Importance of Restricting Sportive Activity and Time from Injury to Surgery in Anterior Cruciate Ligament Reconstruction

Ersin Erçin*¹, M. Gokhan Bilgili¹, Zafer Atbasi² and Bulent Tanriverdi¹, S. Hakan Basaran³ and Cemal Kural¹

¹Department of Orthopaedics and Traumatology, Bakirkoy Dr Sadi Konuk Training and Research Hospital, Istanbul, Turkey
²Department of Orthopaedics and Traumatology, Ankara Mevki, Military Hospital, Ankara, Turkey
³Department of Orthopaedics and Traumatology, Karahük University, Turkey

Abstract: Objectives: It is unclear that how long reconstruction may be delayed before additional intraarticular injuries occur. Our aim was to determine the relationship of time period from injury to surgery with the incidence of meniscal and chondral injuries recorded at the time of surgical treatment for ACL tears. The effect of sportive activity restriction, grade of chondral lesions and their locations were also evaluated.

Patients and Methods: 213 patients who underwent arthroscopic anterior cruciate ligament reconstruction were evaluated retrospectively. Data were analyzed for association between time period before surgery and patients sportive activity restriction with rates of meniscal and chondral injuries. According to time from initial trauma to surgery less than 12 months grouped as group I (101 patients) and 12 months and longer defined as group II (81 patients). Patients who had surgery before 12 months were divided into groups of smaller time scales (0 to 3 months, 4 to 6 months, 7 to 9 months, 10 to 12 months) to examine the relationships more closely. For sportive activity restriction a functional scale was used that described restricted activities including military training.

Results: One hundred eighty-two patients were included in the study. 81 patients restricted sportive activity before surgery. 18 (% 22.2) of these patients had chondral injury [6 (% 33.3) operated before 12 months and 12 (% 66.7) operated after 12 months]. The difference was statistically significant (p=0.005). 81 patients (group II) were operated after 12 months. There were 44 (% 54.3) patients with chondral injury in this group [32 (% 72.7) patients who continued their sportive activity and 12 (% 27.3) patients who restricted their sportive activity]. The difference was statistically significant (p=0.026). Correlation analysis showed that with increasing time from initial trauma to surgery chondral lesion incidence and grade of these lesions increases (p=0.001, p=0.001).

Conclusion: The results indicate that the prolonged time from injury to surgery and continuing sportive activity before surgery increases the incidence of the chondral lesions. Also, time limit of 12 month is important to prevent chondral injury in anterior cruciate ligament reconstruction.

Keywords: ACL reconstruction, chondral injury, meniscal injury, sportive activity.

INTRODUCTION

Anterior cruciate ligament (ACL) injury is very common. Reconstruction of anterior cruciate ligament is one of the most commonly performed orthopedic surgeries. Some patients with anterior cruciate ligament injury deny surgical treatment or delay their surgical treatment. However delayed surgical reconstruction or intense sports activity during conservative treatment can cause repeating incidences of giving way. This may lead to additional intraarticular injuries. In recent studies Magnussen RA et al. and Ghodadra N et al. mentioned that additional medial compartmental cartilage injuries increased in patients with delayed anterior cruciate ligament reconstruction [1, 2]. Sri-Ram K et al. conclude that the chance of additional meniscal injury increased by a factor of two if surgery delayed more than five months and by a factor of six if surgery was delayed more than twelve months [3]. Incidence of meniscal lesions and chondral injuries is not documented well in patients who did not restrict their sportive activities. Also it is unclear that how long reconstruction can be delayed before additional intraarticular injuries occur. Dumont GD et al. found active daily life and increasing time from injury to surgery has higher risk of re-injury and higher prevalence of intraarticular injury [4]. Patients who had anterior cruciate ligament injuries are usually active patients who participate in sportive activities. These patients may have the idea that, by restricting their sportive activities they can delay their surgery with no harm. It is unclear that which is more important to avoid additional injuries restricting sportive activity or not delaying surgery. If restricting sportive...
activity is important it is possible for these patients to delay their surgery before additional intraarticular pathologies occur. Our aim was to determine the relationship of time period from injury to surgery with the incidence of meniscal and chondral injuries recorded at the time of surgical treatment for ACL tears. The effect of sportive activity restriction, grade of chondral lesions and their locations were also evaluated.

