

# Anterior Cruciate Ligament Reconstruction Surgery Timing with Respect to Meniscal-Chondral Damage

Mohammadreza Minator Sajjadi, Mohammad Ali Okhovatpour, Adel Ebrahimpour, Reza Zandi, Meysam Jafari Kafi-Abadi, Mehrdad Sadighi

Department of Orthopedics, Taleghani Hospital, Shahid Beheshti University of Medical Science, Tehran, Iran

## ORCID:

Mohammadreza Minator Sajjadi: <https://orcid.org/0000-0003-2081-7619>

Mohammad Ali Okhovatpour: <https://orcid.org/0000-0001-6779-6662>

Adel Ebrahimpour: <https://orcid.org/0000-0002-7676-3369>

Reza Zandi: <https://orcid.org/0000-0002-0095-6745>

Meysam Jafari Kafi-Abadi: <https://orcid.org/0000-0003-0930-4951>

Mehrdad Sadighi: <https://Orcid.org/0000-0002-4333-3126>

## Abstract

**Background:** Anterior cruciate ligament (ACL) tear is one of the most common types of knee injuries. Delay in diagnosis and treatment of ACL injuries can lead to further damage of the meniscus and cartilage. In this study, we tried to show the distribution of injuries over time and types. **Methods:** This retrospective study was performed on 336 patients with the diagnosis of primary ACL tear without other ligament injuries. The data including site and grade of the meniscal tear and cartilage damage, based on the International Cartilage Repair Society Classification, the time between diagnosis and surgical procedure, and the treatment method were collected. In this study, we divided patients into four groups according to injury to surgery time. Groups were 3 months, 3–6 months, 6–12 months, and over 12 months to surgery. **Results:** The results showed that a rate of cartilage damage had no significant correlation with a time interval between injury and surgery ( $P = 0.54$ ). Furthermore, no significant correlation was found between the site of cartilage damage and the interval time after injury to surgery. The results indicated that the meniscal tear increases in case of a delay to perform surgery ( $P = 0.004$ ). However, no significant relation was found between the site and pattern of meniscal injury and time. Moreover, patients with a complete ACL tear had a significantly higher rate of meniscus injury compared to those with a partial ACL tear (0.048). **Conclusion:** The findings of this study show that there is no significant relationship between the time of surgery and the risk of chondral damage after the ACL tear over time. ACL-ruptured patients should undergo the ACL reconstruction surgery up to 3 months from knee trauma to prevent further meniscal injuries.

**Keywords:** Anterior cruciate ligament, anterior cruciate ligament reconstruction, chondral damage, meniscal injury

## INTRODUCTION

Anterior cruciate ligament (ACL) injuries are the most common knee injury among athletes. The annual incidence rate of ACL tear is up to 0.05% every year in Australia; it is 0.15%–3.7% for contact sports athletes. The rate of such injury for amateur athletes is higher than those belonging to the general population, but it is lower among professional athletes.<sup>[1,2]</sup> Meniscus tears and chondral lesions are often concomitant with the ACL tear at the time of arthroscopic reconstruction.<sup>[3-5]</sup>

Meniscus and chondral lesions associated with ACL tear may occur due to the onset of ACL injury or ACL-related knee instability. ACL injury can cause anterior–posterior and rotary

knee instability over time. Finally, it will increase mechanical pressure on the meniscus and joint cartilage, and this leads to meniscal and cartilage damage.<sup>[6-10]</sup> Delay in diagnosis and treatment of ACL injuries can lead to further damage of the meniscus and cartilage. There is inadequate evidence about determining the best time for ACL surgery to avoid the meniscus and cartilage damage.<sup>[11]</sup>

**Address for correspondence:** Dr. Mehrdad Sadighi,  
Shahid Beheshti University of Medical Science,  
Taleghani Hospital, Tehran, Iran.  
E-mail: mehrdad\_1330@yahoo.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** reprints@medknow.com

**How to cite this article:** Sajjadi MM, Okhovatpour MA, Ebrahimpour A, Zandi R, Kafi-Abadi MJ, Sadighi M. Anterior cruciate ligament reconstruction surgery timing with respect to meniscal-chondral damage. Arch Trauma Res 2018;7:87-91.

