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Prevalence and Topology of Pain in Professional Male and Female Tennis Players

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Original scientific paper

Abstract

The aim of this paper was to determine and explain the prevalence and topology of pain in professional tennis players. In accordance, 42 male and 38 female tennis players, who participated in the ITF tournament in Turkey (Antalya, 2012) filled out a modified SEFIP questionnaire, which was constructed with regard to the specificities of tennis. More precisely, male and female tennis players evaluated pain intensity for each of the 14 body parts on a Likert-type scale from 0 to 4. The results show that in male tennis players, 92.1% of subjects have experienced pain of average intensity of 1.60 in one or several body regions. On the other hand, 91.7% female tennis players reported pain of average intensity of 1.59. The highest incidence of pain was reported in the lower back area, both in male and female tennis players. Regardless of the gender, a relatively high sum of intensity was reported for shoulder, wrist and knee pain, and somewhat lower for elbow pain. A high sum of pain intensity in the upper back is the specificity of tennis players. By analysis of differences, it has been established that female tennis players had a significantly higher sum of pain intensity in the upper and lower back areas, as opposed to male tennis players. In conclusion, gathering information about pain incidence should be just the first step towards the goal – prevention, i.e., reducing the number and gravity of tennis injuries.

Key words: **pain topology, pain intensity, tennis**

Sažetak

Cilj ovog rada bilo je utvrđivanje i objašnjenje učestalosti i topologije boli profesionalnih tenisača. U skladu s ciljem, 42 tenisača i 38 tenisačica, sudionika ITF turnira u Turskoj (Antalya, 2012. god.) je popunilo modificirani SEFIP upitnik koji je konstruiran uvažavajući specifičnosti tenisa. Preciznije, za svaki od 14 dijelova tijela tenisačice i tenisači su procjenjivali intenzitet boli na Likertovoj skali od 0 do 4. Rezultati pokazuju da kod tenisača, 92.1% ispitanika osjeća bol u jednoj ili više regija tijela prosječnog intenziteta 1.60. S druge strane, kod tenisačica 91.7% ispitanica su prijavile bol prosječnog intenziteta 1.59. Kod tenisačica i tenisača najveći zbroj intenziteta boli prijavljen je u području donjeg dijela leđa. Neovisno o spolu, prijavljen je relativno visok zbroj intenziteta boli u ramenu, zglobu šake, koljenu i nešto manje laktu. Specifičnost tenisačica je velik zbroj intenziteta boli u gornjem dijelu leđa, što kod tenisača nije slučaj. Analizom razlika utvrđeno je da tenisačice imaju značajno veći zbroj intenziteta boli u odnosu na tenisače u gornjem i donjem dijelu leđa. Zaključno, prikupljanje informacija o pojavi boli treba biti samo prvi korak u prema cilju – prevenciji, odnosno smanjenju broja i težine ozljeda u tenisu.

Ključne riječi: **topologija boli, intenzitet boli, tenis**

Introduction

Analysis of incidence of injuries and detection of factors which cause them is certainly a distinct goal of kinesiological and medical scientific research in sports (Pluim et al., 2006; Ellenbecker et al., 2002). Progressive increase of the extent of training and number of competitions, which represent the demands of contemporary professional sports, cause increasingly frequent exposure of muscle groups to microtrauma, and acute, even chronic injuries in time (Bahr & Bahr, 1997). In tennis, most injuries happen as a consequence of overexertion of tendons and ligaments due to numerous repetitions of movements and hitting with maximum power and speed (Fernandez et al., 2006). Consistent with the biomechanical motion complex which is characteristic to tennis, the most frequent injuries in tennis are: rotator cuff injury – injury of tendons which suffer highest load during serve (shoulder injury), and injury of muscle tendons involved in hand extension during backhand, or injury of muscle tendons involved in hand flexion during serve and forehand stroke (tennis elbow). These are followed by injuries of the wrist, trunk and lower back, adductors, knee and ankle joint. It must be emphasized that tennis is a sport of unilateral loads, which means that right-handed people dominantly employ musculature of the right hand and right side of the body, and vice versa. Research studies (Bahr & Bahr, 1997) indicate that after the injury has occurred the first time, the chances are increased for the same injury to occur again, which further supports the importance of injury prevention among athletes. Besides a systematic everyday prevention programme which should be carried out, it is also important to have prompt and reliable feedback about the topology of pain, and based on this information, a professional expert team can take appropriate steps in order to reduce the risk of injury or its recurrence if it had already occurred. A simple, quick and

reliable way of gathering information about pain incidence is through questionnaires of verified metric characteristics. One of such questionnaires is the SEFIP (***S**elf-**E**stimated **F**unctional **I**nability because of **P**ain*), which has been used mostly among dancers. For the purposes of the present research, the questionnaire has been adapted for tennis.