**PATIENTS AND METHODS**

213 patients who underwent arthroscopic anterior cruciate ligament reconstruction evaluated retrospectively. Approval of the Ethics Committee was included in the study. All patients were male military personnel and their mean age was 25 years (ranging 20 to 47 years). Clinical history, time from initial trauma to surgery, age and activity level during preoperative time was recorded. Details of inclusion criteria are shown at Table 1. The type of chondral lesions and their locations were recorded by same surgeon to a standard form. Chondral lesions were recorded according to International Cartilage Repair Society classification. Grade I and II lesions considered as low grade lesions whereas grade III and IV lesions considered as high grade lesions. The localization of chondral lesions was defined according to the location in the articulation surface. Six different localizations for lesions were described as follows: medial femoral condyle (MFC), lateral femoral condyle (LFC), femoral articulation surface of patella (P), femur trochlear articulation surface (FT), medial tibial plateau (MTP) and lateral tibial plateau (LTP).

Total of 182 patients’ met the criteria and included the study. All operations made in the same institute by same surgeon. Patient’s initial MRI’s were investigated and only isolated ACL injury patients included to the study. All of the records were reviewed to evaluate the incidence of meniscal and chondral injuries. Additional details such as a mechanism of injury, type of reconstruction were also recorded. Localization of the chondral and meniscal injury was also documented. Patients were grouped according to time period after initial trauma that caused ACL injury. According to time from initial trauma to surgery less than 12 months was defined as group I (101 patients) and 12 months and longer was defined as group II (81 patients). Then the patients who had surgery before 12 months were divided into groups of smaller time scales to examine the relationships more closely. These were: A) 0 to 3 months; B) 4 to 6 months; C) 7 to 9 months; D) 10 to 12 months. As regards the groups with smaller time scales, there were 23 patients in group A, 35 in group B, 19 in group C and 24 in group D. Later in all groups patients were subdivided into two; one who restricted their sportive activity and the other who didn’t restricted their sportive activity before ACL reconstruction surgery. Restricted physical activities were listed in a form which includes basic physical training activities and combat physical training activities (Table 2). Incidence of meniscal tears and chondral lesions was determined and compared with the time of surgery and patients sportive activity.

**Statistical Analysis**

IBM SPSS Statistic Version 20.0 software was used for statistical analysis. In evaluation of the data descriptive statistical methods (mean, standard deviation) and Spearman’s rank correlation test was used to test whether time from initial trauma to surgery was significantly correlated with the presence or absence of cartilage lesions and grade of cartilage lesions. For crude analysis of independent groups of qualitative data, Fisher’s exact test, Chi-square test and Chi-square trend test were used. A 95% confidence interval, significance at p < 0.05 were accepted.

| Age < 50 years at time of surgery      |
|--------------------------------------|
| No associated injury to the medial collateral ligament, posterolateral complex or posterior cruciate ligament |
| Isolated ACL injury in initial MRI    |
| No revision of reconstruction of the ACL |
| No previous knee surgery             |

**Table 1. Details of the inclusion criteria.**

| Basic Physical Training               |
|--------------------------------------|
| Pushup                               |
| Sit up                               |
| Rope-climb                           |
| High-jump                            |
| Long-jump                            |
| Ladder exercise                      |
| 100 m sprint                         |
| 1600-2500 m run                      |
| Vault exercise                       |
| Cushion exercise                     |

| Combat Physical Training             |
|-------------------------------------|
| Hurdle run                          |
| Chest to chest combat               |
| 3 km run with rifle and equipment   |
| 5 km run without rifle and equipment|
| 5 km run with rifle and equipment   |
| Shooting target by running          |
| Jump out and cringe from moving vehicle|
| Military pentathlon                 |
| Walk with skies and pallets         |
| Mountaineering, nature sports and likewise sportive contests.|