### Access this article online

#### Quick Response Code:



**Website:**  
[www.archtrauma.com](http://www.archtrauma.com)

**DOI:**  
10.4103/atr.atr\_29\_18

Such information about patients with ACL rupture, such as changes in the incidence and pattern of meniscus and cartilage damage, could point our chosen time in ACL reconstruction surgery over time.

The aim of this retrospective study was to evaluate the incidence rate of ACL tear-associated injuries, such as cartilage and meniscus lesions and their pattern changes, based on the time. Patient-related parameters were also investigated.

## METHODS

This retrospective study was performed on 336 patients diagnosed with primary ACL tear and without any other ligament injuries during 2015–2017. The patients underwent arthroscopic reconstruction and their ACL injuries were diagnosed by clinical examination and magnetic resonance imaging studies. All the patients had been treated by one senior knee surgeon in the Taleghani Hospital of Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Files of these patients were reviewed. After that, necessary data, including the location and grade of cartilage damage based on the International Cartilage Repair Society Classification (ICRS),<sup>[12]</sup> the location and pattern of meniscus tears, the time between diagnosis and surgical procedure, and the treatment method, were collected.

The demographic characteristics of the patients, such as age, sex, and mechanism of damage, were recorded as well. Both descriptive and statistical analyses were performed.

## RESULTS

From a total of 336 consecutive patients who underwent primary ACL reconstruction, 291 were male (86.6%) and the remaining were female (13.4%). The mean age of the patients was 28.5. In total, 191 patients were athletes and had the ACL rupture during sports activity. There were 145 nonathletic patients. As many as 314 cases were diagnosed with a complete ACL tear and others had an incomplete tear. Figure 1 shows the time interval between injury and surgery, with the latter being divided into four groups: injury up to 3 months, 3–6 months, 6–12 months, and finally, patients with surgery after 12 months.

Medial femoral condyle was the mode region of cartilage damage, but an intact cartilage with a rate of 57.4% was the dominant pattern [Table 1]. Grade II cartilage damage in accordance with the ICRS classification with a rate of 81.35% was the most seen pattern, following Grade I cartilage damage with a rate of 4.46% [Table 2]. As many as 108 patients had no meniscus injury (35.22%). Among patients with meniscus injury, the most frequent site was the posterior horn of medial meniscus (59.63%) [Figure 2]. The most prevalent pattern of meniscus tear during arthroscopy was the bucket-handle type (39.3%), followed by complex and longitudinal tears [Table 3]. All treatments for the patients with meniscus tears have been summarized in Table 4.

According to the results of this study, 40% of cartilage damages were seen in Group 1 (first 3 months) and 49% in Group 2 (3–6 months), 44% in Group 3 (6–

