × 8.5 mm length) were placed into four New Zeland rabbits tibiae assessed at 1 to 16 weeks. Histologic sections were prepared and analyzed histomorphometrically.

Results: The dual acid etched non submerged implants achieved higher levels of bone contact percentage. The enhanced contact level was apparent by 4 weeks healing 42.47%, 8 weeks 39.2%, 12 weeks 41.2% and 16 weeks 40.97%. All the implants were all osseointegrated.

Conclusion: The exposure of expanded platform implants on the top of the bone crest, with osseotite surface, let the bone a good response to cover the treated surface with high quality of bone at 16 weeks. Osseotite surface yielded more bone-to-implant contact possibly as the result of better fibrin clot retention and growth factor enhancement into rabbits tibiae model.

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Biological response after porcine hidroxyapatite graft. experimental study in rabbits

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Purpose: To evaluate the biological response after porcine hydroxyapatite paste (cash) in rabbits of New Zealand after 15 months follow-up period.

Material and methods: Twenty New Zealand rabbits of 3.900–4.500 Kg were used in the study. The graft was placed in the proximal tibiae zone. Two holes were performed in each tibiae, one control and one test perforation. The diameter of bone defects were 4 mm filling with porcine paste bone Osteobiol PUTTY (Tecnoss Dental, Italy). All the rabbits were divided in 4 groups: 1 month (Group I), 4 months (Group II), 8 months (Group III) and 15 months (Group IV). A radiological study was realized by means of two radiographic projections (anteroposterior and wings), of the bony tibiae. The samples were inserted in formalin and processed with Hematoxiline-Eosine.

Results: Osteobiol Putty have inflammatory response in the first months, with the only isolated macrophages and dispersed linfocites. No fibrosis and newly bone formation around the porcine graft were observed in all the periods.

Porcine bone putty has an osteoconductive property acting as scaffolding for the bony cells. This biomaterial produced an osteoid formation and progressive resorption of the biomaterial after 15 months follow up period.

Conclusions: The porcine Osteobiol Putty bone can be considered to be a new biomaterial, biocompatible, resorbable and osteoconductive acting as a good bone substitute.

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Calcium phosphate based synthetic bone grafting materials: present, and future

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Introduction: Guided bone regeneration (GBR) is a treatment for reconstruction of bone or periodontal defects. GBR requires bone grafting materials and resorbable or non-resorbable membranes. Bone grafting materials can be classified as natural or synthetic. Natural derived bone grafting materials are bovine bone, porcine bone, coralline, allograft, etc. Calcium phosphate (CaP) based synthetic bone grafting materials are hydroxyapatite, tri-calcium phostphate (alpha or beta), biphasic tri-calcium phosphate, carbonate apatite, etc. CaP based synthetic bone grafting materials are widely used in the implant dentistry because of its excellent osteoconductive property and free of immune response. CaP biomaterials allow attachment of cells and their differentiation directly on the surface to result in intimate bonding with the newly formed bone creating a uniquely strong interface.

Purpose: The purpose of present research is to review current CaP biomaterials used in implant dentistry and the prospects for the future development of synthetic bone grafting materials.

Materials and methods: Total 78 articles were reviewed. The characteristics and the properties of each different synthetic bone grafting were summarized. The histology evaluation of each material was observed and discussed. The present manufactured CaP based synthetic bone grafting materials used in the dentistry was also compared according to their composition and characteristic. The scanning electron microscopy (SEM) image was captured and the energy dispersive system was used to identify composition of each materials.

Discussion and conclusion: The present research addressed the advantage and disadvantage of synthetic bone grafting materials. According to current research, the CaP based synthetic bone grafting materials can be used as carrier for growth factors. This property can be facilitating the future development of new grafting material which will show optimal properties for new bone regeneration.

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Ex vivo gene expression of osteoblasts in maxillary sinus grafting

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Purpose: The aim of this study is to validate a strategy to analyse gene expression profiles of osteoblasts obtained from maxillary sinus grafted with bioceramics.

Materials and methods: Ten patients requiring unilateral maxillary sinus lift were included in this study. All patients received as graft material a porosity-graded hydroxyapatite ceramic (SintLife, Finceramica, Faenza, Italy). One case was randomly selected to obtain preliminary results. Radiographic examinations were performed at 5 months from grafting. Six months after surgery, 2 biopsies were harvested where titanium implants would be inserted, and immediately placed in sterile tubes containing culture medium. To obtain human primary osteoblasts, bone biopsies were cut into small pieces under sterile conditions and digested. The released cells were separated from the bone chips by filtration, resuspended and plated at different densities in culture dishes. PCR amplification of each cDNA specific segment was performed. To achieve semiquantitative conditions, the amplification curve for each specific product was determined, and a specific number of cycles was selected within the linear segment of the amplification curve, so as to obtain a quantitative and comparable measure.

Results: All patients completed the healing period following sinus lift procedure without complications. The grafted material allowed a satisfactory implant placement and achieved implant stability. Radiographic outcomes showed graft integration and

radiolucency. Biomolecular assays demonstrated that gene expression of proteins associated to bone healing and metabolism was detectable via PCR amplification.

Discussion and conclusions: This ex vivo assay could provide osteoblast gene expression to evaluate osteogenic potential of the biomaterial.

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All-on-Four® versus Toronto-Brånemark: A biomechanical study

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Purpose: Target of the present study was to evaluate the biomechanical effects of the *All-on-Four® versus* Toronto-Brånemark configuration at the trabecular bone level for the rehabilitation of a single patient, by using the finite element method.

Materials and methods: Due to the symmetry condition, only one half of the mandible was set up. Cylindrical fixtures (4 mm diameter, 15 mm length) and cylindrical abutments (4 mm diameter, 4 mm length) were built. Setting the *All-on-Four®* configuration, a 5 mm and a 15 mm cantilever length were constructed, while for the Toronto-Brånemark configuration a 15 mm cantilever length and a five implants whole configuration were built. All the materials were assumed as linear elastic isotropic. A masticatory working force equal to 100 N was applied to the right-side cantilever portion of the superstructure, while three regions corresponding to the attachment areas of the masticatory muscles were fixed in all the directions.

Results: The maximum value of principal compressive stress was found to be about 5 MPa in the *All-on-Four®* 15 mm model, while in both the *All-on-Four®* 5 mm model and the Toronto-Brånemark model it was found to be around 3 MPa. In all the models, the principal compressive stress reached its maximum value in the proximity of the distal implant but, in both the *All-on-Four®* models it was distally located, while in the Toronto-Brånemark model it was more lingually located. Higher values of principal compressive stress were predicted in the trabecular bone near the mesial implants both in the Toronto-Brånemark model and in the *All-on Four®* 15, as compared to the *All-on-Four®* 5 model.

Discussion: On the basis of our numerical results, higher values of principal compressive stress are found near the distal and medial implant in the *All-on-Four®* 15 configuration, as compared to the *All-on-Four®* 5 and the Toronto-Brånemark configuration.

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Soft tissue adhesion to titanium versus composite components: a transcutaneous animal model.

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Objective: Various materials are used at the transmucosal level of implant reconstructions without proven biocompatibility. A transcutaneous animal model was developed to evaluate the effect of material composition on soft tissue adhesion.

Material and methods: Transcutaneous cylinders (height 5 mm, Ø 4 mm) were transcrewed on the calvarium of nine New-Zealand rabbits and the soft tissues were tightly sutured. A first group of cylinders were entirely made of titanium with a SLA surface. In the second group, cylinders were made of dental composite. Four cylinders were randomly allocated per rabbit. After six weeks, animals were sacrificed and histomorphometric measurements were performed to analyze the soft tissue/implant interface and the remodelling of the peripheral bone.

Results: A soft tissue seal was established at the skin level with two distinct epithelial and connective compartments, as at the mucosal level. The apical termination of the junctional epithelium was located 0.58 mm more apically on composite components than on titanium ones; the length of connective tissue was comparable at composite (0.51 mm) and at titanium (0.6 mm) cylinders, with a mean peripheral bone remodelling of 0.77 mm at composite and 0.25 mm at titanium components.

Conclusion: The new transcutaneous animal model of soft tissue/implant interface described here showed that a more pronounced apical migration of the junctional epithelium is observed at dental composite components than at titanium ones, leading in parallel to a higher peripheral bone remodelling. The biocompatibility of dental composite at the soft tissue level should therefore be questioned.

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The influence of implant shape to the bone stress

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The objectives of the investigation: The influence of implant shape to the cortical and cancellous bone was analyzed by using FEM (finite element method/COSMOS Works Designer). Three implant systems, JNE implant body (JNE, GC), Nobel Speedy implant body (SP, Nobel Biocare) and microthread implant body (MT, Astra) were investigated.

Methods: 3D model data of the bone buried implant by using 3D CAD (SolidWorks) was calculated. The hypothetical situation of thickness of cortical bone: 2 mm, cancellous: 6 mm were applied for the calculation. 1000 N load was vertically applied to the upper surface of implant and the bottom of cancellous bone was fixed using FEM. The influence of each implant shape to cortical

and cancellous bone was calculated with von Mises equivalent stress.

Results:

FEM results	JNE	SP	MT
Ave. stress to cortical bone	12.8	132	60.3
Ave. stress to cancellous bone	34.9	22	31.8 (MPa)

JNE showed significantly low average stress to cortical bone among the examined three materials.

Conclusion: The reduced bone absorption nature for JNE is expected due to its low stress to the cortical bone.

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Accuracy of the mechanical torque-limiting devices

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Aim: The aim of this study was to evaluate the torque delivery accuracies of brand new and six months-in-clinical-use torque wrenches of 10 different implant manufacturers.

Materials and methods: Each implant analog provided by the implant manufacturers included in the study (***Nobel Biocare, Camlog, Paragon, Frialit, Swissplus, ITI, Astra, Biolok, BioHorizons, Anthogyr***), along with its respective abutment attached was held firmly in TOHNICHI model BTGGOZ torquemeter. 10 sequential torque readings was performed by the same clinician using the respective implant system's brand new and six months-in-clinical-use torque devices. The data were evaluated with T-tests and Duncan post-hoc tests ($P < 0.05$).

Results & conclusion: There were significant differences between individual units and the target torque levels for the ***Camlog, Paragon, Swissplus, ITI, Astra, Biolok, BioHorizons, Anthogyr*** implant system's torque devices ($P < 0.05$). This fact indicates the need for recall appointments in order to secure target torque values in order to prevent screw loosening and further complications such as screw or implant body fractures.

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Effects of load cycling on abutment screws and this removal torque statement of problem

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Aim: The purpose of this study was to evaluate the effects of load cycling on the preload loss of two-piece abutment screws of these implant systems.

Materials and methods: A total of 30 abutment and screws of these implant systems; Swissplus, Biohorizons and Frialit II. The abutment screws of each system is evaluated considering the initial and final lengths, counterclockwise displacement, tightening and removal torque values after a 50.000 load cycles with 50 N load. The initial and final lengths were measured with reflection profilometer and the tightening and removal torque values were measured with a torquemeter. No significant differences between the amount of counterclockwise screw displacement values of the different implant systems tested.

Conclusion: The loosening of the abutment screws as a consequence of load cycling indicated the importance of regular recall appointments considering the need for retightening of abutment screws. Further investigations are needed in order to determine the behavior of abutment screws of multiple unit restorations after load cycling.

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Stress distribution around single and multiple splinted tooth and implant abutments in implant-tooth supported restoration

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Statement of problem: The aim of this study was to evaluate the stress distribution around single or multiple splinted tooth and implant abutments in tooth-implant supported restoration.

Material and methods: A total of 36 mathematical models as indicated for the study design: two loading conditions(oblique and axial), three loading locations, distal and mesial location of non-rigid connector, and whether one or two teeth are considered as abutment. A simulated load of 250 N is applied on the mathematical model and the resulting Von mises, tensile and compressive stress values were considered for evaluation.

Results: The results showed greater stresses around rigid connections while slightly decrease is observed when two splinted teeth were considered as abutment. The loading direction did not caused a significant difference while the load location caused greater stresses around the abutment at the respective location. Greater stress accumulation observed around implants and abutments when the non rigid connector is located on the distal proximity of tooth abutments being independent from whether one or two splinted tooth are considered as abutment.

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Enhanced bone response to calcium reinforced oxidized implants

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Background: By adding calcium ions via anodic oxidation calcium can be incorporated into the implant surface. The purpose is to enhance osseointegration and maybe create a possible chemical bond between the implant and its surrounding tissues. Calcium reinforced oxidized implants have in earlier studies shown to have good qualities for bone ingrowth. The aim of the present study was to compare a calcium reinforced oxidized implant to an oxidized implant without calcium. A blasted implant (Bl) with 75 µm sized Al_2O_3 particles, was used as control.

