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Implant Rehabilitation of Internal Root Resorption after Dental Trauma

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Abstract

Internal root resorption is a result of complex interaction of resorbing and inflammatory cells which are responsible for progressive destruction of intraradicular dentin along the middle and apical thirds of the canal walls due to osteoclastic action. It is a rare phenomenon that can manifest through a slow or rapid progression. If the IRR is extensive and the prognosis of endodontic treatment questionable, extraction of the tooth with socket preservation is recommended so that further complications can be avoided. After tooth extraction, a series of processes take place including scarring of the alveoli, with an inevitable three-dimensional loss of alveolar bone. Over the years many different techinques of socket preservation and socket grafting have been used, preserving the socket from collapse during normal healing process. A 20-year old female patient was referred by the endodontist to the Department of Oral Surgery, School of Dental Medicine, University of Zagreb because of a progressive internal root resorption of upper right lateral incisor and upper left central incisor. She reported trauma in the area of upper incisors in her childhood during playing with peers but without any further consequences until now. After analysing few different solutions, the patient agreed to have her teeth extracted with socket preservation and after healing period of 6 months for the implants to be placed in the extracted site. Dental implants (4.0 mm/12 mm for central incisor; 3.3 mm/12 mm for lateral incisor) were inserted in the positions of the missing teeth. The implants were loaded after 6 months with individual CAD/CAM made zirconia abutments with CAD/CAM made temporary acrylic crowns mainly for emergence profile modelling. Two lithium-disilicate crowns, supported with individual CAD/CAM zirconia abutments served as final restoration.

Keywords: Root resorption; Alveolar bone; Socket; Dental implant; Crown;

Introduction

Internal Root Resorption (IRR) is a result of complex interaction of resorbing and inflammatory cells which are responsible for progressive destruction of intraradicular dentin along the middle and apical thirds of the canal walls due to osteoclastic action. Main etiological factors are infection, traumatic injury (including mechanical, chemical or thermal injury) and orthodontic treatment [1]. It is a rare phenomenon that can manifest through a slow or rapid progression. At the initial stage patient might experience pulpitis, and at later stage due to pulp necrosis, periapical periodontitis might occur [2]. In some cases, IRR is asymptomatic and is detected by routine radiographic examination which reveals a round-to-oval radiolucent enlargement of the pulp space. Conventional radiographic examination provides a two-dimensional representation of a three-dimensional object, so it unable to reveal the thickness of remaining root. The introduction of Cone-Beam Computed Tomography (CBCT) in endodontics overcomes many limitations of the conventional radiography and provides more details about the nature and size of the resorptive defect [3]. Early endodontic treatment of this condition prevents further loss of tooth structure and potential root perforation. If the IRR is extensive and the prognosis of endodontic treatment questionable, extraction of the tooth with socket preservation is recommended so that further complications can be avoided [2].

After tooth extraction, a series of processes take place including scarring of the alveoli, with an inevitable three-dimensional loss of alveolar bone. The bone resorption occurs due to anatomic, metabolic and functional factors. First three months after extraction are characterized by unavoidable collapse of vertical and horizontal dimension of alveolar socket [4]. Over the years many different techinques of socket preservation and socket grafting have been used, preserving the socket from collapse

during normal healing process. Studies found that covering the grafted socket with a collagen membrane or soft tissue graft gave better results from the perspective of the bone formation amount than uncovered grafted sockets because the collagen membrane prevents soft tissue migration into socket and maintains the space [5-7]. Postextraction maintenance minimizes residual ridge resorption and, thus, allows implanto therapy that satisfies esthetic and functional criteria [7].

The aim of this case report was to describe implant rehabilitation of rapid internal root resorption of upper incisors after dental trauma.

Case report

A 20-year old female patient was referred by the endodontist to the Department of Oral Surgery, School of Dental Medicine, University of Zagreb because of a progressive internal root resorption of upper right lateral incisor and upper left central incisor. Patient did not notice any changes in teeth colour and did not have any symptoms. These lesions were noticed by her general dentist as a random finding after routine radiographic examination (Figure 1).