**RESULTS**

In between these 182 patients there were 81 patients who restricted their sportive activity before surgery. In between these 18 patients (% 22.2) had chondral injury [6 (% 33.3) patients were operated before 12 months and 12 (% 66.7) patients were operated after 12 months]. The difference was statistically significant (p=0.005). Also 55 (% 67.9) patients had meniscal injury [33 (% 60) operated before 12 months 22 (% 40) operated after 12 months]. There were no
statistical difference between them (p=0.642). According to time from initial trauma to surgery there were 101 (% 55.5) patients in group I which had surgery before 12 months and in group II there were 81 (% 44.5) patients which had surgery after 12 months. In Group I (time from initial trauma to surgery less than 12 months) there were 15 (% 14.9) patients with chondral injury. In between these patients 9 (% 60) were who continued their sportive activity and 6 (% 40) patients were who restricted their sportive activity. There were no statistically significant difference between them (p=0.425). Also in Group I there were 66 (% 65.3) patients with meniscal injury. In between these patients 33 (% 50) were who continued their sportive activity and 33 (% 50) were who restricted their sportive activity. There were no statistically significant difference between them (p=0.831). Also after applying smaller time scales as A) 0 to 3 months; B) 4 to 6 months; C) 7 to 9 months; D) 10 to 12 months there were no significant difference between them in respect to chondral and meniscal injury (Table 3). In Group II (time from initial trauma to surgery more than 12 months) there were 44 (% 54.3) patients with chondral injury. In between these patients 32 (% 72.7) patients were who continued their sportive activity and 12 (% 27.3) patients were who restricted their sportive activity. And the difference was statistically meaningful (p=0.026). Also in Group II (time from initial trauma to surgery more than 12 months) there were 62 (% 76.5) patients with meniscal injury. In between these patients 40 (% 64.5) were who continued their sportive activity and 22 (% 35.5) were who restricted their sportive activity. There were no statistically significant difference between them (p=0.351). The correlation coefficient, between time from initial trauma to surgery and chondral lesion was 0.395 (p<0.001) and between time from initial trauma to surgery and grade of these lesions was 0.244 (p=0.001). Correlation analysis showed that with increasing time from initial trauma to surgery chondral lesion incidence and grade of these lesions increases (p=0.001, p=0.001). The localization of chondral lesions was defined according to the location in the articulation surface (Fig. 1).