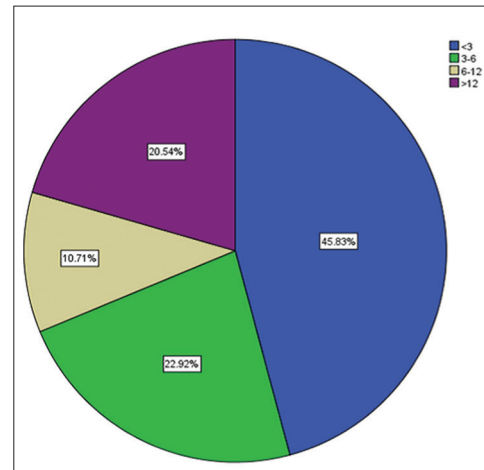


Figure 1: Distance: Time interval between injury and surgery

Table 1: Distribution of cartilage damage during arthroscopy

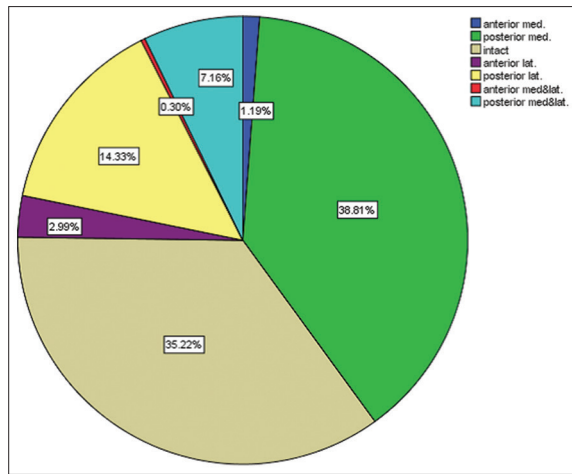
Damage area	Frequency (%)
Medial femoral condyle	110 (32.7)
Lateral femoral condyle	30 (8.9)
Intact	193 (57.4)
Patellofemoral	3 (9)
Total	336 (100.0)

Table 2: Grade of cartilage damage

Cartilage damage grade	Frequency (%)
0	201 (59.8)
1	15 (4.5)
2	109 (32.4)
3	9 (2.7)
4	1 (0.3)
Total	335 (99.7)
Missing	1 (0.3)
Total	336 (100.0)

Table 3: Patterns of meniscus injury

Patterns of meniscus injury	Frequency (%)
Radial	3 (0.9)
Horizontal	4 (1.2)
Longitudinal	37 (11.0)
Bucket handle	89 (26.5)
Complex	50 (14.9)
Root	10 (3.0)
Intact	108 (32.1)
Total	301 (89.6)
Missing	35 (10.4)
Total	336 (100.0)



**Figure 2:** Meniscus lesion site distribution. MEN.L: Meniscus lesion, Med: Medial, lat: Lateral

Procedure	Frequency (%)
Repair in-out	117 (34.8)
Repair out-in	7 (2.1)
Partial meniscectomy	88 (26.2)
Meniscectomy	7 (2.1)
Without meniscus procedure	115 (34.2)
Total	334 (99.4)
Missing	2 (0.6)
Total	336 (100.0)

12 month), and 39% for Group 4 (>1 year following ACL tearing).

Furthermore, the results showed that the rate of cartilage damage had no significant correlation with a time interval between injury and surgery ( $P = 0.54$ ). In addition, no significant correlation was found between the location of cartilage damage and the interval time after injury to surgery [Figure 3 and Table 5].

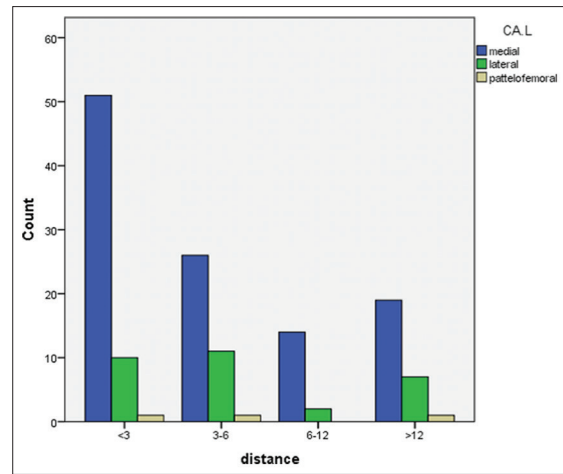
The results indicated that meniscal tears increased by delay in performing surgery ( $P = 0.004$ ). However, no significant relation was found between the site and pattern of meniscal injury and the time [Figures 4 and 5].

Moreover, the results revealed that the type of meniscus tear treatment did not change with delay in surgery ( $P = 0.49$ ).

Furthermore, patients with a complete ACL tear had a significantly higher rate of meniscus injury compared to those with a partial ACL tear (0.048). However, there was no significant difference between complete and partial ACL injuries regarding the site and pattern of a meniscus tear.

## DISCUSSION

Isolated ACL tears have remained a common orthopedic injury with an annual incidence of 68.6/100,000 person-years.<sup>[1-3]</sup> Owing to rotational knee instability after ACL rupture, chondral and meniscus injury is a major concern.<sup>[13,14]</sup> In consequence,



**Figure 3:** Cartilage lesion based on time. CA.L: Cartilage lesion

knee pain could influence one’s activity, quality of life, and association with secondary knee osteoarthritis over time.<sup>[13,15]</sup> In this regard, this study aimed to investigate the time of choice for ACL reconstruction to improve the postoperation results.