Figure 1: Initial condition before treatment.

On questioning, the patient denied any systemic disease or condition and reported no previous surgeries. A general physical examination was unremarkable. She reported trauma in the area of upper incisors in her childhood during playing with peers but without any further consequences until now. Sensitivity test of upper right lateral incisor and upper left central incisor was negative and the patient was referred to endodontist. CBCT scans were made and revealed that both incisors had extensive root perforation (Figure 2). Clinical examination showed grade I teeth mobility in the horizontal direction tested by manual palpation, with mild tenderness to percussion and periodontal probe revealed defect in bone and teeth structure. Endodontist carefully analysed CBCT scans and decided that further endodontic treatment had poor prognosis. The patient was briefed regarding situation and suggested a treatment plan. After analysing few different solutions, the patient agreed to have her teeth extracted with socket preservation and after healing period of 6 months for the implants to be placed in the extracted site.

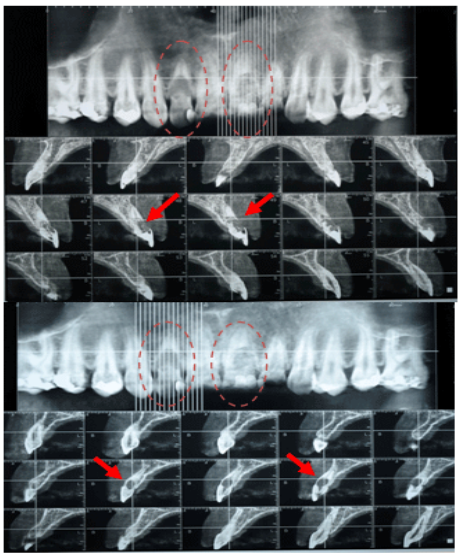

Figure 2:CBCT scans.

In accordance with the ethical protocol of the School of Dental Medicine, University of Zagreb, Croatia, written consent was obtained from the patient before surgery. First, regional nerve block anesthesia (4% articaine with epinephrine 1:200 000; 3.6 mL) was administered. The minimal invasive envelope mucoperiosteal flap was made, and the teeth were extracted using piezosurgery (Piezomed, W&H, Bürmoos, Austria) to preserve the surrounding bone (Figure 3). Finally, a upper forceps was used to remove the teeth without trauma. There was a labial bone defect in the region of left central incisors after extraction. All inflamed soft tissue was removed (Figure 4). Using a perioosteal elevator the gingiva around the defect was reflected for placement of the collagen membrane (Jason membrane, Botiss, Berlin, Germany). It was shaped to cover the labial bone defect and placed above the bone and below the gingiva. Part of the collagen membrane remained outside the socket to cover the socket after bone graft placement in order to prevent soft tissue migration into socket. Alveolar socket was filled with bovine material (Cerabone, Botiss, Berlin, Germany) which was mixed with saline and applied in layers until the whole defect was covered (Figure 5). The exposed part of the membrane was flipped underneath palatal mucosa and sutured with 4-0 resorptive suture. Alveolar socket of the right lateral incisor did not have labial bone defect so it was filled using bovine material and covered with collagen sponge (Jason fleece, Botiss, Berlin, Germany) and sutured with 4-0 non-resorptive suture (Figure 6).

After 2 weeks, two temporary Fiber Reinforced Composite (FRC) bridges were made directly in the mouth of the patient using the crowns of the extracted teeth which where bonded without the preparation of the neighbouring teeth. First, the roots were removed from the extracted teeth using diamond drills under water cooling and all defects due to IRR were closed using composite resin material (G-aenial AO3, A2 and A3). Small

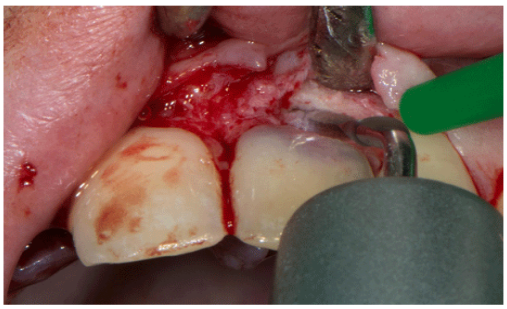

Figure 3: Minimally invasive extraction using piezotome.