Materials and methods: Turned threaded c.p. titanium implants (Ospol AB, Sweden) were anodically oxidized in an anodizing bath with calcium ions (Ca) or without (Ox). The implants were topographically characterised using an optical interferometer. Ten rabbits received one implant in the distal femoral metaphysis and two in the proximal tibial metaphysis. After twelve weeks the rabbits were sacrificed, biopsies from six rabbits were taken for histomorphological evaluations.

Results: Surface roughness analysis revealed three different surfaces. S_a values for the Ca/Ox/Bl implants were 0.3/0.6/0.9μm. There were significantly more bone contact to Ca-implants (47.1%) compared to Ox (30.1%) and Bl (34.0%) placed in tibia. In addition, Ca-implants revealed significantly greater bone contact (31.8%) compared to Ox-implants (20.0%), when placed in femur. Bone area measurements were similar for the implants both in tibia and femur.

Conclusion: Compared to the rougher implants (Ox and Bl) the smooth Ca-implants showed an enhanced bone formation after twelve weeks in rabbit.

Grants were obtained from the Swedish Research Council.

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Analysis of the osteointegration in rabbits of the titanium SLA surface submitted to the variation of time exposition to the acid

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The treatment of the surface of implants influences the growing and metabolic activity of the osteoblasts providing benefits to the osteointegration process. Several kinds of changes on titanium have been proposed over the last years in order to assist and make the events related to the process of integration bone/implant easier. The purpose of this study was to evaluate the process of bone integration of dental implants in tibias of rabbits. The implants were firstly blasted with aluminum oxide, and afterwards exposed to a triple acid bath at different times to the elaboration of microporosity on their surface. It was possible to observe that the increase from 5 min to 10 min of exposition time speeded the initial phases of the process. These events are showed by the bone markers evaluated in microscopy. This work demonstrate what the surfaces of titanium with increase of exposition in acid promoted de acceleration of the osteointegration time.

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Influence on the variation of exposition time in the acid of SLA titanium surface

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The aim of this study was to evaluate the influence on the variation time of the acid bath of implants with surface type *SLA (Sandblasted Layer Acid)*. Firstly, these implants were blasted with 60 microns aluminum oxide particles to the elaboration of the larger roughness. Then, they were submitted to a triple acid attack to the regulation of the porosity and elaboration of microporosity, increasing the bone integration area. The variation in the exposition time occurred during the immersion on the second sequence, which presented an association with sulfuric acid and chloridric acid at 5, 7, 10 and 15 min. The samples were evaluated in electron microscopy to check their topography, and subsequently to compare with the surfaces in the market. The surface, which received the acid bath for 10 min, presented a topographic aspect more standardized than the other samples.

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Primary bone cell adhesion on newly engineered titanium surfaces

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Rough titanium surfaces were advocated to improve bone cells adhesion on titanium surfaces. The aim of this study was to assess the adhesion of osteoblasts-like cells on different laser treated titanium surfaces with regular roughness texture *in vitro*.

Osteoblasts-like (OBs) cells were obtained from volunteers undergoing wisdom tooth removal following a standardized protocol. OBs were seeded in 96-well plates in 150 μl of alpha-MEM and allowed to attach overnight on 5 different surfaces. Tested surfaces were: sandblasted titanium disk (SBT), 5 μm regular micropores titanium disk (5 T), 10 μm regular micropores titanium disk (10 T), 20 μm regular micropores titanium disk (20 T) and the glass of human cell wells (CTRL). After rinsing OBs adhesion was evaluated at 24 hrs using a MTT cell proliferation assay. Statistical analysis was performed using ANOVA test.

The results indicated that OBs attached to the different surfaces. Test surfaces showed a lower grade of adhesion than control ($P < 0.001$). No significant differences were noticed between sandblasted and the laser treated titanium surfaces ($P > 0.5$). Higher adhesion was obtained on 10 T disks, however no statistically significant.

These results indicate that engineered regular roughness allows osteoblasts-like cells adhesion. In particular, wider porosity seems

to promote adhesion. Further testing on cells proliferation and differentiation are needed to finally evaluate the global effect of this surfaces on human cells.

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Growth factor enhanced injectable composite for periodontal and alveolar indications

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Objectives: As the periodontium encompasses several tissues, it remains a challenge to develop biomaterials that fulfill necessary requirements to achieve a balanced support of periodontal regeneration. Several BMPs and biomaterials have been tested in combinations. A promising candidate is growth and differentiation factor-5 (GDF-5)/BMP-14/CDMP-1. This study describes the development of a novel injectable, in-situ setting composite activated by rhGDF-5 for minimally invasive procedures and use as convenient technology for surgical augmentation of periodontal and implant defects.

Materials and methods: The composite constitutes a bioresorbable poly(lactic-co-glycolic acid) (PLGA) with various excipients, enhanced by rhGDF-5. *In-vitro* characterization included injectability, porosity (SEM), biodegradation (mass balance, GPC), bio-interaction (histology), and rhGDF-5 release (ELISA, ALP-assay). Biocompatibility without rhGDF-5 was compared to ß-TCP and absorbable collagen sponge (ACS) following implantation into one-wall intrabony periodontal defects in Beagle dogs (healing 8 weeks, histologic/histometric analysis).

Results: Injectability (standard needles) for clinical convenience and minimally invasive applications; Highly porous, interconnected, space providing matrix after *in-situ* setting; Complete biodegradation finished within 4 weeks; Tight bio-interaction of the composite with human blood; Slow, sustained rhGDF-5 release over one week correlating with biologic activity; Neither obstruction of bone formation nor inflammatory lesions *in-vivo*; Compared to ß-TCP and ACS, no significant difference in regeneration of bone and cementum.

Conclusion: Characteristics of this novel composite makes it a model candidate for delivery of rhGDF-5 to support native wound healing processes and regeneration of relevant tissues in periodontal and implant defects.

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Evaluation of beta-tricalcium phosphate grafted in rat mandibular bone defect

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Objective: Highly pure porous beta-tricalcium phosphate (beta-TCP) granules were grafted to rat mandibular bone defect to evaluate its role as a bone regeneration scaffold.

Material and methods: Highly pure porous beta-TCP granules and allogenic bone were grafted to both sides of a rat mandibular bone defect using beta-TCP alone (TCP), allogenic bone alone (Allograft) and allogenic bone combined with beta-TCP (Combined). On one side, platelet-rich plasma (PRP) was added to the materials. The rats were sacrificed at one, three and five weeks after surgery. From the ratios of the newly formed bone and remaining beta-TCP per bone defect, the bone formation rate (BFR), remaining beta-TCP rate (RTR), beta-TCP absorption rate (TAR), whole amount of beta-TCP (WTCP) and total rate of BFR and RTR (TBR) were measured.

Results: The Combined group showed equivalent BFR to the Allograft group at five weeks. The Combined group showed higher RTR and TBR at one week and higher BFR and TBR at five weeks than the TCP group. WTCP of the Combined group was not different from that of the TCP group in each week. The Combined group with PRP showed higher TAR than that without PRP at three weeks.

Conclusion: The combination with allogenic bone showed reduced beta-TCP absorption, enhancing the role of beta-TCP as a bone regeneration scaffold. These findings suggested that highly pure porous beta-TCP can be a better scaffold for bone regeneration by reducing early absorption without bone regeneration using osteogenic material.

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Precision of fit in implant frameworks

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Objectives: To examine and compare the precision of fit to implants of cast frameworks for implant-supported fixed complete prostheses fabricated according to the Cresco Ti Precision method® (Astra Tech AB, Mölndal, Sweden) made either in Commercial Pure (CP) titanium (Cresco-Ti) or in a cobalt-chrome alloy (Cresco-CoCr). These results are compared with the results earlier presented by Örtorp et al.* concerning computer numeric controlled (CNC) milled frameworks in CP titanium (Milled-Ti) and in a cast gold alloy (Cast-Au).

Experimental methods: Ten frameworks in CP titanium and 10 in a cobalt-chrome alloy were fabricated from a master model according to the routine protocol of the Cresco method. The fit of the frameworks were measured in a coordinate measuring machine (CMM) in the same way as earlier done by Örtorp et al.* The frameworks in Örtorp's study served as a reference material. The significance level was set at 5%.

Results: The Cresco-CoCr frameworks had a significant better fit than the Cresco-Ti frameworks. The Milled-Ti frameworks had a significant better fit compared to the other three groups. The Cresco-Ti frameworks straightened out significantly whereas the other groups presented a significant contraction towards the centre of the castings.

Conclusions: CNC milled titanium frameworks has a better fit to implants than frameworks in CP titanium or cobalt-chrome fabricated according to the Cresco method.

*Örtorp A, Jemt T, Back T, Jälevik T. Comparisons of precision of fit between cast and CNC-milled titanium implant frameworks for the edentulous mandible. Int J Prosthodont 2003; 16(2):194–200.

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PEEK and osteoblast cytocompatibility for endosteal dental implants

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Implantable grade Polyetherether ketone (PEEK) is a high performance thermoplastic alternative to metals or ceramics, used particularly in spinal and orthopaedic applications. Although many studies have examined PEEK, there are few that directly compare to titanium using a human primary cell model in a dental context. Here, two PEEK-based biomaterials (unfilled and carbon fibre reinforced) were compared to commonly used titanium (cpTi Grade 1) to observe whether PEEK could be a suitable candidate for endosteal dental implants.

Two industrial process surface finishes (injection moulded or machined) of PEEK were presented to human primary osteoblasts for cytocompatibility. All of the biomaterials demonstrated HOB adhesion at 4 h. Injected moulded PEEK surfaces demonstrated no significant difference in the amount of adhesion when compared to cpTi. Proliferation, as measured by [^{3}H]-thymidine incorporation at 48 h culture, showed that the injection moulded unfilled PEEK had significantly greater ($P = 0.10$) proliferation than all of the other test materials. ALP activity (M/min/mg protein) at 72 h was greatest on injection moulded, unfilled PEEK and the polished titanium, with no significant difference between them. After two weeks culture, mineralisation (calcium content) was greatest on machined unfilled PEEK surfaces, which were significantly higher than similarly performing cpTi (unpolished) or injection moulded CFR-PEEK and unfilled PEEK.

The presence of mineralization suggests that PEEK may lend itself to osseointegration of dental implants and that further work should follow to investigate fulfilling the mechanical requirements of such an implant system.

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Improved photo-induced hydrophilic surface enhances cell behavior and bone apposition

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Objectives: Anodized-porous-titanium have photocatalytic hydrophilicity after ultraviolet (UV) illumination. However, this effect was not sufficient for the significant improvement of cell response or bone apposition.

The purpose of this study was to improve the photocatalytic properties of anodized-porous-titanium by a fluoride chemical modification and to investigate the *in vitro* initial cell behaviors and *in vivo* bone apposition during the early stages of osseointegration.

Methods: Anodized titanium disks were treated with 0.175% ammonium hydrogen fluoride (NH_4F-HF_2). This ideal concentration showing the highest photo-induced hydrophilicity was confirmed by a static wettability assay. Subsequently, pluripotent mesenchymal precursor C2C12 cells were either cultured on non-illuminated anodized (control) or UV-illuminated NH_4F-HF_2-treated-anodized (experimental) disk. The initial morphology, attachment and proliferation were evaluated *in vitro*. Thereafter, animal study with rabbit tibia was carried out using the anodized implant ($n = 6$). The implants were either blinded (control) or NH_4F-HF_2-treated followed by UV-illumination (experimental). Animals were sacrificed after 2 and 6 weeks and undecalcified ground sections were processed for histomorphometrical bone-to-implant contact analysis (BIC; three best consecutive threads).

Results: The experimental disk showed significant improvement in cell attachment and proliferation. Cells on the experimental disks were extremely flattened, whereas a round/spherical morphology was observed on the control disks. The experimental implants demonstrated a significantly greater value of BIC compared with control implants after 2 weeks (50.3%; control: 36.5%; $P = 0.009$) and 6 weeks (47.6%; control: 37.1%; $P = 0.042$) of healing.

Conclusion: The improvement of the photo-induced hydrophilicity enhances the initial cell reactions and early bone apposition to the implant.

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Electric potencials of titanium implants. Study desing

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Introduction: While many studies in vitro for the analysis of electric potencial exist, do not exist any clinical study that evaluates in vivo the electric behavior of titanium implants.

The objective of the present poster is to present a clinical method, simple, quick and effective to determine electric potentials generated among osseointegrated implants within the oral cavity. As

previous phase we have accomplished an experimental study in vitro to validate the data registers and the clinical application of this method.

Material and method: We use a sample of 11 dental implants and one titanium machined abutment (Mycrodent System). The set-up was realized in a solution of artificial saliva at 37°C. The measurement device is composed by one electronic meter for redox-potentials, one periodontal probe and one referential electrode (Ag/AgCl, 3 M KCL).

