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Anterior cruciate ligament injuries at the office workers who have irregular sport activity on the artificial surfaced playing areas

Düzensiz spor aktivitesi olan ofis çalışanlarında sentetik zeminli yüzeylerde ortaya çıkan ön çapraz bağ yaralanmaları

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Abstract

Aim: The aim of this study is to evaluate the anterior cruciate ligament (ACL) tears in Turkish office workers on the artificial playing surfaces.

Materials and Methods: Eighty-seven patients who were operated for anterior cruciate ligament tear that had injuries on artificial surfaced playing areas (ASPA)s were evaluated retrospectively. Evaluations were undertaken using Lysholm and Tegner Activity Scale pre-operatively and in the last follow-up. Injury mechanisms, shoe types, frequency of sporting activity, time of warm-up exercises before sporting activity were assessed. Types of ASPA's, body mass index (BMI) and return to work period were also determined.

Results: Increase in Lysholm and Tegner activity scale between the preoperative and postoperative scores was found to be statistically significant ($p<0.001$). ACL tear occurred with non-contact injury in 65 patients, 22 patients had ACL tear with direct contact trauma. Football activity on the ASPAs is social allocation rather than a sportive activity. The rate of wearing special designed shoes for ASPA in sporting activities was low. The mean frequency of sporting activity was 1.4 times/month and the mean warm-up exercise time was 6.42 minutes. Sixty-nine ASPAs were made with 3th generation turf, 18 were 2nd generation turf. The mean BMI was 23.32 kg/m². The mean period for return to work was 17.41 weeks.

Conclusion: Irregular sportive activity with insufficient equipment on the ASPA causes serious ACL injuries that have to be managed by surgical procedures with loss of working time and economical casualties.

Keywords: Anterior cruciate ligament, artificial playing surface, office workers.

Öz

Amaç: *Sentetik zeminli spor alanlarında ofis çalışanlarında ortaya çıkan ön çapraz bağ yaralanmalarını değerlendirmek.*

Gereç ve Yöntem: *Sentetik yüzeyli zeminlerde spor esnasında ön çapraz bağ yaralanması olan ve opere edilen 87 hasta retrospektif olarak değerlendirildi. Hastaların opere edilen dizleri ameliyat öncesi ve son kontrollerde Lysholm ve Tegner Aktivite Skalaları ile değerlendirildi. Yaralanma mekanizması, yaralanma esnasında kullanılan ayakkabı tipi, sportif aktivite sıklığı, sportif aktivite öncesi ısınma süresi, spor yapılan sahanın zemin tipi, vücut kitle endeksi ve işe dönüş süresi araştırıldı.*

Bulgular: *Ameliyat öncesi ve son kontrollerdeki Lysholm ve Tegner aktivite skalalarında istatistiksel olarak anlamlı artış tespit* edildi ($p<0.001$). *Altmış beş hastada temassız travmalar sonucunda, 22 hastada ise direkt* temaslı travmalar *sonucunda ön çapraz bağ yırtığı oluştuğu tespit edildi. Hastaların sentetik zeminli yüzeylerde yaptıkları sportif aktiviteleri sosyal aktivite olarak gördükleri tespit edildi. Sentetik zeminli yüzeyler için uygun ayakkabı kullanımı düşük oranda idi. Hastaların aylık ortalama sportif aktivite sayıları 1.4, ortalama ısınma süresi 6.42 dk olarak bulundu. Sentetik yüzeyli sahaların 69'u 3. jenerasyon, 18'inin ise 2. jenerasyon yüzeyler idi. Hastaların ortalama vücut kitle endeksi 23.32 kg/m² idi. Cerrahi girişim sonrası işe dönüş süresi 17.41 hafta olarak belirlendi.*

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Sonuç: *Uygunsuz ekipman ve düzensiz spor aktivitesi olan kişilerin sentetik zeminli yüzeylerde yaptıkları sportif aktiviteler cerrahi tedavi gerektiren ön çapraz bağ yaralanmalarına neden olabilmektedir. Bunun sonucunda çalışma zamanında azalma ve ekonomik kayıplar ortaya çıkmaktadır.*

