

## Timing of Anterior Cruciate Ligament Reconstruction and Incidence of Meniscal and Chondral Injury within the Knee

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### ABSTRACT

**Background:** To review a single-surgeon series of 616 athletic patients with anterior cruciate ligament reconstructions in order to evaluate the relationship between the timing of the reconstruction and the incidence of meniscal and chondral injuries.

**Methods:** Six group of patients were categorized based on the time interval from their injury to surgery in the following manner: <3 months, 3-6 months, 6-9 months, 9-18 months, 18-36 months, and >36 months. The presence of meniscal tears was documented and chondral pathology was scored based on the Outerbridge classification.

**Results:** Incidence of medial meniscus tear was significantly higher in patients undergoing reconstruction after 3 months from their injury ( $P = 0.032$ ). The opportunity of patients with chondral pathology was recorded to be significantly higher in the groups operated on after 6 months from their injuries time ( $P = 0.008$ ).

**Conclusions:** Considering the effect of time on the rate of having meniscus injury and chondral pathology, reducing the time between the injury and surgery could improve the long-term health outcomes in this population.

**Keywords:** Chondral injury, ligament reconstruction, meniscal

### INTRODUCTION

Every year, a large number of athletes experience knee trauma during training session and competitions. The anterior cruciate ligament (ACL) is the most commonly injured ligament of the knee, which mainly affects patients between 15 and 45 years of age.<sup>[1]</sup> ACL tear can be secondary to contact or non-contact traumatic situation. However, non-contact condition is more prevalent.<sup>[1-4]</sup> The ACL rupture can occur not only as a sole event but also in association with the rupture of meniscus and other ligaments.<sup>[5-7]</sup>

While the reconstruction of an injured ACL is considered as one of the most important procedures in sport injury, the optimal timing for the operation remains uncertain.<sup>[8]</sup> The safety and efficacy of the timing of the operation is controversial.<sup>[9]</sup> It appears that some consensus has been achieved on this issue with

more surgeons waiting for the resolution of the acute hemarthrosis and the restoration of normal gait and range of movement before performing the surgery. It has also been suggested that any undue delay in surgery may lead to an increase in meniscal pathology such as experiencing recurrent episodes of giving ways, which could damage the articular surface.<sup>[10]</sup> The timing of surgery is of importance in counseling patients regarding the outcome of surgery and could be of particular interest while treating patients within a healthcare system with limited resources. It may also help surgeons to set priorities to their waiting list.

Recent long-term clinical researches have pointed out the increased risk of secondary meniscal damage and chondral lesion in patients with chronic ACL deficiency.<sup>[11-13]</sup> The present study, therefore, was designed to evaluate the association between ACL deficiency and its impact on meniscal and articular cartilage injury among groups of professional Iranian athletes and also to determine whether there is a correlation between the timing of reconstruction and these types of injuries.

## METHODS

The present retrospective study was conducted on the medical records of 616 consecutive professional athletes gathered from referral hospitals between 1995 and 2009. Based on these records, the studied athletes had visited a single orthopedic surgeon (M.R.) because of knee injury and they were diagnosed with ACL tear, which was confirmed by magnetic resonance imaging (MRI) and arthroscopy. Athletes who were injured through a non-exercise mechanism such as experiencing a car accident, those experiencing concomitant ACL tear and tibia or fibula fracture, and those with a positive history of meniscal tear in the same leg were excluded.

The demographic information of the athletes including their age, gender, the injured leg, the sport in which they were involved, the duration between the time of injury and the surgery, and the injured ligaments was recorded in a questionnaire. The sport in which the athletes were involved consisted of soccer, wrestling, ball games (handball, volleyball, and basketball), martial arts, and others (ski, tennis, table tennis, running, badminton, skating, etc.). The duration between the time of injury and that of surgery was classified as <3 months (Group A),

3-6 months (Group B), 6-9 months (Group C), 9-18 months (Group D), 18-36 months (Group E), and >36 months (Group F). In cases with meniscal tear, the data on individuals with total meniscus injury regardless of their grade were entered and those with partial tears were excluded. Chondral lesion was graded based on the Outerbridge classification. Severity of chondral pathology was divided into two groups: Low graded groups (type 1 and 2) and high grade groups (type 3 and 4).

The data gathered from 616 athletes were entered and then analyzed using SPSS.<sup>[14]</sup> Chi-square test was used to evaluate the correlation between the presence of the meniscal tear, chondral damage, and the duration between the time of injury and that of surgery.

## RESULTS

Overall, 564 (91.6%) out of a total of 616 athletes with ACL tear enrolled in this study were male. The mean age was 27.6 years, ranging from 13 to 60 years. Table 1 outlines the gender distribution and the sports in which the athletes were involved.