In a first experience, we repeated the measurement of electric potential for the same implant 25 times. In a second experience, we measured the electric potential for 10 differents implants.

Results: The average potential of the first sample's implant was 3.7 mV. The mean value of electric potential for the second sample of 10 implants was 9.7 mV.

Conclusions: The method developed to measure the electric potential on the surface of the dental implants is reliable, because we obtain reproducible values in similar conditions. This preliminary work allows us obtaining oral data.

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Comparative study of bone formation between Bio-Oss and OSTEON

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Purpose: In this study, we evaluate the biocompatibility and osteoconductivity of inorganic bovine bone mineral (Bio-Oss™) and porous synthetic bonegraft (OSTEON™) using rabbit's calvaria model with respect to healing time.

Methods: Bovine bone graft and synthetic bone graft are used. Those are, 1) OSTEON(Genoss, Co., Ltd, Suwon, Korea) which is TCP coated HA scaffold, 2) Bio-Oss™ (Osteohealth). The particle size of OSTEON™ was 0.5 ~ 1.0 mm and that of Bio-Oss was 0.25 ~ 1.0 mm. Implantations were conducted in rabbit's calvaria. A critical defect size was Ø 8.0 mm in diameter perforated using trephine drill. General euthanasia was conducted after a period of 4, 12, 24 weeks. After fixation in formaldehyde, tissue samples were made with undecalcified resin block stained by masson trichrome or H&E.

Results: Bone tissue augmentation were similar between OSTEON, Bio-Oss. After 4 weeks, new bone and osteoid was found around OSTEON that had porous sturucture was founded. New bone formation was augmentated in both OSTEON and Bio-Oss with respect to healing time.

Conclusions: OSTEON™ synthetic bone graft was a good osteoconductive and biocompatibile material like Bio-Oss™ derived from bovine bone. There was no evidence of immune or inflammatory responses. Bone aubmentation in rabbit calvaria is found according to healing time.

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Gene-expression of MC3T3-E1 osteoblast cells cultured on Anodized titanium surface and Machined titanium surface by means of cDNA microarray

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The purpose of this study was to evaluate adhesion and gene expression of the MC3T3-E1 cells cultured on machined titanium surface and anodized titanium surface using MTT test, Scanning electron micrograph and cDNA microarray.

Scanning electron micrograph, MTT Assay, Microarray assay MC3T3-E1 cells suspension ($1X10^5$ cell/ml) were incubated on Ti disks (12 mm diameter and 1 mm thick (Osstem, Pusan, Korea) for 12 h to evaluate the influence of the substrate geometry on titanium surface using a scanning electron micrograph (SEM).The absorbance at 570 nm was measured using microplate reader at 24, 48 hr. The cDNA microarray Agilent Rat 22 K chip was used and was monitored the expression of 21575 genes.

Results: 1. there was significant difference in cell viability among the machined surface(MS) and anodized surface (AS) ($P < 0.05$) at 24 h in MTT assay.

2. connective tissue growth factor (up regulation – 1.01), insulin-like growth factor 1 receptor (down regulation 1.19) were obtained.

Discussion: Microarray assay 24 h revealed that the adhesion molecules on the biomaterial were higher on the anodized surface than machined surface, which will affect the phenotype of the plated cells depending on the surface morphology.

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Alpha-TCP containing simvastatin as bone substitute: animal and clinical studies

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We have reported that alpha-TCP is resorbable bone substitute exchanging to new bone when grafted in the bone defects. On the other hand, simvastatin, one of the cholesterol-lowering drugs, stimulates BMP2 expression in osteoblasts and local application of simvastatin to bone increases bone thickness. The purpose of the present study was to examine efficacy of alpha-TCP containing simvastatin (a-TCP-S) as bone substitute. Porous alpha-TCP particles of 500–700 micrometer in diameter, which contained simvastatin in the small pores (1 mg simvastatin/1 g alpha-TCT), were prepared. Firstly, 3 months after extracting the mandibular premolars of the three beagle dogs, 3 wall-bone defects (5 mm width and 8 mm depth) were prepared and the defects were filled with silicon rubber. One month later the silicon rubber was removed and the defects were treated with three ways: no treatment, alpha-TCP and a-TCP-S. One and 2 months after the treatment the animals were sacrificed and the defects were analyzed

radiographically and histologically. Secondarily, after getting approval of institutional ethical committee and patients' informed consents, we applied a-TCP-S to the bone defects of three patients. In the animal experiment the defects, which were treated with a-TCP-S, healed much faster than the ones treated with alpha-TCP, whereas healing of the untreated defects delayed. Degradation of alpha-TCP was also evident. In radiographs of the patients the grafted material fused to the surrounding bone and the defect was covered with hard bone at 3 months. These results indicate that alpha-TCP containing simvastatin would be useful as resorbable bone substitute in dental implant treatment.

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Preparation of custom-made implant materials using stereo lithography

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In this study, we prepared custom-made implant materials which can fit the defect shape using 3D replica of the defect with stereo lithography reconstructed from CT images. The plastic mold prepared using stereo lithography was filled with HAp sol. We could then obtain a sintered body by calcining the dried specimen. We evaluated the molding accuracy of HAp sintered body by measuring its volume contraction rate and density.

We prepared 3D plastic replica of the right viscerocranium defect using stereo lithography reconstructed from the patient's CT images and the prosthesis of the defect skull (right side) formed after cancer of maxilla excision from the mirror image of the left skull that was a healthy side using a Boolean operation. Since rapid prototyping was suitable for the reproduction of defective part and spicule, its applicability to epithese was checked in the same case. Epithese is an artificial body for the patient with some defects as prosthesis for the purpose of esthetics and recovery of the function in congenital or postoperative of tumor and injury. We prepared a skin surface from the same patient's CD data changing the threshold values. We could then prepare the prosthesis of the defect skin from the mirror image of the left skin that was the healthy side using a Boolean operation.

The 3D plastic replica prepared with stereo lithography was effective for the preparation of custom-made implant materials and epithese.

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Copolymer study in the primary stability of osseointegrated implants

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The primary stability in the installation of dental implants is one of determinative the main ones in the osseointegration process. Some clinical situations disable the adequate stability of the implantation. A gap may occur between the bone and the implant provoked by overdrilling or tooth extractions sockets implantations indicates the use of biomaterials to occupy this space. The aim of this study was to analyze the use of polylactic and polyglicolic copolymer in the primary stability of osseointegrated implants, through removal torque test and a microscopic evaluation with fluorochromes. For this, 14 cylinders of Ti cp GII had been installed in the right tibia of 14 rats, divided in 2 groups: Group Implant with Stability (GIS), whose osteotomy was realized with spiral drill of 1,4 mm diameter and Group Polymer (GP), whose osteotomy was realized with spiral drill of 2,0 mm diameter, the implants were placement envolved in copolymer, without primary stability. The fluorescent bone markers were injected in the periods of 7, 15 and 21 days, and the animals were sacrificed after 35 days. The analysis of the laminas was realized through epifluorescence microscopy and the areas of bone deposition were measured. The obtained data were submitted to the "*t*" of Student test. The implantations had supported of removal torque and had not been found differences statistically significant, in the final periods, between the averages of the areas of the periphery of the implants. The copolymer kept the implants position and did not hinder the bone deposition.

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The effects of hyaluronic acid gel on the healing of oral mucosa

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Purpose: To evaluate the effects of local application of hyaluronic acid gel on wound healing of the oral mucosa using an animal model.

Materials and Methods: Young adult New Zealand White rabbits, weighing between 2.5 and 3.0 kg, were used. Almost uniform round ulcers were created on the gingiva of rabbits with a chemical injury from acetic acid. To determine the effect hyaluronic acid gel on the ulcer caused by acetic acid three groups were studied. In the first group, Hyaluronic acid gel (Gengigel®) was applied to the ulcer area once a day. In a second group there was no treatment. And in the last group, a gel with exactly the same elements as Gengigel®, except for the Hyaluronic acid, was used for treatment. The size of the ulcers were measured at the longest and shortest axes of the ulcers and calculated as the area of the ulcer. Slides were reviewed for histological examination by light microscopy.

Results: The results showed that the number of fibroblasts, new blood vessels and the epithelial thickness was greatest in the control group with no treatment. The presence of hyaluronic acid promoted proliferation of fibroblasts and keratinocytes isolated from gingival tissue of rabbits *in vitro*. Topical application of hyaluronic acid accelerated the healing of the ulcers created in rabbits.

Conclusion: Hyaluronic acid may be effective for wound healing of oral mucosal lesions.

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The effect of alkali-and heat-treated titanium surface on differentiation of osteoblast

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Purpose: The purpose of this study was to elucidate cellular events that followed cell adhesion to alkali-and heat-treated (AHT) titanium surface and some of the cellular pathways that regulated some cytokine releases.

Materials and methods: Osteoblast-enriched cell preparations were obtained from Sprague-Dawley 21 day fetal rat calvaria by sequential collagenase digestion. Polished Grade-II titanium (cp-Ti) disks or AHT titanium disks or titanium 6-aluminum 4-vanadium (15 mm in diameter, 1 mm in thickness) were placed in a 12-well plate. To investigate the cell attachment and proliferation, cells (50,000/ml) were seeded and allowed to attach onto each titanium dishes for 72 hrs in bGJb solution containing 10% FBS. Cells seeded onto cp-Ti disks were served as the positive control. The biological response of fetal rat calvarial cells on AHT titanium was assessed by cell proliferation, enzyme-linked immunoabsorbent assay (ELISA), alkaline phosphatase activity, and reverse transcription polymerase chain reaction (RT-PCR) analysis.

Results: Cell proliferation on AHT surfaces showed significantly higher level than on Ti-6Al-4V surface ($P < 0.01$). In ELISA analysis, concentration of IL-1β and IL-6 were significantly raised on AHT surfaces when the cells were grown to day 7, compared with other Ti alloys ($P < 0.001$). In comparison to cp-Ti and Ti-6Al-4V alloy, AHT titanium enhanced alkaline phosphatase activity ($P < 0.001$). In RT-PCR analysis, alkaline phosphatase (ALP), bone sialoprotein (BSP), receptor activated nuclear factor ligand (RANKL) mRNA expression increased on AHT titanium however, mRNA level of osteoproteogerin (OPG) was unchanged.

Conclusion: These results suggest that alkali- and heat-treated titanium stimulates osteoblasts differentiation and facilitates bone remodeling.

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Effects of fibrin glue on bone formation in combination with deproteinized bone xenografts in humans

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Thirty-six sinus grafts were performed in 34 patients with an alveolar crest bone height in the posterior maxilla of 3 to 5 mm before grafting. The sinuses were grafted using Bio-Oss alone or mixed with fibrin glue. Group 1 was the control group and included 25 patients who received a xenograft mixed in saline. Group 2 comprised 9 patients who received a xenograft and fibrin glue. The study was further subdivided at the time of 9 months. This histologic study evaluated by hematoxylin-eosin (H&E) and histomorphometric analysis whether fibrin glue in combination with Bio-Oss enhances bone regeneration in sinus floor elevation in humans. The degree of new bone formation (bone forming activity) and composition ratio of the tissue sample were determined by measuring and comparing the area of new bone formation using computer-assisted histomorphometry. The new bone formation was better in Group 2 than in Group 1, but the difference was not significant. The absorption of the graft material was faster in Group 2 than in Group 1, in the short term, but better in Group 1 over the long term, although the difference was not significant. Lamellar bone was formed earlier in Group 1 compared to Group 2, but the difference was not significant. The long-term difference was not evident in lamellar bone formation. Overall, the surgery site stabilized earlier with new bone formation in Group 2 than in Group 1, but the difference was not significant. New bone was seen in Bio-Oss and with Bio-Oss plus Tisseel, although the difference was not significant. Combining a fibrin sealant and Bio-Oss could lead to improved scaffolds for bone tissue engineering based on the synergistic effects of the biomaterials. Therefore, Bio-Oss or Bio-Oss plus Tisseel may be used depending on the situation.

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An experimental study for developing bioresorbable membranes

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The purpose of this study was comparing the effect of 4 newly designed bioresorbable membranes on bone regeneration in rat cranial defects. Standardized artificial bony defects were prepared at 30 rat craniums, and covered with polydioxanone(PDS), PDS/F-127, polylactide glycolic acid (PLGA), and PLGA/F-127 membranes, respectively. The animals were classified 5 groups; group 1 - no membrane (6 rats), group 2 - PDS (6), group 3 - PDS/F-127 (6),

group 4 - PLGA (6), and group 5 - PLGA/F-127 (6). These animals were sacrificed at 4 and 8 weeks and the operation to make specimens was done and the specimens were observed with light microscopy. The comparative effects in the bone regeneration of each groups were evaluated and the remaining rate of each membranes were analysed. The new bone formation was greater in PLGA and PLGA/F-127 membrane groups than PDS or PDS/F-127 groups. And the former groups were resorbed more lately than the latter. PLGA/F127 was good to manipulate because of its hydrophillic property, but resorbed more rapidly than PLGA. So, the amount of new bone formation in groups using PLGA/F127 was less than in groups using PLGA. In conclusion, PLGA was the best membranes among the membranes used in this study.