Anahtar Sözcükler: *Ön çapraz bağ, sentetik yüzeyli spor alanları, ofis çalışanları.*

Introduction

Artificial Surfaced Playing Areas (ASPA), has emerged in the second half of the last century. Its popularity has grown all over the world with various technical changes (1). Larger audiences with higher capacity stadium and sports facilities has increased the need for ASPA. The other important factor is limited natural grass fields in growing cities and the request of urban population for large sporting areas without time and climate limitations. ASPAs has increased in sporting activities of children living in crowded cities (2).

ASPA's have social, economic and sporting benefits. But they have some controversial disadvantages, like; high injury rates, infections and carcinogenic effect that all are still a subject of discussion (3,6).

Conspicuously, anterior cruciate ligament (ACL) tears are the third most common type of knee injury and surgical reconstruction of the ACL is the second most common type of surgery (7). The individuals who underwent to surgical procedure are commonly in working-active decades of life.

Our hypothesis is ASPA's have an important role on ACL tears. The aim of this retrospective study is to evaluate the ASPA's and related ACL tears in patients who had irregular sports activities at irregular intervals in Turkish office workers.

Materials and Methods

Our study was done after the approval ethics committee of our university (10840098-604.01.01-E.27513). We evaluated retrospectively 532 knee injuries that occurred on ASPA's between April 2012 and January 2014 in our clinic. 112 patient had ACL tear. 87 patients who were operated for ACL tear that had injuries on ASPA's were included to the study. The average age of the patients was 34.02 (25-51) years. All the patients were male. All the patients were evaluated with knee radiographs at admission. No bony lesion secondary to trauma were identified. MRI was performed for the patients who had suspicion for ACL tear according to the findings of clinical examination. Arthroscopic ACL repair surgery was recommended to the patients who had ACL tear verified by MRI.

Operations were performed 3 weeks after the trauma. Evaluation of patients were performed with Lysholm and Tegner activity scale pre-operatively, at the 1th and 6th months postoperatively and in the last follow up. Level of activity was evaluated between 0-10 according to Tegner activity scale. All of the patients were included for the same physical therapy and rehabilitation program at the postoperative period.

All operations were performed arthroscopically assisted with the use of Endobutton (Smith & Nephew, Memphis, Tennessee) and tibial fixation was achieved with bio screw and u-staple. The mean follow-up period was 8.3 (6-16) months.

Patients questioned about the injury mechanisms, shoe types, frequency of sporting activity, time of warm-up exercises before sporting activity, types of ASPA. Body mass index (BMI) of the patients were calculated, return to work period was determined.

Preoperative and postoperative values of Tegner and Lysholm scores were evaluated statistically with Wilcoxon test which is non-parametric version of paired-t test. 95% confidence interval and $p<0.05$ were considered statistically significant. Analysis were performed with SPSS16.0 version.

Results

Thirty-eight patients were evaluated as medium, 49 patients were evaluated as poor according to Lysholm scores preoperatively. There were 10 patients in level 1, 40 patients in level 2, 20 patients in level 3, 8 patients in level 4 and 9 patients in level 5 according to Tegner Activity Scale preoperatively. Thirty-nine patients were considered as perfect, 36 were good and 12 were medium according to Lysholm scores in last follow-up. There were 10 patients in level 10, 29 in level 9, 24 in level 8, 12 in level 7 , 9 in level 6 and 3 in level 5 according to Tegner activity scale in the last follow up (Tables 1-2). Increase between the preoperative and postoperative scores was determined to be statistically significant ($p<0.001$).

Table-1. Preoperative Tegner Activity Scale.

Tegner activity scale	Level 1	Level 2	Level 3	Level 4	Level 5
Number of patients	10	40	20	8	9

Table-2. Postoperative Tegner Activity Scale.