In 1983, Noyes *et al.* tried to find the best treatment for the torn ACL, and finally, they cited lack of enough data about associated injuries with the torn ACL.<sup>[16]</sup> In 1993, Keene *et al.* investigated 176 consecutive patients with ACL insufficiency and concluded that there is a high incidence of meniscal injury, which could increase with chronicity of the instability, and there is an indication for early arthroscopy to diagnose the repairable tear of the medial meniscus.

The findings showed that there is a concomitant meniscal injury that might happen during primary trauma or after the ACL tear by an unstable knee. This could influence the ACL reconstruction results and accelerate the osteoarthritis formation.<sup>[13-15]</sup>

Appropriate preoperation rehabilitation and the effect of an unstable knee on the meniscus and cartilage are challenging issues regarding ACL reconstruction. In 2002, Millett *et al.* studied 39 skeletally immature patients with ACL deficit to clarify the controversial issues about the time of surgery. Their results have advocated early reconstructive surgery with no point of operation time,<sup>[17]</sup> so the ideal timing for ACL reconstruction has remained open to research.

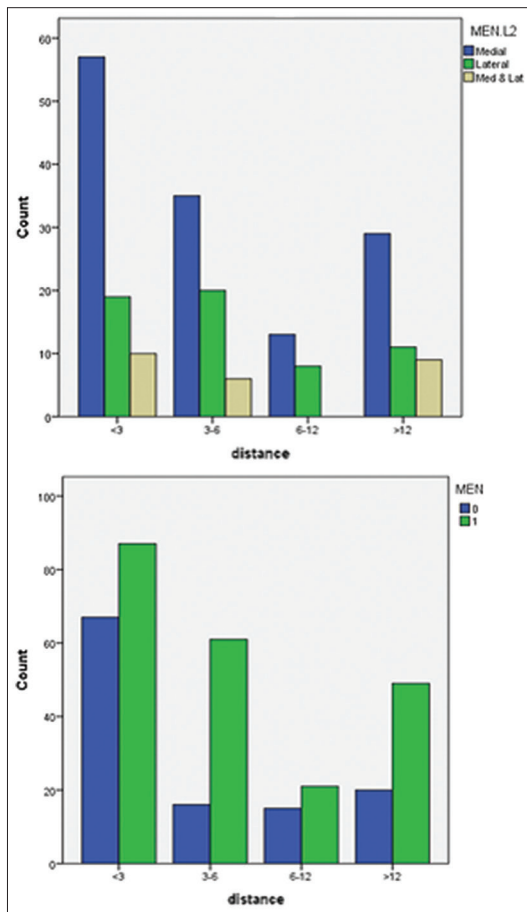
In 2009, Granan *et al.* studied 3475 patients and concluded that the cartilage lesion increased by 1% every month from the time of ACL rupture to ACL reconstruction; moreover, the damage rate of the other one is about twice frequent by the presence of cartilage or meniscal lesions.<sup>[11]</sup> The same results have been achieved by other studies.<sup>[7-10]</sup>

Another study conducted by TeTsuo Hayiho on 549 patients between 2006 and 2014 concluded that ACL tears occur mostly due to sports injuries. The prevalence of meniscus tear was 79% (72.7% in a phase < 8 weeks and 84.8% in a phase > 8 weeks). There is a stronger relationship between lateral meniscus tear with

**Table 5: Meniscal and cartilage injuries in four time groups' chondral lesion and meniscus lesion**

Parameters	Injury	Under 3 months (%)	3-6 months (%)	6-12 months (%)	Over 12 months (%)
CL	With	40.3	49.4	44.5	36.7
	Without	59.7	50.6	55.5	63.3
Prevalence		Injuries occurred in prevalence of 40.3% up to 3 months	Injuries occurred in prevalence of 52.4% over 3 months		
MENL	With	56.2	79.2	40	71.7
	Without	43.8	20.8	60	28.3
-		Injuries occurred in prevalence of 56.2% up to 3 months	Injuries occurred in prevalence of 70.4% over 3 months		