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Cellular activities of osteoblast-like cells on surface-modified titanium discs for use of dental implants: in-vitro study

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Introduction: The purpose of this study was to investigate the cellular activities of MG63 osteoblast-like cell on surface-modified titanium discs for use of dental implants.

Materials and methods: The experiment was composed of three groups. Group 1 surfaces were machined surface. Group 2 surfaces were hydroxyapatite blasted surface. Group 3 surfaces were anodized surface. The morphology of each sample was investigated by using SEM. For osteoblast activity test, MG63 osteoblast-like cells in Minimum Essential Medium containing 10% FBS were cultured on each sample for 1–14 days. The morphology of MG63 osteoblast-like cell cultures of surface-modified titanium discs was investigated by using SEM and the initial cell attachment activity, the cell proliferation activity (MTS assay), the cell differentiation activity (alkaline phosphatase activity) was measured.

Results and discussion: 1. The three groups showed specific microtopography. The machined group had machining grooves, the RBM group had a rough and irregular pattern with reticulated appearance and the anodized group had homogeneous oxide film having crater-like pores of about 2–3 μm diameter.

2. From evaluating the early cell attachment pattern, the attached cells exhibited more obvious lamellopodia and flattened membranes were observed on the anodized specimens and RBM specimens, especially the anodized specimens, compared to the machined specimens.

3. The initial cell attachment activity, the cell proliferation activity and the alkaline phosphatase activity were higher on the anodized group than the other groups ($P < .05$).

Conclusion: Cell proliferation and differentiation as well as attachment were enhanced by the anodic oxides. The surface treatment by anodization provides a potential of improving cellular activities, eventually osteointegration, which is a major factor to be considered in dental implants.

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Surface characteristics of anodized titanium oxide nanotubes

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Purpose: To investigate the surface characteristics on machined (MA-Ti) and restorable blast media treated titanium (RBM-Ti) by anodizing.

Materials and methods: Machined titanium (MA-Ti) and resorbable blast media treated titanium (RBM-Ti) were prepared in the form of a disc (diameter, 15 mm; thickness, 1 mm) as sample materials. The samples were anodized in the elecrolyte of 1 M H_3PO_4 solution mixed with 1.5wt.% HF. under a 20 direct current voltage for 10 min. After anodizing, the specimen was washed in water for 20 min and dried for 1 h in an oven at 200°C with the heat rate of 1°C/min. All samples were imaged using field emission scanning electron microscope (FE-SEM), X-ray photoemission spectroscopy (XPS), X-ray diffraction (XRD) and transmission electron microscopes (TEM) for both qualitative and quantitative surface analysis.

Results: FE-SEM image indicated that the structure of nanotubes on smooth (MA-Ti) and roughened (RBM-Ti) surface was not different either in diameter or length respectively with 40–100 nm and 500 nm. XPS revealed that the titanium was present mainly in the oxide state. XRD showed that only Ti peaks were detected, which means that the nanotube layer was amorphous. TEM images showed that the nanotube layers were open at the top end while the nanotubes are closed at the bottom. The selected area diffraction pattern revealed that TiO_2 nanotubes were amorphous structures.

Conclusion: The structure of nanotubes on smooth (MA-Ti) and roughened (RBM-Ti) surface was not different in diameter and length of nanotube respectively with 40–100 nm and 500 nm. The nanotubes were mainly consisted of TiO_2 and the crystal structure was amorphous.

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Influence of biomimetic oligopeptide-coated surface on bone formation

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Background: Bone defects can be restored using several types of bone substitute materials which have only a scaffold function. Reliable bone regeneration requires the additional application of suitable bioactive substances to the surface of the grafted material in order to enhance osteoblast differentiation and proliferation. We developed biomimetic peptides from the FN structure and evalu-

ated in vitro osteoblastic cell response and in vivo bone formation.
Methods: PCR primers were designed to recognize the cell adhesion recognition motif RGD as well as the synergistic motif PHSRN of FN including the adjacent sequence as a linker and purified as F20 biomimetic peptides. Osteoblastic cell (MG63) was prepared for cell adhesion and differentiation assays. For *in vivo* assessment, critical-sized bone defects were surgically made in the calvaria of Spague-Dawley rats and filled with F20 peptide-coated bone substitute material. Newly-formed bone area was measured by a computer-assisted image analysis system.
Results: F20 biomimetic peptide promoted osteoblastic cell adhesion and differentiation two-fold higher than control. At 3 weeks after the surgery, F20-coated bone graft material effected a statistically significant newly-formed bone area compared with the non-coated control ($P < 0.05$).
Conclusion: Within the limit of this study, we believe that F20 biomimetic peptide promotes bone formation by enhancing osteoblastic cell adhesion and differentiation, and consider it to be possibly a useful bioactive substance supplementary to bone replacement material.
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Behaviour of three different calcium phosphates in a critical-size defect

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Objectives: The authors compared the induction of new bone formation and the degradation of three different bone replacement materials based on calcium phosphate in a critical-size defect.
Methods: In 12 months old Göttingen minipigs critical-size defects ($> 5\ cm^3$) on both sides of the anterior mandible were created. The defects were filled with three different calcium phosphates. In the control group the defect was filled with a gelatine sponge. Histomorphometrical examination was performed 8 months following implantation. Variance analysis was used to check for statistical differences. The 6 animals were subdivided into 4 groups.

group a: sintered hydroxyapatite ceramic (0.6 mm granule diameter)
group b: sol-gel hydroxyapatite matrix (1.5 mm granule diameter)
group c: sintered ß-tricalciumphosphate (0.5–1.0 mm granule diameter)
group d: control group (gelatine sponge)

Results: 8 months following implantation histomorphometrical investigation revealed for group b a significant ($P < 0.01$) higher amount of new bone compared to the 2 other biomaterials. New bone formation (in percent based on the original defect cross sectional area) was 56.9% for group a, 98.7% for group b, 57.6% for group c and 48.4% for group d. The degradation rate of the hydroxyapatite matrix (group b) was higher compared to the sintered calcium phosphates. Biomaterials residues (in percent based on the original defect cross sectional area) were found in group a: 16.6%, group b: 1.3%, group c: 6.3%.
Conclusion: The biological behaviour of the sol-gel hydroxyapatite matrix was superior when compared with 2 conventional sintered calcium phosphate ceramics.

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Biomechanical and histological behavior of zirconia implants. An animal experiment

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This study aimed at the evaluation of the integration of zirconia implants into rat femur bone. Zirconia implants with different surface topographies were compared to titanium implants. Titanium and zirconia cylinder implants were placed into the femurs of 42 Sprague-Dawley rats. Four groups of implants were utilized, namely machined zirconia implants, zirconia implants with a novel surface topography, machined titanium implants, and TiUnite® implants. The surfaces (average roughness R_a) were examined using atomic force microscopy (AFM). After a healing period of 14 days, the load-bearing capacity between the bone and the implants was tested applying a push-in test. Additionally, after a healing period of 14 and 28 days respectively, bone tissue specimens were processed and histologically analyzed. The surface topography parameter R_a amounted to 0.13 µm for the machined zirconia, to 0.05 µm for the machined titanium, to 0.32 µm for TiUnite®, and to 0.36 µm for the novel zirconia surface. The differences were statistically significant between the machined and the ''rougher'' surfaces. The push-in test showed the highest values for the structured implant surfaces with no significant difference between TiUnite® (34 N) and zirconia (45.8 N). These values were significantly higher compared to the machined implants. The mean mineralized bone-to-implant contact showed the highest values after 14 and 28 days for the structured surfaces (TiUnite®: 36%/45%; zirconia: 45%/59%). Within the limits of the investigation it can be concluded that the novel zirconia surface is accepted by bone at least as good as the established TiUnite® surface.

The implant materials were kindly provided by NobelBiocare, Gothenburg, Sweden.

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Fracture strength of zirconia implants after artificial aging

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No data is available on the fracture strength of one-piece zirconia (ZrO_2) oral implants. The object of this study was to evaluate

fracture strength of ZrO_2 implants simulating occlusal forces exerted in the oral cavity. One hundred and twenty ZrO_2 and titanium (Ti) implants were used. ZrO_2 implants manufactured from yttria-stabilized tetragonal ZrO_2 polycrystal (Y-TZP), from Y-TZP dotted with alumina (Y-TZP-A), and from Y-TZP-A with a modified surface were used. In some groups the implant heads were prepared with diamonds. A subgroup of each implant type was subjected to thermomechanical cycling in a chewing simulator prior to fracture testing. Test specimens were then loaded until fracture occurred. ZrO_2 implant fracture occurred at 725–850 N when the implants were not prepared, and at 539–607 N when prepared. The results suggest that implant preparation has a negative influence on the implant fracture strength. However, mean fracture strength values were all within limits of clinical acceptance.

The implant materials were kindly provided by NobelBiocare, Gothenburg, Sweden.

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Scanning electron microscopial and energy dispersive x-ray spectrometer analysis of dental implant surface after Er,Cr:YSGG laser treatment

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Recently, in addition to these conventional tools about peri-implantitis, the use of different laser systems has also been proposed for treatment of peri-implant infections. As lasers can perform excellent tissue ablation with high bactericidal and detoxification effects, they are expected to be one of the most promising new technical modalities for treatment of failing implants. Recently, Hao and Lawrence found that the improved wettability of the zirconia-based bioceramic following CO2 laser irradiation resulted favourable fibroblast and osteoblast cell response. It is introduced that Er,Cr:YSGG laser, operating at 2780 nm, ablates tissue by a hydrokinetic process that prevents temperature rise.

We studied the change and elemental composition of the titanium implant surface under scanning electron microscopy and energy dispersive x-ray spectrometer after using Er,Cr:YSGG laser at various energies. In this study, water laser irradiation of implant fixture showed different effects according to implant surface. Er,Cr:YSGG laser irradiated in RBM surface (OSSTEM) not alter the implant surface under power setting of 3 W. But in RBM surface (DIO) and nano surface (Puretex) alter above power setting of 2 W. And as oxigen weight% is increased, microfracture and melting of implant surface is increased. But It was found that the improved surface roughness, surface oxygen content and surface energy generated by the high power diode laser treatment were accounted for the better wettability characteristics of the material and enhancement of the work adhesion with the biological liquids used

So we concluded that surface oxygen content will provide the better wettability and enhancement of cell adhesion when irradiating Er,Cr,YSGG laser within limit not altering implant microstructure.

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Scanning electron microscopic study of implant surface after Er,Cr:YSGG laser irradiation

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Today, there is considerable evidence to support a cause-effect relationship between microbial colonization and the pathogenesis of implant failures. The presence of bacteria on implant surfaces may result in an inflammation of the peri-implant mucosa, and, if left untreated, it may lead to a progressive destruction of alveolar bone supporting the implant, which has been named as peri-impantitis. Several maintenance regimens and treatment strategies for failing implants have been suggested. Recently, in addition to these conventional tools, the use of different laser systems has also been proposed for treatment of peri-implant infections. As lasers can perform excellent tissue ablation with high bactericidal and detoxification effects, they are expected to be one of the most promising new technical modalities for treatment of failing implants. It is introduced that Er,Cr:YSGG laser, operating at 2780 nm, ablates tissue by a hydrokinetic process that prevents temperature rise.

We studied the change of the titanium implant surface under scanning electron microscopy after using Er,Cr:YSGG laser at various energies, irradiation time.

In this study, Er,Cr:YSGG laser irradiation of implant fixture showed different effects according to implant surface. Er,Cr:YSGG laser in TPS surface with RBM not alter the implant surface under power setting of 4 Watt(W) and irradiation time of 30 sec. But in TPS surface with Ca3P coating alter above power setting of 2W and irradiation time of 10 sec. TPS surface with RBM showed microfracture in 4 W, 30 sec and TPS surface with Ca3P coating showed destruction of fine crystalline structure, melting in excess of 2 W, 10 sec. We concluded that proper power setting, air, water of each implant surface must be investigated and implant surface must be irradiated under the damaged extent.