Tegner activity scale	Level 5	Level 6	Level 7	Level 8	Level 9	Level 10
Number of patients	3	9	12	24	29	10

In 65 individuals ACL tear occurred with non-contact injury, while the remaining 22 of the patients had ACL tear with direct contact trauma.

It was questioned how the operated patients consider the activity they performed. Two different answering options were available: Whether they consider the activity as sportive activity or as social activity. Eighty of the participants stated that they considered this football activity on the ASPAs as a social allocation with colleagues rather than a sportive activity.

Only 7 patients were wearing special designed shoes for ASPA's sporting activities, others were standard shoes.

The mean frequency of sporting activity was 1.4 times/month (range 0-4 times) irregularly. The mean warm-up exercises for each activity was 6.42 minutes (range 0-15 minutes). While 69 ASPAs were made with 3^{th} generation turf, 18 were 2^{nd} generation turf where the ACL injury was took place.

The mean BMI was 23.32 kg/m² (range 19.1-29.4 kg/m²). The mean period for return to work was 17.41 weeks (range 12-24 weeks).

While 39 patients returned to football game on ASPA again after recovery period, 40 patients expressed that they had changed their sportive activity type and 8 patients gave up to their sportive activities.

Discussion

There is growing interest, at all levels of football, in new generation ASPA's that use synthetic infill materials. Therefore, for the first time a reference to the field surface was included in the Laws of the Game of football on 1 July 2004 with the phrase; Matches may be played on natural or artificial surfaces, according to the rules of the competition (8). Turkey Football Federation issued a circular in 2009 for the first time and has set the standards for the supervision and control of ASPAs (9).

First generation ASPAs were introduced to the professional sporting activity in 1960s (10). These fields are produced from stiff nylon fibers including no filling materials like sand or rubber (1). Risk of skin injuries were high on these surfaces (11). Second generation ASPA's improved in the 1970s that fibers were made from soft polyethylene with sand as a filling material (1). In 1990s third generation ASPA's were introduced that made of polyethylene monofilaments that textured and coated with rubber particles or sand as filling materials (1). In our study while 69 ASPA's were third generation turf, 18 were second generation. ACL injury can occur on both type of ASPA's. For this reason structure of the playing surface is not the most important factor on ACL tears in Turkish office workers population who have irregular sport activity.

Shoe and playing surface interaction contains many different factors. These are body weight, velocity, acceleration, deceleration and surface type (12). The sole, cleat or stud material and number, size of cleats and their configuration in shoe are the important factors that affect the shoe and ground interaction (1). Generally the conventional soccer and football shoes have different cleat lengths and types of sole and the ASPA shoes have dense pattern of short elastomeric studs over the all surface of sole (1). New generation ASPA shoes modified to include midsole weight absorbing to distribute the force during ground contact. In our study, only 7 individuals were wearing the special designed shoes for football playing on ASPA's. The remaining were other types of shoes for designed other types of sporting activities, as walking, jogging, tennis playing or running. In our opinion, improper shoes on ASPAs may one of the most important factor predisposing for ACL tears that pointing to insufficient equipment.

The strength, balance and flexibility of the surrounding musculature of the knee are the important factors for preventing knee from injuries. Consequently, warm-up exercise before any type of sporting activity is an important procedure. The football is a contact sport and the rate of ACL injuries are relatively high whether ASPA or natural grass players. The warm-up exercises before playing was found effective at preventing common injuries as well as ACL injuries in football (13-15). Several studies reported that warm-up exercises showed 57-77% reduction in the knee injury incidence (16-17). According to the results of Mandelbaum et al. during the year of 2000 football season, there was an 88% decrease in anterior cruciate ligament injury. During the year of 2001 football season, there was a 74% reduction in anterior cruciate ligament tears with 20 minutes warm-up exercises performed before matches and training (18). Therefore the warm-up exercises must be the essential part of the football before playing in order to prevent injuries. In our study, sparing time for warm-up exercise before football in individuals who had ACL injury on ASPAs were mean 6.42 minutes with a range between 0-15 minutes.