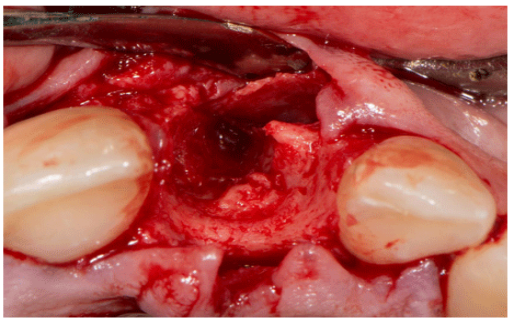

Figure 4: Post extraction socket of left upper central incisor

Figure 5: Alveolar socket filled with bovine material.

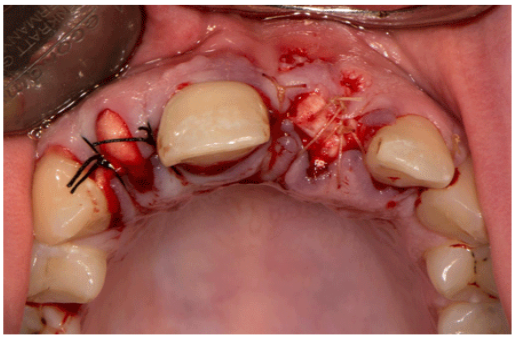

Figure 5: Alveolar socket of upper lateral incisor filled with bovine material and covered with resorbable collagen sponge.

horizontal preparation 3 mm deep and 3 mm wide was done on the palatal surfaces of the prepared crowns and standard adhesive procedure was performed (acid etching of the enamel for 10 s, rinsing for 10 s, drying, application of G-aenial Bond-GC, Tokyo, Japan and polymerization according to the instruction of the manufacturer). One half of the mesio-distal distance of the palatal surfaces of the neighbouring teeth were etched with 37% orthophosporic acid for 60 s, rinsed, bond was applied (G-aenial Bond, GC) and polymerized according to the instructions of the manufacturer. Small amount of flowable composite resin material (G-aenial Universal Flo A3, GC, Tokyo and Japan) was applied on the palatal surfaces of the neighbouring teeth and in the palatal preparations of the prepared crowns. EverStick C&B (GC, Tokyo, Japan) fibers were used to attach the crowns to the neighbouring teeth which were polymerized in the correct position while holding the crowns and pressing the fibers to the palatal surfaces using hands while wearing latex free gloves. After polymerization, the fibers were covered with a thin layer of flowable composite (G-aenial Universal Flo A3, GC) which was again polymerized and afterwards, occlusion and articulation was checked and adjusted. The final result is shown in (Figure 7).

After 6 months, the patient came back for a recall and for further implant prosthetic therapy. A crestal incison under local anesthesia was performed to expose the crestal bone. Dental implants (4.0 mm/12 mm for central incisor; 3.3 mm/12 mm for lateral incisor) were inserted in the positions of the missing teeth (Aadva, GC, Tokyo, Japan) according to the bone drilling protocol recommended by the manufacter (Figure 8). The implants had very high primary stability and the flap was sutured with 4-0 silk suture. The patient was instructed about postoperative oral hygiene and the sutures were removed ten days after surgery.

Figure 7: Temporary Fiber Reinforced Composite (FRC) bridges.

Figure 8: X-ray after dental implants insertion.

Figure 9: Photograph of the temporaries

Figure 10: Final restoration with two lithium-disilicate crowns.