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Influence of surface characteristics on bone integration of titanium implant surface design; resonance frequency analysis and histomorphometric analysis study in minipig

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Titanium has been widely used in dental implantology, maxillofacial traumatology and successfully for various types of bone-anchored reconstruction. Implants are manufactured with pure titanium and oxidized to create a layer of titanium oxide(TiO2). It

is believed that properties of oxide films covering titanium implant surfaces are of crucial importance for a successful osseointegration, in particular at compromised bone site.

The aim of the present study is to investigate the effect of anodized surface to osseointegration of implant by using of resonance frequency analysis (RFA), quantitative and qualitative assessment of an anodically modified implant type with regard to osseous healing qualities. A total of 96 screw-shaped implants were prepared to this study. 72 implants were prepared by electrochemical oxidation with different ways. 24 (Group1 SP) were prepared at galvanostatic mode in 0.25 M sulfuric acid and phosphoric acid, 24 (Group 2 GC) were prepared at galvanostatic mode in calcium glycerophosphate and calcium acetate and 24 (Group 3 CMP) were prepared at galvanostatic mode in 0.25 M sulfuric acid and phosphoric acid followed by Calcium metaphosphate (CMP) coating. Rest of 24 (Control Group RBM) were control group of RBM surface.

Bone tissue responses were evaluated by resonance frequency analysis (RFA) that were undertaken at 2, 4 and 6 weeks after impalnt insertion in mandible of mini-pig. Group 1 SP (Anodized with sulfuric acid and phosphoric acid implants) demonstrated slightly stronger bone responses than Control Group RBM (RBM surface implants). Group 2 GC (Anodized surface with calcium glycerophosphate and calcium acetate implants) demonstrated no difference compared with control group. Group 3 GMP (Anodized and CMP coated implants) demonstrated slightly stronger and faster bone responses than any other implants. But, All observation result of RFA showed no significant differences betweens groups with surface type.

Histomorphometric evaluation demonstrated significantly higher bone-to-implant contact for Group 2 GC. Significantly more bone was found inside the threaded area for Group 2 GC.

It was concluded that Group 2 GC (Anodized surface with calcium glycerophosphate and calcium acetate implants) had influence on bone tissue responses than RBM surface. In addition, Calcium metaphosphate (CMP) showed a tendency to promote bone tissue responses.

Key words: Anodized surface, Resonance Frequency Analysis(RFA), Calcium metaphosphate(CMP), Resorbable Blast Media(RBM)

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The effect of Neodymium magnet on bone formation around titanium

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Magnetism induced osteogenesis around implant located in tibia of rabbit; hence through new researches and experiments, if optimal intensity of magnetism that induces osteogenesis in living body can be found and if this level of magnetism could be applied continuously around implant, positive effects like reduction of treatment period or early loading of implant would be possible in treating patient with implant. In addition, more studies would have to be done to prove the effective mechanism of Neodymium magnets on loving cells, and the most effective applying methods or durations of applications would have to be researched.

The purposes of this study were to find out the intensity of magnetic field where magnetism in the titanium implant specimen inserted into the bone could affect the bone formation, and to discover the possibility of clinical application in the areas of dental implants and bone grafts. 20 adult male rabbits (mean BW 2 Kg) were used in this study. Titanium implant specimens were surgically implanted on the mesial side of the tibia of rabbits. Neodymium magnets(Magnedisc 500, Aichi Steel Corp. Japan) were placed into the implants of experimental group except control group, just after placement of the titanium implants. At 2, 4 and 8 weeks after the surgery, the animals were sacrificed, specimens were obtained and stained with Hematoxylin-Eosin for light microscopic evaluation and histomorphometric analysis. The Statistical Analysis was done with Mann-Whitney U Test ($P < 0.05$).

The results were as follows: 1. In radiographic findings, increased radiopacity downward from crestal bone was observed along the titanium implant specimen at experimental period passed by 2,4, and 8 weeks in both control and experimental group. 2. In histoiogic findings, increased new bone formation was shown in both control and experimental group through the experiment performed for 2,4, and 8 weeks. More new bone formation and bone remodeling were shown in experimental group. 3. In histomorphometric analysis, the bone contact ratios were 11.88% for control group and 38.48% for experimental group ($P < .05$).

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Bone response in free form fabricated scaffolds

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Objectives: In the present study, a free form fabrication process was used to produce tailored scaffolds with identical macroporosity, to evaluate how the scaffold material and total porosity influenced the bone response.

Experimental methods: Scaffold was installed in each femoral condyle (circular defects, Ø 3.8 mm) for 6 weeks using a randomised implant insertion scheme ($n = 8$) in adult, New Zealand White rabbits**.** Evaluation was performed with light microscopy and focused ion beam (FIB)/transmission electron microscopy (TEM).

Results: The macroporosity was around 40% in all scaffolds and consisted of identical squarely shaped and interconnected pore channels with a size of around 350 µm. After 6 weeks, the bone ingrowth in scaffolds of hydroxyapatite was three times larger compared to identical scaffolds of zirconia. The addition of micropores further enhanced the bone response in otherwise identical hydroxyapatite scaffolds. All three materials demonstrated totally different interfaces with regard to the apatite layer.

Conclusions: With the fabrication process developed scaffolds of different materials with identical shape and macroporosity as

well as different porosities were prepared. The use of these designed scaffolds as research tools made it possible to evaluate how the scaffold material and the porosity influenced the early bone response and the structure of the interface.

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DNA microarray analysis of osteoinductive properties of commercial implant surfaces

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Implant characteristics such as surface composition, chemical and mechanical modification, energy and topography play a key role in implant integration with bone. Limited knowledge is available regarding their influence at the early stages of the osseointegration process at a molecular level.

The primary objective of this study was to analyze the expression profile of osteoblast-like MG 63 cells cultured at the surface of dual acid etched (Osseotite), sandblasted and acid etched (SLA) and hydroxyappatite (HA) coated implants using a particularly designed human osteogenesis gene DNA microarray.

For this purpose, osteoblast-like MG 63 cells were allowed to grow in monolayer cell cultures in the presence of all implant type for a time period of one week. Smooth-machined surface implants and plastic disks were used as control. Messenger RNA (mRNA) from MG 63 cells that remained attached to various implant surfaces and plastic disk was extracted. Complementary DNA (cDNA) probes were prepared for microarray analysis using mRNA templates. A specific array was prepared involving 112 genes regulating early events in human osteogenesis.

In osteoblasts cultured in test implant surfaces, out of 112 genes used, a variety of genes were found to be overexpressed (> 2 times) when compaired to controls as well as to internal positive and negative controls. These genes are prominent in biological processes such as cell migration, adhesion, growth factor regulation, nuclear transcription factor expression and osteoblast maturation. Results obtained provide scientific evidence of the osteoblastic phenotype portrait of all implant surface.

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Biological investigation of an exeperimental laser sintered titanium implant surface

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Introduction: Rapid prototyping is a revolutionary technique which enables to directly generate physical objects with defined structure and shape on the basis of virtual 3D data. Direct laser metal forming is an application in which the basic material particles are fused in a laser focus. The aim of this study was to evaluate biological behaviour of a new laser sintered titanium surface (Leader srl, Milano-Italy) versus conventional machined titanium surface.

Materials and methods: 10 laser sintered titanium discs were manufactured. The original surface microstructure consisted of roughly spherical particles, with remnants of the original powder. Exposure to organic acid mixture was performed, in order to remove remnants and to obtain the final test surface, consisting in grooves and pores.10 conventional machined titanium discs were prepared as control. SEM evaluation of calvarian rat osteoblasts cultured on both surfaces was performed.

Results: All test specimens showed cavities extended beneath the surface to form a three-dimensional network of intercommunicating passages. Cells appeared sparse in cavities, attached to protruding features of surface, tightly stretched overlying pits in surface. Cell shape was governed by attachment and surface features, with some evidence of extracellular matrix secretion. In control specimens, surface was covered with confluent layer of flattened cells, with no evidence of extracellular matrix deposition.

Conclusion: Test surface regulates cell shape, encouraging the expression of a mature osteoblastic phenotype, inducing bone formation. This study demonstrated the application of sintering process for titanium to obtain reproducible surface architecture for engineered implants.

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Micro CT scan evaluation of functionally seated locking taper connection

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Introduction: Precision at implant connection level is essential to avoid peri-implant diseases caused by bacterial infiltration.

Aim of the study: Micro CT scan analysis of the Bicon Implant System with certified bacterial seal was evaluated at his locking taper connection level before and after functional load.

Methods: 3 implant- abutment samples with a mechanically seated locking taper and 1 implant-abutment sample with 5 years functional load were engaged in a *cylinder-formed* resin in order to obtain axial, vertical and horizontal tomography slides. A micro CT scan analysis was performed in order to evaluate the accuracy of the locking taper seal on both, non loaded and loaded implants. A 3-D reconstruction and measurements were obtained using appropriate software.

Results: A hermetic seal was observed in all tomography slides at contact level between the implant well and the abutment post. The contact area of the 5 years loaded implant-abutment sample was increased compared with the mechanically loaded.

Conclusions: The Micro CT scan evaluation of the 4 samples demonstrated the tight connection between the abutment post and the connecting cavity of the fixture which avoid formation of micro-gaps and consequently the potential infiltration of bacterial pathogens at peri implant level.

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Nano size structures for enhanced early bone formation

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Early events that take place after oral implant insertion are in part dictated by biomolecules that interact with the material surface. Several components of the initial healing cascade are on the nanometer scale. Moreover, bone exhibits a 3D nanotopography mainly formed by the collagen-apatite complex. In a series of experiments, nano size features (25–60 nm) were introduced at titanium implants surface to investigate the effect on early bone formation. Nano size features were obtained through different chemical methods; fluoride-modified implants (AstraTech, Mönldal, Sweden) were treated with hydrofluoric acid; hydroxyapatite nano-coated implants were modified by a surfactant-mediated method (Promimic, Göteborg, Sweden); and titania nano-coated implants were modified through a sol-gel method (Vivoxid, Turku, Finland). Surface topography evaluation at high resolution of the fluoride-modified, hydroxyapatite-coated and titania-coated implants revealed nano features with specific dimensions and surface coverage area. Bone response was investigated after 4 weeks, placed in the rabbit tibia. Histological analyses of cut-ground sections and removal torque test revealed enhanced bone response, in all experiments, to the implants with nano features when compared to control implants. The enhanced bone formation to implants with nano features was observed both on blasted implants ($S_a \sim 1{,}3\,\mu m$), so-called moderately rough implants, and on very smooth polished implants ($S_a \sim 100\,nm$).

Based on our recent *in vivo* experiments, the importance of nano size structures for enhanced bone formation was demonstrated to titanium implants with different chemical composition and different micro-topography.

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Clinical and histological comparison of Bio-Oss and Emdogain

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Reconstruction methods are an essential prerequisite for functional rehabilitation of the stomatognathic system, especially in the correction of traumatic bone loss or atrophic changes of the alovelar processes. Emdogain (an enamel matrix derivative) as a periodontal regenerative material can be a potentially useful adjunct to bone substitute materials (ie. xenografts) in oral and maxillofacial bone and implant reconstructive surgery. This animal study was carried out to investigate the influence of Emdogain on the regeneration of bony defects, treated with Bio-Oss (Deproteinized Bovine Bone Mineral).

Six New Zealand White rabbits were included in this randomized, blinded, prospective pilot study. Four equal $3 \times 6\,mm$ cranial bone defects were created and immediately grafted with DBBM, Emdogain, DBBM + Emdogain and no treatment as control. The defects were evaluated histologically and histomorphometrically after 1 month.

The results showed a significant increase in histomorphometric bone area, trabecular thickness and maturity in both DBBM and DBBM + Emdogain samples compared with others. There wasn t any significant increase in bone formation with the addition of Emdogain to Bio-Oss. No foreign body reactions or severe inflammation were observed in any of the specimens.

Under the limitations of this study using Emdogain in combination with Bio-Oss, didn t show any positive effects on the rate and quality of bone regeneration.

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Cellular response of microfabricated titanium obtained from wire-type EDM

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Objectives: We already demonstrated wire-type EDM treated titanium (W-Ti) demonstrated excellent bone biocompatibility both *in vitro* and *in vivo* because of microfabricated surface with irregular morphology and oxidized surface chemical structure. In this study we aimed to investigate which surface characteristic of W-Ti predominated cellular responses by examining cell differentiation of bone marrow cells using titanium coated epoxy replicas of W-Ti (R-W-Ti) as an experimental model.

Methods: W-Ti and polished smooth titanium plates (Ti) ($10 \times 10 \times 1.0\,mm$) were prepared. R-Ti and R-W-Ti was prepared by epoxy resin with coating titanium. The surface of each specimen was characterized by SEM, XRD, and XPS. Each specimen was incubated in α-MEM containing 10% FBS with and without rat bone marrow stromal stem cells (RMSC). Adsorption of cell-binding proteins by each specimen was examined by XPS. Expression of integrin αV, osteopontin, osteocalcin, collagen I, alkaline phosphatase (ALP) and cbfa-1 was examined by RT-PCR. The findings were analyzed statistically by ANOVA ($n = 6$).