It must be pointed out that some metric characteristics of the SEFIP questionnaire (Ramell et al., 1999) have been tested. SEFIP was constructed with the purpose of evaluating the incidence of pain in dancers, and has been used most frequently on this population. For the purposes of evaluating pain in dancers, the questionnaire was expanded to 14 body parts (Ramell et al., 1999; Miletić et al., 2009; Miletić et al., 2011). The shortcomings of these types of research were presented by Bahr (Bahr, 2009). The author suggested that the collection of data should be conducted on various occasions, by a valid and sensitive instrument which would take into consideration not only the incidence of pain, but the incidence of both pain and other important symptoms which might precede the injury. The author also suggested that, thereafter, the gravity of the injury should not be measured by the time elapsed before the athlete resumes training, but rather until he/she regains his/her full function. The same author also pointed out the necessity of unambiguous definition of sports injuries.

In a research conducted by Roetart & Ellenbecker (2003) on a sample of 148 professional tennis players, 38% of participants stated they had missed a tournament at least once because of lower back pain, 52% of players said they had experienced a tennis elbow injury during their career, 41% of participants experienced mild or severe shoulder injury, while 18% of players experienced a knee injury during their sports career.

According to Pluim et al. (2006), the ITF (*International Tennis Federation*) conducted a two-year study which involved players included in the ITF programme for under-developed countries. The results reveal the highest prevalence of pain in upper extremities – 21%, 10% of which refers to shoulder pain, 12% to elbow pain, and 5% to wrist pain, while 20% of participants reported trunk (back and abdominal) pain. The largest number of participants (40%) reported pain in their lower extremities. Namely, 12% of participants reported foot pain, 8% reported ankle pain, 5% reported calf pain and 15% reported knee pain. Also, the ITF organization, using a sample of elite junior athletes to investigate the question of pain prevalence, obtained the following results: back – 24%, shoulder – 21%, foot – 19%, knee – 15%, wrist – 12% and elbow – 12%. ITF pointed out that the purposes of both research studies have served a function in injury prevention, and had been intended for education of tennis coaches and their work in conditional preparation of tennis players.

Research results (Winge, Jorgensen & Lassen, 1989) indicate that Danish recreational athletes experienced averagely 2.1 injuries in 1000 hours of tennis play. 45% of these were injuries of the upper extremities, 17% were shoulder injuries, 67% was overexertion (muscle inflammations, etc.), 14% were sprains and strains, 2% were fractures and 5% were blisters. On the other hand, ATP conducted a research (Bahr et al., 2004) about the injuries that make professional male and female tennis players seek medical assistance. The results indicate that 30 – 50% of all injuries occurred in the lower extremities, 20% in the upper extremities, and 20% in the lower back area. In 15 – 30% cases, players just asked for a massage or stretching, but many players usually don't even ask for help because of chronic syndromes, which presents a limitation of this research. Research studies (Nigg & Segesser, 1988) indicate that incidence of injuries in professional male and female tennis players is related to different court surfaces and specificities of each match.

Table 1 shows the specificities of injuries in relation to tennis court surfaces.

Table 1. *The specificities of tennis injuries in relation to tennis court surfaces (according to Roetert & Ellenbecker,2003; Nigg & Segesser, 1988)*

Surface type	Characteristics/demands on players	Most probable sites of injury
Clay	Longer matches Longer points Baseline game High bouncing ball	Shoulder Elbow Wrist Abdominals Upper back
Grass	Lower bouncing ball Short points (1-1.5 sec on average) Greater balance demands	Lower back Hamstring Hips Groin
Hard	The most demanding court surface Suits players with great and fast footwork who are physically balanced and adaptable	Shoulder Lower back Knee Thigh

In accordance with the abovementioned, the aim of this research was to determine the prevalence and topology of pain in male and female tennis players. Specific goal was to determine if there were significant differences between male and female tennis players in prevalence and topology of pain.