Typically, ACL tears happen as a result of trauma. During sudden deceleration, turning and pivoting movement, ACL tears may occur. The most common mechanism of ACL injury is knee hyperextension with tibial varus and internal rotation. While both medial collateral ligament and medial meniscus tears can occur with severe valgus and external rotation force before the ACL tears, severe varus force can cause lateral collateral ligament tear and ACL tear and not withstanding, ACL tears with hyperextension and hyperflexion are rarely seen (19). In our study 65 individuals had ACL tear with non-contact injury, while the remaining 22 of the patients had ACL tear with a direct contact due to any type of trauma.

Sparing less time for warm-up exercise is producing seriously trauma like ACL and also the other injuries. The number of non-contact injured ACL individuals is significantly higher than contact injured ACL individuals in our series. It is clearly provides that most ACL tears occur with non-contact injuries in individuals who perform less, insufficient, ineffective knee and corresponding muscularity warm-up exercise on ASPAs while sporting.

Playing surface had a significant effect on injury rates with an incidence rate of 1.73 ACL injuries per 10,000 on ASPAs compared with a rate of 1.24 per 10,000 on natural grass and the rate of ACL injury on ASPA's is 1.39 times higher than the injury rate on natural grass surfaces (13). Significantly higher rates of all types of injury in football have been reported on ASPA's compared with natural grass (3-6). However, some reports documented that no difference in ACL injury rates on ASPA's and natural grass surfaces (20-21), while a different study found increased rates of noncontact ACL injuries on natural grass compared with ASPA's (22). Interestingly, most of the patients in our study are considering this activity as a social activity that having time with friends rather than a regular sport activity.

Among 4307 patients from Turkey population with mean age 47.1±14.7 years (20-83) the average body mass index was determined as 28.3±5.2kg/m² (23). According to Turkey nutrition and health study, 62.8% of the population between the ages 19 to 30 the body mass index was below 25 kg/m² and 38.9% of the population between the ages 31 to 50 body mass index was 25-30 kg/m² and 38.9% of the population between the ages 31 to 50 body mass index was over 30 kg/m² (24). In our study, the mean BMI is 24.9 kg/m² (range 19.2-32.8 kg/m²). The mean age of patients was 34.02 (21-51). The mean BMIs of patients in our study are almost at the normal levels of Turkish population.

Patients with ACL tear whose profession was sports return to sportive activity most commonly occurs at least 6 months postoperatively (25). The mean period for return to work was 17.41 weeks (range 12-24) according to our study. But patients were not professional athletes in our study.

Conclusion

ASPA's can be a reason for higher rate of injury. The reason for injuries on ASPA's are irregular sportive activity, poor equipment, and short warm-up exercise period before sports activities as a result of our study. Irregular sportive activity with insufficient equipment on the ASPA causes the serious ACL tears that have to managed by surgical procedures resulting with loose of working time due to indispensable hospitalisation and rehabilitation period and significant economic losses in our country.