Results: The adsorption of serum proteins on W-Ti was significantly higher than that with the other specimens. The expression of integrin was detected on all specimens. The expression of osteopontin and cbfa-1was detected earlier on W-Ti in 1 week.

Conclusions: The cellular response on W-Ti, at least in the initial adhesion stage, was stimulated by both chemical structure and the surface topography. Since the cell differentiation of adhered bone marrow cells to osteoblastic cells was enhanced on W-Ti, we suggested chemical structure of W-Ti predominated bone biocompatibility.

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Assement of the effect of a biphasic ceramic on bone response in a dog mandibular bone

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Objective: Calcium phosphate ceramics are being extensively used for orthopaedic, periodontal, and dental application. The biphasic calcium phosphate ceramic of our study consists of a hydroxyapatite bioactive matrix and a dispersed phase of reabsorbable phosphate. Therefore, it can provide good scaffold for the new bone to grow owing to HA, otherwise, it can have bioactivity for bone remodelling owing to α-TCP. This study aimed the effect of this biphasic ceramic on the osteogenesis in a dog mandibular bone.

Methods: 6 beagle dogs were enrolled in the study. All premolars were removed from both sides of the mandible in each dog. Three months later, four cylinders (5 mm. diameter and 6 mm. depth) composed of 85% hydroxyapatite (HA) and 15% α-tricalcium phosphate (α-TCP) were implanted in each side of mandible of dogs for 4, 12 and 26 weeks respectively. Two dogs were used in each time point. The harvested samples were processed for histologic and histomorphometric analysis and SEM.

Results: Histologic evaluation: No apparent inflammatory reaction response could be recognized in any case. Implants were surrounded progressively with blood vessels and newly formed bone although they weren't colonized by bone cells.

Histomorphometric analysis: The bone volume and contact surface were 42.36%/27.43% at 4 weeks, 60.70%/64.10% at 12 weeks and 81.73%/72.83% at 26 weeks.

SEM evaluation: The image obtained by SEM showed that the biphasic ceramic was surrounded progressively with new bone. The results obtained by semi-quantitative analysis indicated that the ratio of Ca/P at the central region of the implant were 1.41 at 4 weeks, 1.44 at 12 weeks and 1.52 at 26 weeks, similar to the normal bone mineral range (1.56–1.77). At the same time, it was observed a small quantity of magnesium at the central region of the implant that increased during the study (0.062 mol% at 4 weeks, 0.071 mol% at 12 weeks and 0.076 mol% at 26 weeks) although its value was lower than the normal bone mineral range (1.1–1.5 mol%).

Conclusions: The histological study indicates that this biphasic ceramic is biocompatible. At the same time, the histomorphometric analysis and SEM evaluation prove that is an osteoinductive and osteoconductive material. However, it wasn't observed any resorption of the phosphate phase and the subsequent migration of bone into the pores. This date concludes that this biphasic ceramic doesn't offer any advantage over other hydroxyapatite ceramics because it doesn't increase the osseointegration level.

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Diachronic study on interface microstructure between bone and titanium implants

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Purpose: The purposes of this study were to prepare experimental titanium-coated plastic implants suitable for electron microscopy examination of the titanium-bone interface and the response of tissue surrounding titanium, and to histologically investigate surrounding tissue responses in titanium coated plastic implants.

Materials and Method: Experimental plastic implants were prepared from a plastic rod coated with a thin film of titanium. Plastic implants without coating were used as controls. The implants were placed into tibiae of 8-week-old male rats. The specimens with implants were harvested 1, 3, 5, 7, 14, and 28 days after placement and observed under a light microscope and a transmission electron microscope.

Result: In the transmission electron microscopy, the titanium layer of the experimental implant was uniform and was approximately 100 nm wide. Under an electron microscope, on the fifth day, newly formed bonelike tissue was observed along the implant surface. On the 28th day after placement, the following areas were observed: (1) an area with a direct contact between the titanium and bone, (2) an area at the interface where an amorphous layer was observed, (3) an area with progressing calcification in the surrounding tissue where the cells were adjacent to the titanium surface, and (4) an area in which bone resorption and apposition were observed and remodeling was thought to be occurring.

Conclusion: Newly developed experimental implants with thinner titanium layers were considered to be highly useful in observing the responses of the surrounding tissue to the titanium surface.

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Bone absorption post-extraction

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Introduction: After dental extraction, a bone process of absorption and organization takes place. This process often spreads for several months. The aim of this study is to determine which is the highest degree of bone absorption in order to establish a normally pattern.

Methods: We performed 30 unitary extractions to 10 subjects previous dental implantation. We made resin-positioners that were used to take radiographs with parallel technique two

months later. Then, we measured the highest convexity of the rope drew by the joint of cemento-enamel junction from neighbouring teeth and the angles made between the rope and tangent of each tooth.

Results: We found differences significant ($P < 0.05$) between the distance mesio-distal from multiradicular 7.48 (CI: 6.57, 9.10) or uniradicular 5.38 (4.70, 6.06). However, there were not differences respect to mesial or distal angles or in relation to the height.

Conclusions: The mesial-distal distance post-extraction depends on the size of the edentulous place. In spite of it, this distance does not affect to bone loss in height. The bone absorption in height takes place until reaching a level of balance in the midpoint that we could consider a constant, being its mean of 4.05 mm. (CI: 3.63-4.47).

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Comparison of stability with different implant surface topographies in dogs

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Purpose: This study was performed to observe the stability changes of various surface treated implants by measuring ISQ and Periotest® value (PTV).

Materials and methods: Eight different surface topographies of dental implants were especially designed for this study. Machined surface implants were used as a control group. 4 nano-treated surface implants [TiO_2 sputter coating, heat-treated TiO_2 sputter coating, CaP sputter coating, heat treated CaP sputter coating] and 3 micro-treated surface implants [resorbable blast media (RBM), sandblast and acid-etched (SAE), anodized RBM] were used as the experiment groups. All 24 implants were placed in the mandibles of 3 dogs. Periotest® and ISQ values were measured every week and all animals were sacrificed to perform histological analyses at 8 weeks after implantation.

Results: In ISQ values, the lowest stability was observed at different times in the each case. The ISQ values were shown to have a tendency to increase after 5 weeks in every group and after 4 to 5 weeks, the values were stabilized. There was no statistic correlation between the ISQ values and PTV. In the histological findings, the bone formation was shown to be generally adequate and no differences between the 8 surface-treated implants.

Conclusion: Within the limitation of this study, it is considered that the differences in the implant surface treatment do not affect stability of implant.

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Quantitative PCR: a promising technique investigating the early bone-implant interface

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Objectives: Studies on the early tissue response to materials are difficult due to the inaccessibility of the interface zone and lack of sensitive techniques. The purpose of the present study was to apply quantitative PCR (qPCR) in combination with LM and SEM for the evaluation of early gene expression response as well as cellular reactions close to titanium implants.

Experimental methods: Anodically oxidized titanium (TiUnite™; Nobel Biocare AB) and machined titanium implants (2 mm × 2 mm) were inserted in the rat tibia. After 1,3, and 6 days, implants were unscrewed and surrounding bone was retrieved. Both the implants and bone were analyzed with qPCR, routine histology and SEM. The amount of mRNA was normalized to 18S protein subunit.

Results: After the initial inflammatory response, the tissue located inside the threads became rapidly organized. SEM analysis showed mesenchymal-like cells extending their processes into the pores of the anodically oxidized surface. qPCR demonstrated significantly higher 18S around anodically oxidized screws and in the surrounding tissues. Alkaline phosphatase (osteoblast marker), TRAP and Cathepsin K (osteoclast markers) mRNA, but not the inflammatory markers (TNF-alpha and IL-1beta) were expressed at different levels around the two surfaces.

Conclusions: The results demonstrate that the experimental model and qPCR provide interesting possibilities to analyze the mechanisms of osseointegration. Furthermore, remodelling and in particular the molecular processes occur at implant surfaces *in vivo* already 3 days after implantation.

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Histologic evaluation of two bone substitute material for bone regeneration

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Aim: Regeneration approaches are increasingly attentioned in the scope of periodontal and implant therapies. The main objective of present study, is the evaluation of quality, density and thickness of newly forming bone in experimental defects treated with anorganic bovine bone mineral (Bio- oss®) and Bio apatite- collagen (Biostite®).

Materials and methods: Fifteen identical cuboidal defects were prepared in the alveolar edentulous mandibular ridges in 10 male sheep.

Defects were randomly assigned for treating with Bio- oss®, Biostite®, or remained unfilled (control group).

In these three groups of defects, differences in the extent and features of healing were histologically examined 6 months later.

Results: The mean percentages of Bone regeneration in Bio- oss®, Biostite® and control group were 51.40 ± 3.57%, 27.66 ± 4.18% and 19 ± 1% respectively ($P < 0.05$). Defects filled with Bio- oss and control defects didn't show foreign body reaction, while Biostite particles had such a reaction in 40% of specimens. Trabecular thickness and type of new regenerated bone were also significantly different between Bio- oss and Biostite ($P < 0.05$) and control group ($P < 0.05$).

Conclusion: The results of present study suggest that implantation of Bio- oss® particles can promote bone regeneration process, more effective than Biostite and both materials were more promising than remaining defects unfilled.

Key words: Bone regeneration, Histomorphometric analysis, Bio- oss®, Biostite®

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Histologic evaluation of Bio-Oss and Beta-TCP in defects of rabbit calvarium

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Objective: The aim of Present study is the histologic comparison 'between anorganic bovine bone (Bio-Oss) and Beta-Tricalcium Phosphate (Bioresorb, Beta-TCP) in the healing of experimental defects in rabbit calvarium.

Methods: Six white New-zelandian male rabbits were selected and with surgery 3 defects were created in their calvarias (total 18 defects). In six of defects Bio-Oss, six of them Beta-TCP and in the other six no biomaterial (negative control) were used. After one month, cases were sacrificed and the histologic sections were provided for the evaluation of: amount of inflammatory infiltration, type of new forming bone and Vitality, Percentage of residual biomaterials and foreign body reaction, thickness of trabeculla and percentage of new bone formation.

Results: The new forming bone in all of the groups were vital and the combination of woven and lamellar types. There are no significant differences between groups in the presence of foreign body reaction and thickness of trabeculla. Amount of inflammatory infiltration in Beta-TCP group was greater than the other groups. (Statistically significantly greater than negative control).

Mean percentage of residual biomaterial were 24.2% and 36.5% in Beta-TCP and Bio-Oss groups, respectively. There is no significant difference (P value > 0.05).

Mean percentage of new bone formation were 14%, 30.83% and 16.83% in negative control, Beta-TCP and Bio-Oss groups, respectively. There are on statistically significant differences (P value > 0.05).

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In vitro human osteoclasts formation and activity on bone graft materials

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To date, the majority of studies on biomaterials have investigated their regenerative properties in both *in vitro* and *in vivo* models. However, little is known about their resorption; it is believed that the ideal biomaterial for bone regeneration must be completely resorbable. This study aimed at defining whether human osteoclasts could be formed and activated on bone substitute materials.

Peripheral blood mononuclear cells from healthy volunteers were used to generate osteoclasts *in vitro* in the presence of M-CSF and RANKL on bovine bone slices (positive control), Bio-Oss®, a new screwable block prototype (Geistlich, Wohlhusen, Switzerland) and Osteoplant® (Bioteck S.r.l., Arcugnano, Vicenza). Osteoclasts morphology and activity were assessed using different complementary approaches.

Light and confocal microscopy revealed the formation of human osteoclasts on all the substrates after 21 days in culture. Osteoclasts appeared well spread and they exhibited positive staining for F-actin and vitronectin receptor as assessed by confocal microscopy. Furthermore differences in the number of osteoclasts generated on such substrates have been detected by TRACP5b-ELISA, which measures the amount of type 5b acid posphatase specifically secreted by mature osteoclasts in culture supernatants.

Osteoclast activity was detected on these substrates by the presence of resorption pits, observed by immunofluorescence staining for type-I collagen. This was also assessed by reflective microscopy.

The present work is the first report of human osteoclasts being generated, attaching and resorbing these substrates. Moreover this study brings new insights into the understanding of biomaterials resorbability, and can be used as a system to study bioresorption and compare resorption rates of various biomaterials.