Materials and Methods

A sample of 80 professional tennis players (42 male and 38 female tennis players) was used in this research. All subjects participated in the ITF tournament in Antalya, Turkey (10000$) at the beginning of 2012. All participants filled out a modified SEFIP questionnaire – taking into consideration the specificities of tennis and body parts in which the incidence of pain is recorded. The participants had to answer if they experienced pain in the following 14 body parts: neck, shoulder, elbow, wrist, upper back, lower back, hip, hamstrings, quadriceps, knee, shin, calf, ankle joint and foot; and if so, of what intensity. For all body parts in arms and legs, the participants filled out separate questionnaires for the left and the right side of the body. The answers were given on a Likert-type scale from 0 to 4 (0 – it doesn't hurt at all; 4 – I cannot train at all because of the pain).

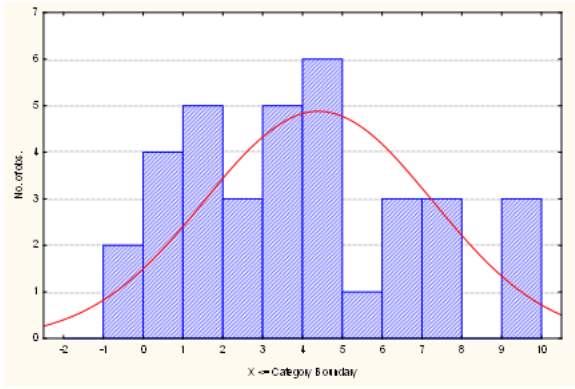
First, basic descriptive indicators related to the characteristics of the sample of male and female tennis players were calculated (chronological and training age, as well as weekly hours of training). After that, by using separate histograms for male and female tennis players, the number of participants who experience pain in one or several body regions was presented. Significance of differences between the sexes in the sum of prevalence and intensity of pain in each body part was calculated by Mann-Whitney U test.

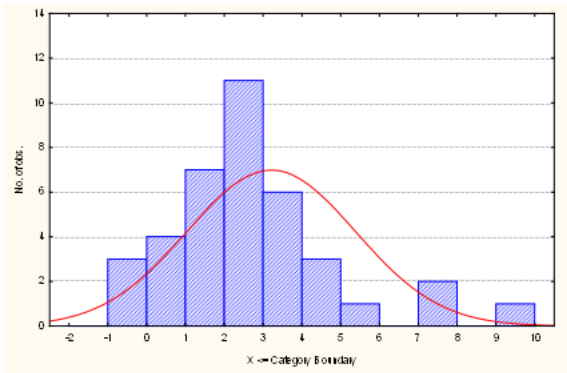
Results and Discussion

It is important to point out that male and female players in the sample used were at the beginning of the competitive season, when they are expected to have finished a quality preparation cycle and should not yet feel a negative effect of strenuous competitions. Parameters of descriptive statistics for chronological age, training age and weekly hours of training are presented in Table 2.

Table 2 shows the basic data about male and female tennis players who participated in the research. It is important to note that both groups have similar mean values of chronological and training age, and equal number of weekly hours of training. According to the aforementioned, it can be concluded that possible differences in pain prevalence and topology between male and female tennis players would not be caused by differences in chronological and training age, neither in the extent of training.

Histogram 1. *Frequency of tennis players according to number of painful body regions*





Histogram 1 shows that only 2 female tennis players have not reported any pain, 4 of them feel pain in 1 body part, 5 of them in 2 body parts, 3 of them in 3 body parts, 5 players feel pain in 4 body parts, and 6 players feel pain in 5 body parts. More precisely, out of the 36 female tennis players, 34 reported pain of average intensity of 1.59.

Table 2. Characteristics of used sample. Cronological age (AGE), years in training (TAGE), number of training hours per week (WT). (mean±standard devation - M±SD, minimal result – MIN, maximal resut – MAX, coefficient of variation - CV)

Female	M±SD	MIN	MAX	CV
AGE	21.1±2.7	16.00	29.00	12.90
TAGE	14.2±2.7	9.00	21.00	19.26
WT	19.7±2.5	7.00	22.00	12.54
Male	**M±SD**	**MIN**	**MAX**	**CV**
AGE	22.4±2.7	18.00	29.00	12.08
TAGE	14.7±2.7	10.00	21.00	18.72
WT	20.6±1.5	16.00	22.00	7.46

Furthermore, it can be seen from the histogram that three female tennis players feel pain in 10 body regions, while 3 players feel pain in 7 or 8 regions.