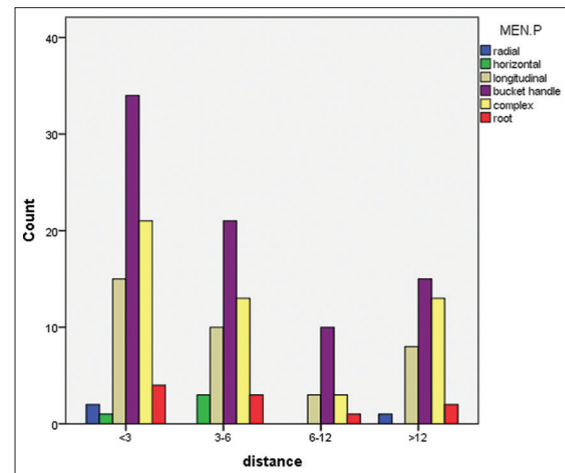
CL: Chondral lesion, MENL: Meniscus lesion



**Figure 4:** Meniscus injury based on time. 0: Intact meniscus, 1: Meniscus tear, MEN: Meniscus MENL: Meniscus location

the acute phase of ACL tear and medial meniscus tear with the chronic phase of ACL tear. Meniscal bucket-handle tear was greater in the chronic phase. Early reconstruction of ACL is recommended for patients with ACL tear to prevent secondary meniscus tear.<sup>[18]</sup> On the other hand, Brambilla *et al.* recommended that ACL reconstruction should not be delayed for more than a year after the injury because of the increased risk of meniscal tear and chondral injuries after this period.<sup>[19]</sup>

One can mention that the results obtained through this investigation support the findings concerning the meniscal injuries mentioned by the Brambilla study.<sup>[19]</sup> However, no evidence has been found to show the relationship between the time of surgery and chondral damage.



**Figure 5:** Meniscus pattern based on time. MEN.P: Meniscus pattern

The investigation of further parameters in the study shows that there is not enough evidence to prove the existence of the relationship between the age of patients, the type of meniscus tear, and the level of cartilage damage. However, a significant relationship between the nature of trauma and the type of the ACL rupture have been identified.

According to the results of this study, meniscal injuries were significantly higher in patients with ACL reconstruction within 3–6 months and >12 months from the ACL tear. However, there was no significant relationship between the time of injury to repair and location and pattern of meniscal injury and consequently the operation method for ACL reconstruction.

The results of this study showed that the type of meniscus tear did not change with a delay in surgery ( $P = 0.49$ ). These results are not comparable to other studies. This is because despite relevant studies, we found no relationship between time of surgery and cartilage damage. This data may affect by the short time window among our patients.

Patients with complete ACL tear had a significantly higher rate of meniscus injury compared to those with the partial ACL tear (0.048). However, there was no significant difference between complete and partial ACL injuries regarding the site and pattern of the meniscus tear.

Our analysis showed that meniscal tear increases in case of a delay to perform surgery over 3 months ( $P = 0.004$ ). These data advocate early surgery within a certain period to prevent

further soft-tissue damage. Moreover, this gap of time is an advantage to preoperative rehabilitation.

Furthermore, the findings of this study showed no significant relation between time of surgery and chondral damage. It seems that if we had the same groups of patients in four groups regarding number, age, and other demographic features, results might be different.

The major limitation of this study was not considering preoperative rehabilitation that may improve the outcome of ACL reconstruction and change the optimal time of surgery. Thus, further research should consider preoperative rehabilitation.