The implants were loaded after 6 months with individual CAD/CAM made zirconia abutments with CAD/CAM made temporary acrylic crowns mainly for emergence profile modelling (Figure 9). Two months later, final impression was taken with preserving emergence profile contour in impression. Two lithium-disilicate crowns (e.max, Ivoclar Vivdaent, Schaan, Liechtenstein), supported with individual CAD/CAM zirconia abutments served as final restoration (Figure 10).

Discussion

Dentistry is evolving into the modern era, so biological processes affecting alveolar bone have to be done using procedures with predictable and successful results. Osseointegration and tissue augmentation are in the focus of modern implant therapy and patients are expecting high quality dental care [8]. The dimensional changes in the post extraction socket result in bone loss in both horizontal and vertical dimensions. Socket preservation is approved by many cases presented in the literature and in the majority of these cases reported that Guided Bone Regeneration (GBR) procedure are unable to prevent resorption, it may only reduce biological dimensional changes of the alveolus [9].

In this case report, we combined socket regeneration for left central incisor and socket preservation for right lateral incisor. In the recent literature most procedures for socket regeneration are done with full raised flap with releasing vertical incision and exposure of complete surgical field. Disadvantages of full raised flap are tension, decreased amount of keratinized tissue and wound dehiscence [10]. Tarnow et al. invented „ice cone“ technique for thin alveolar bone with bone defect [11]. Advanced technique include using bone block or novel material for bone grafting. It is recommended to use an absorbable or non-resorbable membrane to preserve the width of alveolar socket, and using the membrane is more important than the filler to prevent a penetration of soft tissue into the graft. There is a wide range of barrier membranes which have been used over the years as collagen, polyglycolic acid, poly¬tetrafluoroethylene (ePTFE) and polyglactin 910. When using membrane, the total amount of vital bone is not lost [12]. Our treatment was planned in accordance with the scientific evidence found in the literature [10, 12]. We tried to be conservative in our surgical approach, without full flap reflection. Collagen membrane was inserted in the limited space between mucogingival tissue and alveolar bone. This procedure can minimize bone resorption, but not eliminate it, so some resorption was found in the region of upper lateral incisor where initally we did not use collagen membrane because there was no labial bone defect immediately after extraction.

Shakibaie et al. demonstrated an indisputable need for socket preservation if delayed implant placement is planned [13]. It was shown that 6 out of 10 patients who did not receive socket preservation needed some kind of augmentation before implant therapy, while 1 out of 10 who did receive preservation therapy needed guided bone regeneration [13]. In this case, the treatment included preservation and delayed implant placement to avoid subsequent treatment.

Socket preservation techniques are mostly focused on prevention of ridge collapse while dimension and contour of soft tissues have been paid less attention. Adequate keratinized gingiva is important for the long term survival of an implant. Labial keratinized attached gingiva is positioned to coronal aspect to prevent the exposure of the membrane. If there are some complications as lack of adequate keratinized gingiva on the labial side of the implant, the coronal displacement of the mucogingival line and decreased vestibular depth, resulting from decreased width of keratinized gingiva, there is a need for corrective surgery [14]. Soft tissue augmentation is very susceptible procedure with great results as an answer to esthetic challenge. Control of plaque, restorative manipulation, protection from bacterial invasion, maturation of soft tissue and maintenance of oral hygiene around implant supported crowns are enhanced with enough keratinized tissue around it. Rehabilitation of soft tissue after tooth extraction is default method today in modern implantology along with hard tissue reconstruction [15]. Soft tissue in this case was preserved with crestal incision during regeneration procedure and implant placement and shaped with temporary FRC bridges.

Volume of healthy bone is predominant factor of successful dental implant therapy. If the implant is inserted in the thin crestal ridge, results are not predictable. Bone resorption in a socket with labial dehiscence can be reduced using presented technique of guided tissue regeneration which are performed during extraction procedures. The presented case showed the possibility to simultaneously reconstruct hard and soft tissue while fulfilling high esthetic demands.

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