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Titanium and zirconium nitrides used for coating of chromium cobalt alloy

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Technically pure titanium or its alloys are frequently used in recent dental implantology. The aim of our research was to improve the technological processing of a chromium cobalt alloy as well as biological characteristics of the material. To achieve it, we coated a chromium cobalt alloy with a surface layer of biomaterials titanium nitride (TiN) and zirconium nitride (ZrN). The basal material was a casting from chromium cobalt alloy (Co-Cr-W, relative shares of 60.5/28/9%). The surface was finished to reach a roughness of

0.25–0.35 micrometers. Then, the surface was coated with biomaterials TiN and ZrN using the technology of physical vapour deposition (PVD). Finally, several biological (recommended by Federation Dentair International) and physical tests were applied to evaluate characteristics of the coating materials. The results obtained from cell growth, cell dilation, and cell adherence tests, as well as toleration of materials test, test of induction of chromosomal aberrations, and induction test of atypical mitosis confirmed no negative effects compared to control. Mechanical and physical tests showed 2–3 times higher hardness and 3 times higher elasticity of 1.4 micrometer thick TiN/Zr layer compared to a 4.2 micrometer thick pure titanium layer. Test of chemical stability of coated alloy revealed that ZrN coating reduced significantly number of Co ions released from alloy after 60 d treatment in physiological solution.

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Assessment of treated titanium surfaces for enhancing cell gingival attachment

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Objective: Since the principal concern for dental implant success is associated with maintenance of cell adhesion, it is crucial to evaluate all aspects in the process of focal adhesion. The primary purpose of the present study was to assess material capability to promote human gingival activity with respect to cell spreading, viability and protein expression of vinculin and $\alpha_6\beta_4$ integrin.

Materials and methods: A total of three surface-modified titanium discs were investigated. Polished surfaces (Ti-MALP), were used as a control and compared with bioactive alkali etched (Ti-Bio surface, Lasak, Ltd.) and bioglass sputtered (Ti-BG) surfaces. Cell studies were performed using ATCC CRL-2014 human gingival fibroblasts. Viability was measured using a colorimetric WST-1 assay. Fluorescence staining was used to quantify spreading and to visualize vinculin, actin and nuclei. A cell-based ELISA technique quantified vinculin and $\alpha_6\beta_4$ integrin expression levels.

Results: Findings obtained with the WST-1 assay indicated that cells on Ti-BG exhibited significant greater viability during the course of the study compared to the remaining groups. Fluorescence microscopy revealed elevated cell spreading capability on Ti-BG and Ti-MALP compared to Ti-Bio. In contrast, vinculin and $\alpha_6\beta_4$ integrin expression was advantageous on Ti-Bio surfaces compared to Ti-BG and Ti-MALP surfaces.

Conclusions: The present study revealed that each surface modification allowed fibroblast attachment with the greatest cell spreading on Ti-BG, and Ti-MALP surfaces. Provided that an increased vinculin and $\alpha_6\beta_4$ integrin expression reflects the material efficiency to improve cell attachment, Ti-BG as well as Ti-Bio surfaces may represent recommendable implant surfaces for clinical application.

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In vivo human platelet behaviour on titanium surfaces

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In vivo Human platelet behaviour on different titanium surfaces

As described in the recent literature, secondary bone healing at implant interfaces is the evolution of the peri-implant blood cloth: the aim of this work was to study the behaviour of human platelets, *in vivo*, in the earliest phases of this process, that is the beginning of the blood cloth, as a function of surface topography of titanium implants. Experiments were performed by placing titanium cylinders into dental sockets immediately after the extraction of the teeth, for selected time (1 or 2 min); samples were then extracted, rinsed and fixed, then observed by Scanning Electron Microscopy. Parameters taken into consideration were the degree of platelet activation, as evaluated by spreading and morphological changes, and the building up of the fibrin network. Three different groups of samples were tested, bearing the following surface topography: machined; acid etched according to the double-acid-etching (DAE) technique; plasma sprayed. Experiments were performed in 20 patients, 24 cylinders were examined.

In general, the observation of the platelets behaviour on the different surfaces was in good agreement with *in vitro* findings by Davies and coworkers, but ***in vivo the activation time is of about one minute only.*** Platelets on DAE surfaces were more activated than those on machined surfaces, and the clinical osteointegration was the expected one. These results agree with recent theories that suggest that, in the absence of unexpected disturbing factors, clinical effects are precociously determined by the onset of blood cloth formation.

Mortara Remo
Morra Marco
Cassinelli Clara

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Human alveolar bone cell proliferation and expression of osteoblast phenotype on porous titanium

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Titanium (Ti) surface modifications have been proposed to improve its biological properties without affecting mechanical features. Recently, a novel powder metallurgy process for constructing porous Ti has been developed. This study aimed at investigating

the influence of porous Ti on osteoblastic cell response. Porous Ti discs (10 × 2 mm) were fabricated with pore size typically between 50 and 400 μm and porosity of 60%. Osteoblastic cells obtained by enzymatic digestion of human alveolar bone were cultured under osteogenic conditions until subconfluence. Cells were subcultured (2×10^4 cells/disc) on porous and machined Ti. Cell proliferation was evaluated at days 3, 7, and 10 using MTT assay. At days 7 and 10, total protein content and alkaline phosphatase (ALP) activity were measured by colorimetric assays. Real-time PCR was used for evaluating gene expression of the osteoblast markers type-I collagen (COL), ALP, and Cbfa1/Runx2 at day 7. Experiments were carried out at least in triplicate and data compared by Mann-Whitney test. On all evaluated periods cultures grown on porous Ti exhibited increased cell proliferation and total protein content, and reduced ALP activity, at most in 7 days (2.9, 1.7, and 4.7 fold, respectively). Gene expression of COL, ALP, and Cbfa1/Runx2 was reduced in cultures grown on porous Ti compared to machined one (2.8, 106.2, and 2.4 fold, respectively). These results indicate that porous Ti favours cell growth events such as proliferation and protein synthesis and inhibits expression of the osteoblast phenotype as observed by reduced ALP activity and gene expression of COL, ALP, and Cbfa1/Runx2.

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Effect of type I collagen-coated titanium surface on human osteoblastic cell adhesion, proliferation and differentiation

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Titanium (Ti) surface modifications have been produced by physicochemical, morphological and biochemical methods in an attempt to accelerate/enhance osseointegration. Among biochemical modifications, a type I collagen coating, covalently linked to a surface-grafted polyacrylic acid layer on Ti (ColTi) has been developed. The aim of this study was to evaluate the effect of ColTi on human osteoblastic cell behavior. Discs of Ti (10 × 2 mm) were polished with SiC papers in the sequence 280–600 and type I collagen was covalently linked to the Ti surface. Human alveolar bone cells obtained by enzymatic digestion were cultured in osteogenic condition until subconfluence. First passage cells were cultured (2×10^4 cells/disc) on ColTi and untreated Ti samples. For cell adhesion assay, adherent cells were enzymatically released at 4 h and counted. Cells were counted at days 1, 3, 7, and 10 for proliferation assay. At day 7, alkaline phosphatase (ALP) activity was measured by colorimetric assay. Bone-like formation was stained by alizarin red at 21 days and examined by colorimetric assay. Experiments were carried in quintuplicate and data compared by Mann-Whitney test. Cell adhesion ($P = 0.67$) and bone-like formation ($P = 0.17$) were not affected by ColTi. Cell proliferation on days 7 ($P = 0.03$) and 10 ($P = 0.02$) and ALP activity ($P = 0.02$) were increased by ColTi compared to untreated Ti. Our results indicate that colTi enhances intermediary osteoblastic cell events such as proliferation and ALP activity without affecting initial and final events as demonstrated by no significant differences in cell adhesion and bone-like formation between ColTi and untreated Ti.

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Effects of growth factors and serum proteins on human osteogenic cell cultures grown on a machined titanium surface

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Platelet rich plasma has not been demonstrated to enhance bone formation under experimental conditions, even though beneficial clinical results have been reported. This study aimed to evaluate the effects of a mixture of growth factors (GFs) and serum proteins that is typical of platelet extracts on *in vitro* osteogenesis on titanium (Ti). Osteoblastic cells were obtained by enzymatic digestion of human alveolar bone fragments and cultured under osteogenic condition until subconfluence. Cells were subcultured (2×10^4 cells/well) on machined Ti discs up to 14 days. Cultures were exposed during the first 7 days to osteogenic medium supplemented with 27 ng/ml PDGF-BB, 22 ng/ml TGF-β1, 15 ng/ml TGF-β2, 3.7 μg/ml albumin, 2 μg/ml fibronectin, and 0.5 μg/ml thrombospondin, and to osteogenic medium alone thereafter. Control cultures were grown on osteogenic medium alone. At days 7 and 14 direct fluorescence for detecting actin cytoskeleton and cell nuclei revealed that cultures exposed to GFs + proteins exhibited higher number of adherent cells. GFs + proteins cultures showed a weak ALP labeling intensity at day 7 and no Alizarin red-stained bone-like nodules at day 14. At day 7, total cell number was 8.5 ± 2.1 for the control cultures and 24.3 ± 5.1 for the treated group ($n = 4$; Mann-Whitney, $P < .05$); treated cultures exhibited significantly reduced levels for ALP activity (3.7 ± 0.8; for control, 55.9 ± 8.3; $n = 5$, Mann-Whitney, $P < .05$). The present results demonstrated that a mixture of GFs and serum proteins may affect human osteogenic cultures, leading to an increase in the cell population and a reduction in the differentiation process.

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Toxicity in miniature pigs after intravenous application of alizarin complexone

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Fluorescent labels (fluorochromes) incorporated in calcifying tissue provide time marks in the study of growth, turnover and repair of bone and dentin. This clinical case report describes the difficulties,

which appeared after the intravenous administration of the fluorochrome alizarin complexone in miniature pigs. Polychrome sequential labeling was applied to analyze the ossification because this method offers a dynamic picture of the time sequence in bone turnover. On this account eight female miniature pigs received three different fluorochromes intravenously in certain time sequences after augmentation of the upper and lower jaw. Whereas the administration of the former fluorochromes was unproblematic, the intravenous injection of alizarin complexone implicated many difficulties. All probands reacted to the administration of alizarin complexone with shock symptoms and two of them deceased acute. From the findings of the present study we discourage from the intravenous administration of alizarin complexone in miniature pigs and give advice to choose different fluorochromes for polychrome sequential labeling. If it is not possible to renounce the utilization of alizarin complexone, the administration should occur intramuscular respectively intraperitoneal.

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Fracture strength of different temporary abutments

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Objectives: This study compared the fracture strength of PEEK (Polyetheretherketones) titanium temporary abutments (PTT-abutments) and solid titanium temporary abutments (STT-abutments).

Methods: Standard composite crowns (N = 30, 10 per group) were made using a mold of a maxillary incisor. The aesthetic PTT-abutments (SynOcta temporary meso abutment Titanium/PEEK Straumann) were trimmed with a diamond bur to fit the mold (group 1). The STT-abutments (Straumann SynOcta temporary meso abutment, group 2), (Nobel Biocare, group 3) did not need correction to fit the mold. After filling with highly filled indirect composite (Solidex), the restorations were polished and screwed on an implant (Straumann Standard Plus Ø 4.1 mm Regular Neck for group 1, 2) (Nobel Replace Tapered Groovy Ø 4.3 mm for group 3) mounted in PMMA (Palapress, Heraeus Kulzer). The screw hole was closed with composite (Quadrant anterior shine).

After thermocycling the specimens were tested in a universal testing machine where the load was applied from the incisal direction at 137°(1 mm/min).

Results: Significant differences were found between the 3 groups ($P < 0.01$) (one way ANOVA). While PTT-abutments showed mean fracture strength of 94 ± 23N, STT-abutments revealed 624 ± 14N (Straumann) and 993 ± 86N (Nobel Biocare). Failure analyses showed cohesive fracture of the PEEK-titanium interface for group 1 while deformation of the implant neck caused failure in group 2 and 3.

Conclusion: PTT-abutments showed a significantly lower fracture resistance compared to STT-abutments.

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Biomechanical and histomorphological results of hydrophilic surface modification

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The use of osseointegrated dental implants is a predictable and successful treatment method for functional restoration of the endentulous patient. A satisfactory clinical outcome relies on primary stability for load bearing immediately following implantation. This requires mechanical anchorage and osseointegration within a short healing time. While the geometric design of an implant contributes towards mechanical stability, the nature of the implant surface itself is of critical importance for achieving solid osseointegration [Albrektsson, 1981]. The most important surface properties are topography, chemistry, surface charge and wettability.

In the present study, titanium dental implants with the same geometry, but with two different surface treatments, were tested. The osseointegration and the removal torque were compared after 2 weeks of implantation. The first surface treatment was sandblasting and acid etching, the second treatment was sandblasting and acid etching with an additional weak alkaline rinsing.