**DISCUSSION**

Our aim was to determine the relationship of time period from injury to surgery with the incidence of meniscal and chondral injuries recorded at the time of surgical treatment for ACL tears. Also the effect of sportive activity restriction, grade of chondral lesions and their locations were also evaluated. Our findings show a significant increase in chondral injury of the knee in patients undergoing reconstruction of the ACL more than 12 months, also continuing sportive activity increases chondral injury incidence in this group. Some patients with ACL tear delays their treatment some refuses the surgical treatment. Some of the studies imply that delaying ACL reconstruction surgery causes additional meniscal and chondral lesions [5, 6]. Previous studies have revealed that meniscal and chondral lesions are associated with worse outcomes after late ACL reconstruction [6-8]. Although meniscal tears can occur at the time of ACL rupture subsequent meniscal injury is increased after ACL rupture secondary to abnormal loading and shear forces [9]. Some studies have shown a higher incidence of meniscal injury in the chronic ACL deficient knee [10, 11]. In a study which reviewed 5086 patients’ data they found an increasing incidence of medial meniscal tears and chondral injuries. They couldn’t state same increase in respect to lateral meniscus. Also they stated an increase of these injuries by a factor of six if surgery was delayed after 12 months [1]. A study found meniscal tear incidence % 27 in acutely injured ACL and % 90 in chronic ACL tears [12]. There is also data in literature that ACL reconstruction was protective against subsequent meniscal injury and decreases subsequent meniscal reoperation [5, 13, 14]. A retrospective study comparing ACL deficient knees and ACL reconstructed knees of army personnel showed the subsequent meniscus injury was two times higher in ACL deficient knees [15]. But in the prospective study authors didn’t find a difference in meniscal injury occurring in 56% of acute and 56% of chronically injured knees [16]. Our findings correlate with this study as there was no significant increase in meniscal lesions before or after 12 months (% 65.3 to % 76.5). Also in addition, restricting or continuing sportive activity doesn’t change this finding statistically. Articular cartilage is a unique, biologically active tissue. Shift in the normal load bearing surfaces of the knee joint after ACL injury leads to progression of osteoarthritis due to cartilage damage [17]. Kinematics of the knee changes in chronically ACL deficient knee [18]. Persistent laxity results in increased shear stress and additional cartilage injury [17, 19]. Chondral lesion frequency is in between % 11 and % 45 in ACL tears [20, 21]. Studies imply when surgical time delays of chondral lesion frequency increases [9, 22-24]. In the chronic ACL deficient knee, additional chondral injury may be the result of repeated increased tibia-femoral translation. In a study authors stated ACL tear greater than 8

**Table 3. Distribution of meniscal and chondral lesions according to time period and sportive activity before surgery. Patient number (n) and percentage (%).**

|                      | Patients Who Did Not Restricted Their Sportive Activity | p      | Patients Who Restricted Their Sportive Activity | p    |
|----------------------|--------------------------------------------------------|--------|-------------------------------------------------|------|
|                      | A(0-3)  | B(4-6)  | C(7-9)  | D(10-12)  | n  | %  | A(0-3)  | B(4-6)  | C(7-9)  | D(10-12)  | n  | %  |
| chondral lesion      |         |         |         |           |  |  |         |         |         |           |  |  |
| no                   | 6  | 14,3 | 11  | 26,2 | 13  | 31 | 12  | 28,6 | 0,191 | 15 | 31,4 | 17  | 13,6 | 6  | 13,6 | 6  | 33,3 | 0,472 |
| yes                  | 1  | 11,1 | 4   | 44,4 | 0   | 0  | 4   | 44,4 |       | 1  | 16,7 | 3   | 50  | 0  | 0   | 2  | 33,3 |       |
| meniscal lesion      |         |         |         |           |  |  |         |         |         |           |  |  |         |         |         |         |         |       |
| no                   | 3  | 16,7 | 7   | 38,9 | 5   | 27,8 | 3   | 16,7 | 0,390 | 5  | 29,4 | 5   | 29,4 | 3  | 17,6 | 4  | 23,5 |       |
| yes                  | 4  | 12,1 | 8   | 24,2 | 8   | 24,2 | 13  | 39,4 |       | 11 | 33,3 | 15  | 45,5 | 3  | 9,1  | 4  | 12,1 |       |

Fisher’s Exact Test.
weeks and patient’s age are significant factors in medial compartment chondral pathology and delayed reconstruction may increase these injuries [2]. In a cohort study with 15783 patients authors stated that male gender, age, previous surgery and time from injury to surgery more than 12 months are as risk factors for full-thickness cartilage lesions in anterior cruciate ligament injured knees [25]. One study indicates the importance of time to surgery and they found reconstruction carried out in one year of injury was related with a very low incidence of degenerative change in the knee joint [26]. These findings correlates with our results as we showed that there is no significant difference in chondral injury incidence before 12 months even with smaller time scales. Incidence of meniscal and chondral injuries is not documented well in patients who did not restrict their sportive activities. In a study authors found higher incidence of chondral injuries in the group where patients didn’t restrict their daily activities [24]. Another study with 541 patients who underwent ACL reconstruction authors mentioned preoperative episodes of instability predicted medial meniscal tears. Also they stated male sex, sports injuries lesser than 6 weeks from surgery predicted medial meniscal tears [27]. We found a statistically significant increase in chondral injuries with the group who have more than 12 months injury time specially restricting sportive activity is very important to prevent chondral injury in this group. Also our work showed that with increasing time from initial trauma to surgery chondral lesion incidence and grade of these lesions increases. Interestingly we cannot state same result about meniscal injury. Therefore chondral injuries may be the main dilemma of the patients who had ACL reconstruction after 12 months and who didn’t restrict their sportive activity. Some recent studies showed male gender as a risk factor of additional chondral injuries [25, 27]. Consequently all male population of our study limits to generalize these findings to similar populations. Also restriction of patient numbers when analyzing subgroups is another limitation of our study.