References

1. Drakos MC, Taylor SA, Fabricant PD, Haleem AM. Synthetic playing surfaces and athlete health. J Am Acad Orthop Surg 2013;21(5):293-302.
2. Levy IM, Skovron ML, Agel J. Living with artificial grass: A knowledge update. Part 1: Basic science. Am J Sports Med 1990;18(4):406-12.
3. Gorse K, Mickey CA, Bierhals A. Conditioning injuries associated with artificial turf in two preseason football training programs. J Athl Train 1997;32(4):304-8.
4. Guskiewicz KM, Weaver NL, Padua DA, Garrett WE Jr. Epidemiology of concussion in collegiate and high school football players. Am J Sports Med 2000;28(5):643-50.
5. Hagel BE, Fick GH, Meeuwisse WH. Injury risk in men's Canada West University football. Am J Epidemiol 2003;157(9):825-33.
6. Ramirez M, Schaffer KB, Shen H, Kashani S, Kraus JF. Injuries to high school football athletes in California. Am J Sports Med 2006;34(7):1147-58.
7. Bradley J, Honkamp NJ, Jost P, West R, Norwig J, Kaplan LD. Incidence and variance of knee injuries in elite college football players. Am J Orthop 2008;37(6):310-4.
8. Fédération Internationale de Football Association. FIFA Laws of the Game; July 2004.
9. Turkish Football Federation, Halı Sahaların Denetimi ve Sınıflandırılması Hakkında Genelge, 1 Aralık 2009; *www.tff.org*
10. Fleming P. Artificial turf systems for sport surfaces: Current knowledge and research needs. J Sports Engineering Tech 2011;225(2):43-63.
11. Ekstrand J, Nigg BM. Surface-related injuries in soccer. Sports Med 1989;8(1): 56-62.
12. Cawley PW, Heidt RS Jr, Scranton PE Jr, Losse GM, Howard ME. Physiologic axial load, frictional resistance, and the football shoe-surface interface. Foot Ankle Int 2003;24(7):551-6.
13. Dragoo JL, Braun HJ, Durham JL , Chen MR, Harris AHS. Incidence and risk factors for injuries to the anterior cruciate ligament in National Collegiate Athletic Association Football data from the 2004-2005 through 2008-2009 National Collegiate Athletic Association Injury Surveillance System. Am J Sports Med 2012;40(5):990-5.
14. Daneshjoo A, Mokhtar A, Rahnama N, Yusof A. The effects of injury prevention warm-up programmes on knee strength in male soccer players. Biol Sport 2013,30(4):281-8.

15. Alentorn-Geli E, Myer GD, Silvers HJ, et al. Prevention of non-contact anterior cruciate ligament injuries in soccer players. Part 1: Mechanisms of injury and underlying risk factors. Knee Surg Sports Traumatol Arthrosc 2009;17(7):705-29.
16. Kiani A, Hellquist E, Ahlqvist K, Gedeborg R, Michaëlsson K, Byberg L. Prevention of soccer related knee injuries in teenaged girls. Arch Intern Med 2010;170(1):43-7.
17. Steffen K, Meeuwisse WH, Romiti M, et al. Evaluation of how different implementation strategies of an injury prevention programme (FIFA 11+) impact team adherence and injury risk in Canadian female youth football players: A cluster-randomised trial. Br J Sports Med 2013;47(8):480–8.
18. Mandelbaum BR, Silvers HJ, Watanabe DS, et al. Effectiveness of a neuromuscular and proprioceptive training program in preventing anterior cruciate ligament injuries in female athletes: 2-year follow-up. Am J Sports Med 2005;33(7):1003-10.
19. Marzo JM, Warren RF. Acute Anterior Cruciate and Medial Collateral Ligament injuries. Insall J, Windsor R (eds). Surgery of The Knee. 2nd ed, New York, Churchill Livingstone, 1993:403-24.
20. Bradley JP, Klimkiewicz JJ, Rytel MJ, Powell JW. Anterior cruciate ligament injuries in the National Football League: Epidemiology and current treatment trends among team physicians. Arthroscopy 2002;18(5):502-9.
21. Nicholas JA, Rosenthal PP, Gleim GW. A historical perspective of injuries in professional football: Twenty-six years of game-related events. JAMA 1988;260(7):939-44.
22. Scranton PE Jr, Whitesel JP, Powell JW, et al. A review of selected noncontact anterior cruciate ligament injuries in the National Football League. Foot Ankle Int 1997;18(12):772-6.
23. Gundogan K, Bayram F, Gedik V, et al. Metabolic syndrome prevalence according to ATP III and IDF criteria and related factors in Turkish adults. Arch Med Sci 2013;9(2):243-53.
24. Republic of Turkey. Ministry of Health, Health Statistics Yearbook 2011. Ministry of Health, Ankara, 2012;42
25. Erickson BJ, Harris JD, Fillingham YA, et al. Anterior cruciate ligament reconstruction practice patterns by NFL and NCAA football team physicians. Arthroscopy 2014;30(6):731-8.