Implants were inserted in the pelvis of sheep, a location which provides relevant bone structure while allowing comparative testing of many implants in one animal. Per group, 6 implants were used for the biomechanical evaluation and 6 implants for histomorphometric evaluation. Following sacrifice, macroscopic, radiographic and histomorphometric examinations were conducted. Removal torque measurements were performed on the day of sacrifice.

All dental implants were well integrated at the time of sacrifice. There were no significant differences observed in removal torque values between the investigated surfaces. However, for the hydrophilic modified implants, there was a trend towards better results for both the histological and biomechanical evaluation, compared to the unmodified surface.

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Histomorphometric analysis of different type immediate loaded implants in human

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The immediate loading of implants appears to be viable treatment option in the edentulous mandible. Some reports have shown favourable histologic results. Various designs of implant & prosthetic components are recommended by different manufacturers for immediate loading of implants.

It seems to be possible to use different root form implants for immediate loading. Though histomorphometric studies in animals & also in humans have been done for some implant systems, a few showing remarkable results, it is not possible to extrapolate these results to other implant designs.

In this study, implant with US-II implant (Osstem, Korea) was compared with GS-II implants (Osstem, Korea). 12 implants were placed and 10 of 12 implants (1 GS-II test implant, 1 US-II test implant and other 8 GS-II implants) immediately loaded. After 4 months, 3 implants (US-II test, GS-II test, GS-II control) were retrieved with a trephine. Histomorphometrical study is done. Inflammatory response and coronal bone loss could not be observed on both implant specimens. BIC was 70.02% on US-II implant and 82.96% on GS-II implant, but this difference was not statistically different. Bone volume was 67.73% on US-II implant and 65.63% on GS-II implant, but this difference was not statistically different.

Implant design modification and implant surface treatment can affect bone responses in immediate loading of implants. Maybe these developments could lead to favourable bone responses. However, more prospective studies and randomized controlled trials are needed.

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The effect of heat treatment on the dissolution characteristics of synthetic hydroxyapatite

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Purpose: The aim of this study was to prepare a synthetic, porous bone regeneration material based on hydroxyapatite and to determine the effect of heat treatment on the dissolution mechanism using in-vitro static tests.

Materials and methods: The synthetic porous bone regeneration material based on hydroxyapatite powder was prepared by the reaction of aqueous solution calcium hydroxide and phosphoric acid. The HA granules were sintered at 700 and 1200°C. The two sizes of the granules were prepared (0.16–0.3, 1–2 mm). The tests were carried out using unheated and heated HA granules. The initial pH of the corrosion medium was 3.

X-ray diffraction (XRD), scanning electron microscopy (SEM), krypton adsorption (BET), mercury porosimetry and chemical analysis were used to characterize the precipitate.

Results: XRD patterns suggested that the material was hydroxyapatite (PDF database card 9-342) with low crystallinity. The micro pore size of the HA granules was less than 1 um and the specific surface area of the unheated HA granules reached 60 [$m^2.g^{-1}$]. The specific surface area decreased with increasing sintered temperature. At the beginning of the interaction for the unheated and the heated HA granules the leaching of Ca^{2+} and $(PO_4)^{3-}$ was observed. After 20 h of exposure the ion concentrations were stabilized. The dissolution rate decrease can be caused by the solution saturation with respect to hydroxyapatite.

Conclusions: A synthetic, porous hydroxyapatite material with high surface was prepared by the developed preparation method. The heat treatment proved to have significant effect on the dissolution process.

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Osteogenic capacity of periosteum-derived cells on different titamium surface topography

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Objectives: This study determined osteogenic properties of the periosteum-derived cells responding to different titanium surface topographies.

Methods: Two different titanium surfaces were prepared by either machining or acid-etching of commercially pure titanium disks. Cells extracted from the rat femoral periosteum were cultured on these titanium disks in the osteogenic media. Cell proliferation was evaluated using hematocytometer. The osteoblastic phenotypes were assessed by alkaline-phosphatase (ALP) activity and reverse transcriptase-polymerase chain reaction (RT-PCR) for the representative bone-related genes and alizarin red mineralized nodule stain.

Results: The number of the cells was 150% and 100% greater on the machined surface than on the acid-etched surface at days 2 and 5, respectively ($P < 0.001$). The gene expression of collagen I, osteopontin and osteocalcin was generally upregulated on the machined surface compared to the acid-etched surface, by a factor of 2 at least one time point during the culture period (day 3, 7 or 14) for all of the three genes. The ALP positive area measured at day 7 and alizarin red positive area measured at day 21 were approximately 2.5 times greater for the machined surface than for the acid-etched surface.

Conclusion: The osteoblastic cells derived from the rat femoral periosteum showed more osteogenic potential on the machined titanium surface than on the acid-etched surface, which seemed to be different from the current understanding regarding the interaction of titanium surface topography and bone marrow derived-osteoblasts.

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Noble metals as new antimicrobial and biocompatible coatings

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Background: Next generation of implant surfaces has to meet different local and systemic conditions potentially compromising the process of soft tissue tolerance and osseointegration. One of the factors implicated in implant loosening is infection.

New nano-structured coatings, based on noble metals (Ag, Au, Pd), have previously shown good antimicrobial and biocompatible effect. The aim of this study was to screen coatings with different metal ratios with regard to cell viability and inflammatory response *in vitro* and *in vivo*.

Materials and methods: Nine different Ag-Au-Pd coatings on silicone (PDMS) disks were incubated with normal human dermal fibroblasts for 24 and 72 h. Cellular viability, adhesion and transforming growth factor-beta (TGF-beta) production were analyzed. Four coatings were implanted subcutaneously in a rat model for 1, 3 and 21 days. Inflammatory cell recruitment, viability, production of TGF-beta and monocyte chemoattractant protein-1 (MCP-1) measurements and capsule morphometry were performed. Ag-coated and uncoated PDMS were used as controls.

Results: *In vitro* results showed high cellular viability and activity (TGF-beta production) on all coatings. All six materials showed high cell viability when evaluated *in vivo*. Inflammatory cell recruitment and the amounts of MCP-1 were initially elevated, but decreased markedly within 3 days. TGF-beta production was low at all time points, indicating low fibroblastic potential of the coatings.

Conclusion: Our studies showed that Ag-Au-Pd coatings induced low inflammatory and fibroblastic response *in vivo* and are now awaiting further evaluation in bone.

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Enhanced contact osteogenesis on a nanostructured titanium implant surface

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Controlled chemical oxidation of titanium (Ti) with H_2SO_4/H_2O_2 generates a nanotopography that supports enhanced in vitro osteogenesis (de Oliveira et al., J Biomed Mater Res A, 80:554–564, 2007). The aim of the present study was to evaluate whether this chemical treatment can also influence early stages of bone repair adjacent to Ti implants. Screw-typed, machined Ti implants (Neodent Titamax, Curitiba, Brazil) were etched with a mixture of 10N H_2SO_4 and 30% aqueous H_2O_2 (1:1) for 2 h at room temperature. Mandibular premolars were extracted in 8 dogs and, after 12 weeks, 2 treated and 2 untreated implants were placed in each animal. At 3 and 8 weeks, the animals were sacrificed, and the implants with surrounding bone were harvested, fixed with formaldehyde and processed for embedding in LR White. Sections of bone with the implants, about 20 μm thick, were stained with Stevenel's blue and Alizarin red, and analyzed histomorphometrically for percentage of bone-to-implant contact (BIC) and of bone area between threads (BABT). The data were analyzed using two-way ANOVA. High resolution SEM confirmed that the etching process created a nanoporous surface. At 3 weeks BIC values were significantly higher for the treated implants compared with the control, untreated ones ($52.3 \pm 6.6\%$ vs. $35.6 \pm 15\%$, $P < .05$). The BABT values did not significantly alter for both groups. Etched surfaces clearly promoted contact osteogenesis at the cancellous bone level. These data indicate that controlled chemical oxidation of a commercial machined Ti implant surface enhances contact osteogenesis at an early period post-implantation.

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The role of collagen in establishing mineralized tissue-titanium interfacial strength

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The structure and compositions of bone-titanium interfacial tissue, and its contribution to the mechanical property of the integrated tissue to titanium remain unknown. Our previous studies suggested the relationship among collagen deposition, tissue mineralization and biomechanical property at the mineralized tissue-titanium interface. This study examined the role of collagen in establishing the mechanical resistance at tissue-titanium interface in relation to tissue mineralization. Rat bone marrow-derived osteoblasts were cultured onto titanium coated dishes. 1.0 mM of 3,4-dehydroproline to block collagen synthesis by suppression in prolyl hydroxylation was added to the culture for a 6-day treatment during early, mid or late culture stage. The adhesive strength at the mineralized tissue-titanium interface was analyzed by nano-scratch test. The amount of collagen deposition and the mineralizing property was evaluated by sirius red-based collagen colorimetry, RT-PCR, ALP stain, and alizarin red-based mineral quantification. ALP positive areas at days 7 and 14, and the total amount of collagen deposition at day 24 were significantly decreased in early block-culture than in untreated cultures. However, there were little differences in bone-related gene expression pattern and in mineralized nodule area at day 24 between untreated and early-block cultures. Nevertheless, the tissue delamination force at day 24 in early-block culture reached only 50% of that in untreated culture. There were no differences in the components and the biomechanical property of the mineralized tissue between untreated and late block-culture. Early blocking, but not late blocking, of collagen synthesis critically reduced the biomechanical property of the osteoblastic mineralized tissue-titanium interface.

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Microstructure on zirconia ceramic surface produced by ion beam sputtering

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Due to the attractive esthetics, biocompatibility and mechanical properties, bioinert zirconia ceramics are increasingly used for in the

high load-bearing sites such as dental implants. But they do not naturally form an osseo-integration due to their chemical inertness. Microstructure on the ceramic surface was developed with an ion beam sputter process through a thin film mask which exhibits low sputtering rates with the aim to improve the osseo-integration between bioinert zirconia ceramic and bone. The thin film masks covering ceramic surface were fractured to obtain a micro- or submicrocrack network. After sputtering, the network of cracks was transferred as a network of micro- and submicro channels. With this, relatively high aspect ratios for the microstructures can be obtained. Moreover, by filling the cracks with another material with a high sputter resistance, it was also possible to obtain the inverted network microstructure on zirconia ceramic surface.

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Effect of various arc ion platings on the titanium screws

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Statement of problem: A common problem associated with implant restoration is screw loosening by loss of preload. In an attempt to increase preload by reducing frictional coefficient, surface coating has been applied to the abutment screw.

Objectives: The purpose of this study was to evaluate the effect of coating treatment on screw joint stability.

Material and methods: In this study, 140 screws (Ti-6Al-4 V,cp-Ti grade3) of ExFeel® external hexed implant system (Megagen co., Korea) were prepared and divided into 4 groups.

Experimental groups were 1 μm TiN, TiCN, TiC coated screws by arc ion plating method and non-coated screws were used as a control group. The abutment screws were tightened with 32Ncm, and removal torque values and rotational angles were measured. And after the specimens were loaded to 250 N for 10,000 cycles, the variation of removal torque value were evaluated.

Results: In pre-test, rotational angles of coated screws were increased than those of non-coated screws, especially TiC-coated screw group had the largest value. Removal torque values were decreased in all coated screws ($P < 0.05$). The values of torque loss before and after fatigue test showed the smallest in TiC-coated screws, and the largest in non-coated screws ($P < 0.05$).

Conclusion: TiC-coated screws had low torque loss and high rotational angle because of its low frictional coefficient, which suggests that TiC coating increase joint stability of implant-abutment screw.

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Formation mechanism of TiO_2 nanotube anodized on the titanium surface

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State of problem: Many efforts to create a rough surface and enhance the osseointegration of dental implants have been made. Among these, anodizing process can be a method to form the titanium oxide film with nanotube structure.

Objectives: This study was performed to investigate the formation mechanism of titanium oxide nanotube by the anodic current and anodizing time in small amounts of fluoride-containing phosphoric acid electrolyte.

Material and methods: Commercially pure titanium in the form of disc with a diameter of 15 mm and a thickness of 1 mm was used. The anodizing procedure was carried out using a 20 direct current (DC) voltage which lasted about few seconds to 10 min. The structural and morphological changes of the titanium surface were observed with field emission scanning electron microscope.

Results: The pores were produced in few seconds. In constant potential, the morphology of the oxide layer was changed remarkably along with the anodizing time. The pores became deeper and combined with the side pore. And the pore diameter was increased with anodizing time and the nanotubes structure was formed with an irregular diameter. Under optimized anodizing condition, the well-ordered TiO_2 nanotubes were fabricated with 500 mm in length and 100 nm in diameter.

Conclusion: Titanium oxide nanotubes are expected to improve osseointegration and adhesion by increasing the surface area and the wettability of the implant.