In male tennis players, 35 out of 38 participants feel pain in one or several body regions. The average pain intensity in those who have reported it was 1.60. As opposed to women, a much smaller number of male participants reported pain in 6 or more body parts, and the highest number of participants (11) reported pain in 3 body regions.

The highest sum of pain intensity was reported in lower back area in both male and female tennis players. A relatively high sum of pain intensity in the shoulder, wrist, knee, and to a smaller extent, in the elbow, was also reported in both male and female tennis players. The specificity of female tennis players is the high sum of pain intensity in the upper back area. Significance of differences in the sum of pain intensity in different body regions according to gender is presented in Table 4.

Table 3. Significance of differences in total pain intensity between female and male tennis playes by using Mann-Whitney U test. (U and Z – test values, p – level of significance)

	U	Z	p
Upper Back	425	-2,8	**0,00**
Lower Back	506	-1,9	**0,04**
Shoulder	647	-0,4	0,64
Elbow	562	-1,3	0,10
Zglob šake	593	-1,0	0,25
Hip	671	0,1	0,82
Front Thigh	679	-0,1	0,93
Back Thigh	678	-0,1	0,92
Knee	633	-0,6	0,51
Lower Leg – front	679	-0,1	0,93
Lower Leg - back	660	-0,3	0,67
Ankle Joint	678	-0,1	0,92
Foot	597	0,9	0,13

It is evident in Table 4 that a statistically significant difference has been identified in the upper and lower back area. Even though female tennis players experienced a more frequent and intensive pain in lower back, male tennis players are not immune to this problem. It is probable that male tennis players, and especially female tennis players, do not manage to adequately meet the rigid demands of professional tennis play (sudden direction changes, accelerations, stops) which are imposed on their locomotor system. This is primarily a problem of inadequate stability, which is probably confirmed by relatively high prevalence of pain incidence in the knee joint. It is very probable that stability in these joints is also hindered by insufficiently mobile and active hips during extension movements. More precisely, not using the *m. gluteus maximus* in movements of hip extension must be compensated by weaker synergist muscles in the posterior thigh and lumbar spine area, which impairs the stability in those regions and increases the risk of injury (Cook, 2011). It must be emphasized that the body may be compensating the lack of stability in certain body parts (for example, the lower back) by increasing the stability of the hips and thoracic spine. Thus, the mobility in those regions is limited, which increases the risk of pain and injury. Knee pain can also be caused by bandaging the ankle joints (Boyle, 2010). Namely, by bandaging the ankle joints, their mobility is impaired, which is compensated by excessive mobility of the knee. Also, possible causes of high prevalence of pain in male and female tennis players in different body parts may be found in inadequate everyday movement patterns initiated by improper technique and an overly high number of repetitions of certain tennis-specific movements.

During tennis shots performance, great forces are developed which load primarily the hands and the shoulders, but also the overall locomotor system. It must be pointed out that a number of shots of correct technical performance may cause pain and injuries in certain body parts, and the risk is multiplied if the shots are performed by improper technique. Keeping in mind combination of spending free time in a sedentary manner and high loads on the locomotor system during training and competitions, high prevalence of pain is not surprising.

The biggest difference between male and female tennis players in pain prevalence and intensity occurs in the upper back area (Table 4). It can be assumed that men have better stability of the scapula, which allows better control of the shot. However, such explanation is not supported by equal sum of reported pain in the shoulder joint in both sexes. Namely, it can be assumed that stabile and properly positioned scapula will protect the tendons of the rotator cuff and long head of the biceps from inflammation. Scientific research studies are yet to explain the phenomena of the occurrence of isolated shoulder pain in male tennis players and a combination of shoulder and upper back pain in female tennis players (Đurović, 2013).

It is important to conduct a detailed analysis of the posture when the pain occurs, but also of certain movement patterns, with the aim of determining the real cause of the pain. Here, it is important to emphasize that the site of the pain and its cause are almost never found in the same location (Sahrmann, 2001; Cook, 2011).

The causes of dysfunction and the consequential compensation of the nervous and the locomotor system must be determined by good diagnostics procedures, but also (equally important) adequate therapy must be prescribed which will restore the lost function and eliminate the need for compensating movement patterns.