## CONCLUSION

According to the results of the present study, there is no significant relationship between the time of surgery and the risk of chondral damage after the ACL tear over time, and patients with the ACL rupture should undergo ACL reconstruction surgery up to 3 months from knee trauma to prevent further meniscal injuries.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Moses B, Orchard J, Orchard J. Systematic review: Annual incidence of ACL injury and surgery in various populations. *Res Sports Med* 2012;20:157-79.
- Junge A, Rösch D, Peterson L, Graf-Baumann T, Dvorak J. Prevention of soccer injuries: A prospective intervention study in youth amateur players. *Am J Sports Med* 2002;30:652-9.
- Andersson C, Odensten M, Good L, Gillquist J. Surgical or non-surgical treatment of acute rupture of the anterior cruciate ligament. A randomized study with long-term follow-up. *J Bone Joint Surg Am* 1989;71:965-74.
- Buss DD, Min R, Skyhar M, Galinat B, Warren RF, Wickiewicz TL, *et al.* Nonoperative treatment of acute anterior cruciate ligament injuries in a selected group of patients. *Am J Sports Med* 1995;23:160-5.
- Fitzgerald GK, Axe MJ, Snyder-Mackler L. A decision-making scheme for returning patients to high-level activity with nonoperative treatment after anterior cruciate ligament rupture. *Knee Surg Sports Traumatol Arthrosc* 2000;8:76-82.
- Bedi A, Chen T, Santner TJ, El-Amin S, Kelly NH, Warren RF, *et al.* Changes in dynamic medial tibiofemoral contact mechanics and kinematics after injury of the anterior cruciate ligament: A cadaveric model. *Proc Inst Mech Eng H* 2013;227:1027-37.
- Boeth H, Duda GN, Heller MO, Ehrig RM, Doyscher R, Jung T, *et al.* Anterior cruciate ligament-deficient patients with passive knee joint laxity have a decreased range of anterior-posterior motion during active movements. *Am J Sports Med* 2013;41:1051-7.
- Lee SJ, Aadalen KJ, Malaviya P, Lorenz EP, Hayden JK, Farr J, *et al.* Tibiofemoral contact mechanics after serial medial meniscectomies in the human cadaveric knee. *Am J Sports Med* 2006;34:1334-44.
- Murrell GA, Maddali S, Horovitz L, Oakley SP, Warren RF. The effects of time course after anterior cruciate ligament injury in correlation with meniscal and cartilage loss. *Am J Sports Med* 2001;29:9-14.
- Papageorgiou CD, Gil JE, Kanamori A, Fenwick JA, Woo SL, Fu FH, *et al.* The biomechanical interdependence between the anterior cruciate ligament replacement graft and the medial meniscus. *Am J Sports Med* 2001;29:226-31.
- Granan LP, Bahr R, Lie SA, Engebretsen L. Timing of anterior cruciate ligament reconstructive surgery and risk of cartilage lesions and meniscal tears: A cohort study based on the Norwegian National Knee Ligament Registry. *Am J Sports Med* 2009;37:955-61.
- Brittberg M, Winalski CS. Evaluation of cartilage injuries and repair. *J Bone Joint Surg Am* 2003;85-A Suppl 2:58-69.
- Gupta R, Masih GD, Chander G, Bachhal V. Delay in surgery predisposes to meniscal and chondral injuries in anterior cruciate ligament deficient knees. *Indian J Orthop* 2016;50:492-8.
- Coyner KJ, Chavez AA, Riepen DW, Schell B, Khazzam MS. Anterior Cruciate Ligament Tears: Impact of Delayed Presentation on Intra-Articular Injuries. *Orthopaedic Journal of Sports Medicine* 2017;5 (7\_suppl6).
- de Campos GC, Nery Jr W, Teixeira PE, Araujo PH, Alves Jr WD. Association between meniscal and chondral lesions and timing of anterior cruciate ligament reconstruction. *Orthopaedic journal of sports medicine* 2016;4.
- Noyes FR, Mooar PA, Matthews DS, Butler DL. The symptomatic anterior cruciate-deficient knee. Part I: The long-term functional disability in athletically active individuals. *J Bone Joint Surg Am* 1983;65:154-62.
- Millett PJ, Willis AA, Warren RF. Associated injuries in pediatric and adolescent anterior cruciate ligament tears: Does a delay in treatment increase the risk of meniscal tear? *Arthroscopy* 2002;18:955-9.
- Hagino T, Ochiai S, Senga S, Yamashita T, Wako M, Ando T, *et al.* Meniscal tears associated with anterior cruciate ligament injury. *Arch Orthop Trauma Surg* 2015;135:1701-6.
- Brambilla L, Pulici L, Carimati G, Quaglia A, Prospero E, Bait C, *et al.* Prevalence of associated lesions in anterior cruciate ligament reconstruction: Correlation with surgical timing and with patient age, sex, and body mass index. *Am J Sports Med* 2015;43:2966-73.