CONCLUSION

The results indicate that the time of injury and continuing sportive activity before surgery significantly increases the chondral lesions. When time from initial trauma to surgery increases chondral lesions and grade of these lesions increases. Time of injury and restricting sportive activity is very important to prevent chondral injury in delayed anterior cruciate ligament reconstruction.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

ACKNOWLEDGEMENTS

The data discussed in this manuscript were partially presented as a poster presentation at the 16th ESSKA Congress 14-17 May 2014.

REFERENCES

[1] Magnussen RA, Pedroza AD, Donaldson CT, Flanigan DC, Kaeding CC. Time from ACL injury to reconstruction and the prevalence of additional intra-articular pathology: is patient age an important factor? Knee Surg Sports Traumatol Arthrosc 2013; 21(9): 2029-34.

[2] Ghodadra N, Mall NA, Karas V, et al. Articular and meniscal pathology associated with primary anterior cruciate ligament reconstruction. J Knee Surg 2013; 26(3): 185-94.

[3] Sri-Ram K, Salmon LJ, Pinczewski, LA, Roe JP. The incidence of secondary pathology after anterior cruciate ligament rupture in
5086 patients requiring ligament reconstruction. Bone Joint J 2013; 95(1): 59-64.

[4] Dumont GD, Hogue GD, Padalecki JR, Okoro N, Wilson PL. Meniscal and chondral injuries associated with pediatric anterior cruciate ligament tears relationship of treatment time and patient-specific factors. Am J Sports Med 2012; 40(9): 2128-33.

[5] Demirag B, Aydemir F, Danis M, Ermutlu C. Incidence of meniscal and osteochondral lesions in patients undergoing delayed anterior cruciate ligament reconstruction. Acta Orthop Traumatol Turc 2011; 45(5): 348-52.

[6] Shelbourne KD, Gray T. Results of anterior cruciate ligament reconstruction based on meniscus and articular cartilage status at the time of surgery: five- to fifteen-year evaluations. Am J Sports Med 2000; 28(4): 446-52.

[7] Ichiba A, Kishimoto I. Effects of articular cartilage and meniscus injuries at the time of surgery on osteoarthritic changes after anterior cruciate ligament reconstruction in patients under 40 years old. Arch Orthop Trauma Surg 2009; 129(3): 409-15.

[8] Wu WH, Hackett T, Richmond JC. Effects of meniscal and articular surface status on knee stability, function, and symptoms after anterior cruciate ligament reconstruction a long-term prospective study. Am J Sports Med 2002; 30(6): 845-50.

[9] Irvine GB, Glasgow MM. The natural history of the meniscus in anterior cruciate insufficiency. Arthroscopic analysis. J Bone Joint Surg Br 1992; 74(3), 403-5.

[10] Piasecki DP, Spindler KP, Warren TA, Andrich JT, Parker RD. Intraarticular injuries associated with anterior cruciate ligament tear: findings at ligament reconstruction in high school and recreational athletes. An analysis of sex-based differences. Am J Sports Med 2003; 31:601-5.