Conclusion

Gathering information about pain incidence in athletes should be just the first step towards a minutely planned set of procedures which have the ultimate goal of affecting the decrease of prevalence and gravity of sports injuries. Each coach's task, within the context of information about pain prevalence and topology in each athlete and in his/her sport in general, is to implement proper movement techniques, adequate alternation of work and rest, and to prevent the incidence of pain and injuries additionally by quality warm-ups and stretching.

However, coaches should only be a part of the expert team which should take care of increasing the risk of injury. A physical therapist should do preventive examinations of posture and movement patterns, with the aim of noticing the dysfunctions and compensations. He/she should also propose adequate corrective exercises to eliminate the dysfunctions and, consequently, the compensations. Certainly, young athletes must be instructed to report the pain to their coaches, even pain of lowest intensity.

A relatively small subject sample and the fact that pain incidence was recorded only on one occasion are the limitations of this research study. Accordingly, future research of this type should be conducted on larger samples of athletes, and it should be designed as a longitudinal study. This way useful information would be obtained about whether the reaction on pain occurrence will manage to reduce the pain, eliminate it or whether it will be increased. Models between current pain incidence and possible future injuries could also be determined.

Furthermore, future research should certainly investigate the differences in pain incidence between the four major styles of play, grips for executing the forehand (the eastern, the semi-western and the western), grips for executing the backhand (one-handed or two-handed), as well as differences on different levels of competitive efficiency (juniors, ITF futures, ITF challengers and ATP). The whole picture of the abovementioned information would probably structure certain profiles and models of players who are more prone to pain depending on the category to which they belong.

References

Bahr, R.. No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. Br J Sports Med 2009;43: 966–972.

Bahr, R. & Bahr I.A.. Incidence of acute volleyball injuries: a prospective cohort study of injury mechanisms and risk factors. *Scand J Med Sci Sports* 1997;7: 166-171.

Bahr, R., Andersen, S.O., Loken, S., Fossan, B., Hansen, T. & Holme, I. . Low back pain among endurance athletes with and without specific back loading—a cross-sectional survey of cross-country skiers, rowers, orienteerers, and nonathletic controls. *Spine* 2004;29: 449-454.

Boyle, M. *Advances in functional training*. On target publication. Santa Cruz, California. 2010.

Cook, G..Movement. Functional movement systems: Screening, assessment and corrective strategies. On target publications. Santa Cruz, California. 2011.

Đurović, N.. Combined model for estimation of actual quality of top level tennis players. Disertation, Kineziološki fakultet u Splitu. 2013.

Ellenbecker, T.S., Roetert, E.P., Bailie, D.S., Davies, G.J., Brown, S.W. Glenohumeral joint total rotation range of motion in elite tennis players and baseball pitchers *Med Sci Sports Exerc* 2002;34:2052–2056.

Fernandez, J., Mendez-Villaneuva, A. & Pluim, B.M. Intensity of tennis match play *Br J Sports Med 2006;*40:387-391

Miletić, A., Kostić, R., & Miletić, Đ. Pain Prevalence Among Competitive International Dancers. *International Journal of Athletic Therapy & Training* 2011;16: 13-16.

Miletić, A., Kostić, R., Božanić, A. & Miletić, Đ. Pain Status Monitoring in Adolescent Dancers. *Medical problems of performing artists* 2009;24: 119 – 124.

Nigg, B.M. & Segesser, B. The influence of playing surfaces on the load on the locomotor system and on football and tennis injuries *Sports Med* 1988;5:375-385

Pluim, B.M., Staal, J.B. Windler, G.E. & Jayanthi Tennis injuries: occurrence, aetiology, and prevention, *Br J Sports Med* 2006;40:415-423

Ramel, E M., Moritz, U. & Jamlo, G-B. Validation of a pain questionnaire (SEFIP) for dancers with a specially created test battery. *Med Probl Perform Art* 1999;14:196-203.

Roetert, P. & Ellenbecker, T. S. Complete conditioning for tennis. Gopal. 2003.

Sahrmann, S.A. Diagnosis and treatment of movement impairment syndromes. Mosby, St Louis. 2001.

Winge, S., Jorgensen, U. & Lassen Nielsen, A. Epidemiology of injuries in Danish championship tennis. *Int J. Sports Med* 10(5): 1981;368-371.

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