[11] Spindler KP, Schils JP, Bergfeld JA, Andrich JT, Weiker GG, Anderson TE. Prospective study of osseous, articular, and meniscal lesions in recent anterior cruciate ligament tears by magnetic resonance imaging and arthroscopyarthroscopy. Am J Sports Med 1993; 21:551-7.

[12] Hart JAL. Meniscal injury associated with acute and chronic ligamentous instability of the knee joint. J Bone Joint Surg Br 1982; 64-B: 119.

[13] Lebel B, Hulet C, Galaud B, Burdin G, Locker B, Vielpeau C. Arthroscopic reconstruction of the anterior cruciate ligament using bone-patellar tendon-bone autograft. A minimum 10-year follow-up. Am J Sports Med 2008; 36: 1275-82.

[14] Pemin J, Verdonk P, Selmi TAS, Massin P, Neyret P. Longterm follow-up of 24.5 years after intra-articular anterior cruciate ligament reconstruction with lateral extra-articular augmentation. Am J Sports Med 2010; 38: 1094-102.

[15] Dunn WR, Lyman S, Lincoln AE, Amoroso PJ, Wickiewicz T, Marx RG. The effect of anterior cruciate ligament reconstruction on the risk of knee reinjury. Am J Sports Med 2004; 32: 1906-13.

[16] Kilocoyne KG, Dickens JF, Haniu E, Cameron KL, Owens BD. Epidemiology of meniscal injury associated with ACL tears in young athletes. Orthopedics 2012; 35(3): 208-12.

[17] Setton LA, Mow VC, Howell DS. Mechanical behaviour of articular cartilage in shear is altered by transection of the anterior cruciate ligament. J Bone Joint Surg 1995; 13A: 473-82.

[18] Hasler EM, Herzog W, Leonard TR, Stano A, Nguyen H. In vitro knee joint loading and kinematics before and after ACL transection in an animal model. J Biomech 1998; 31: 253-62.

[19] Seedhom BB. Loadbearing function of the menisci. Physiotherapy 1976; 62: 223.

[20] Finsterbusch A, Frankl U, Matan Y, Mann G. Secondary damage to the knee after isolated injury of the anterior cruciate ligament. Am J Sports Med 1990, 18(5): 475-9.

[21] Mitou A, Vallianatos P. Meniscal injuries associated with rupture of the anterior cruciate ligament: a retrospective study. Injury 1998; 19(6): 429-31.

[22] Tandogan RN, Taşer O, Kayaalp A, et al. Analysis of meniscal and chondral lesions accompanying anterior cruciate ligament tears: relationship with age, time from injury, and level of sport. Knee Surg Sports Traumatol Arthrosc 2004; 12(4): 262-70.

[23] Maftuli N, Binfield PM, King JB. Articular cartilage lesions in the symptomatic anterior cruciate ligament-deficient knee. Arthroscopy 2003; 19(7): 685-90.

[24] Yüksel HY, Erkan S, Uzun M. The evaluation of intraarticular lesions accompanying ACL ruptures in military personnel who elected not to restrict their daily activities: the effect of age and time from injury. Knee Surg Sports Traumatol Arthrosc 2006; 14(11): 1139-47.

[25] Ratterud JH, Sivertsen EA, Forssblad M, Engebretsen L, Åroen A. Effect of gender and sports on the risk of full-thickness articular cartilage lesions in anterior cruciate ligament-injured knees a nationwide cohort study from Sweden and Norway of 15,783 patients. Am J Sports Med 2011; 39(7): 1387-94.

[26] Church S, Keating JF. Reconstruction of the anterior cruciate ligament timing of surgery and the incidence of meniscal tears and degenerative change. J Bone Joint Surg Br 2005;87(12): 1639-42.

[27] Kluczynski MA, Marzo JM, Bisson. L.J. Factors Associated With Meniscal Tears and Chondral Lesions in Patients Undergoing Anterior Cruciate Ligament Reconstruction A Prospective Study. Am J Sports Med 2013; 41(12): 2759-65.