The single ACL injury was reported in 103 (16.7%) of the athletes. Table 2 shows the prevalence of meniscal damage in different sports. Medial meniscus injuries were more prevalent than lateral meniscus injuries among our professional athletes.

Also, 115 (18.7%) of athletes had chondral lesions. Among them, 104 (90%) athletes were male and 11 (9%) were female. There was no significant association between chondral pathology and sex of the athletes ( $P > 0.05$ ). After an interval of 6 months, there was a significant increase in the prevalence of chondral lesions (Chi square test,  $P = 0.008$ ) [Table 3].

Based on what was reported and identification by MRI and arthroscopic findings, medial femoral condyl showed more prevalent chondral injuries (58.11%) than lateral side due to ACL deficiency.

The prevalence of medial and lateral menisci tears within the groups is presented in Table 4. Considering the gathered information, the severity of tears in the medial meniscus increases over time since the injury.

## DISCUSSION

The present study was conducted on 616 athletes involved in different sports diagnosed with ACL

**Table 1:** The frequency of athletes involved in different sports

Variable	Soccer		Wrestling		Ball games		Martial arts		Others		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Male	276	44.8	34	5.5	44	7.1	46	8.2	164	26.6	564	91.6
Female	2	0.3	0	0	7	1.2	5	0.8	38	6.2	52	8.4
Total	278	45.1	34	5.5	51	8.3	61	8.3	202	32.8	616	100

**Table 2:** The incidence of medial and lateral meniscus injury in different sports

Sport	Athletes with injured meniscus		Athletes without injured meniscus		Total
	#	%	#	%	
	<b>Soccer</b>				
Medial meniscus	172	61.9	106	38.1	278
Lateral meniscus	73	26.3	205	73.7	
<b>Wrestling</b>					
Medial meniscus	18	52.9	16	47.1	34
Lateral meniscus	13	38.2	21	61.8	
<b>Ball games</b>					
Medial meniscus	41	80.4	10	19.6	51
Lateral meniscus	16	31.4	35	68.6	
<b>Martial arts</b>					
Medial meniscus	29	56.9	22	43.1	51
Lateral meniscus	17	29.2	34	66.7	
<b>Others</b>					
Medial meniscus	133	65.8	69	34.2	202
Lateral meniscus	59	33.3	143	70.8	
<b>Total</b>					
Medial meniscus	393	63.8	278	36.2	616
Lateral meniscus	178	28.9	438	71.1	

tear based on the findings of clinical examination, MRI, and arthroscopy. The first strength of our study lies in the ability of examining a large group of patients by a single surgeon (M.R.). This is of great importance since the identification of pathology during knee arthroscopy has been shown to be related to the observer’s capability.<sup>[15,16]</sup> About 16.7% of the studied population had ACL tear alone. We found an increased incidence of medial meniscal tears if the interval between the injury and reconstruction process was >3 months. A significant reduction was also found in the number of patients with normal articular surfaces after a delay of 6 months in the time of operation.

Prade *et al.*, reported a relatively higher prevalence (44%) of single ACL tear among patients with acute knee injuries accompanied with hemarthrosis over a

90-days period.<sup>[14]</sup> Similarly, Frobell *et al.*, reported the prevalence of ACL rupture in the general population to be about 30%, which was higher than previously described.<sup>[17]</sup> The difference between the diagnostic methods was considered as the main reason contributing to the discrepancies reported in these studies. In other words, while MRI was used to detect ACL tear in the abovementioned studies, our patients were diagnosed by clinical examination, MRI, and arthroscopic evaluations. The higher accuracy of the diagnostic procedures in our study accounts for the reduced number of single ACL tear and increased rate of combined meniscal and/or chondral injuries. The other possibility for having differences of the prevalence of single ACL tear in our population is on the basis of late referral of athletes to orthopedic surgeon. Some of athletes prefer to continue playing without considered their injury. It can extend their knee complications and decrease the rate of single ACL tear.

Based on our findings, there was an association between delayed reconstruction and an increased incidence of medial meniscus tear and chondral pathology after 3 and 6 months, respectively, which is clinically important.

To our knowledge, few studies have investigated the relationship between a delay in reconstruction and the incidence of secondary pathologies. In line with the results published by Papastergiou *et al.*, our finding showed the association between ACL tear and meniscus injury 3 months after the events. It could be concluded that the rate of secondary meniscus injury increases over time and, therefore, the operation should be performed within 3 months of the injury.<sup>[18]</sup> While Rocha *et al.*, described similar findings, they noted a higher rate of lateral meniscus injury within the first 3 months of ACL tear.<sup>[19]</sup> Papastergiou *et al.*, studied 451 patients who had been undertaken reconstructive operation.<sup>[18]</sup> They examined the incidence of meniscal tears based on the interval between the injury and operation, but failed to assess the possible changes in the articular

**Table 3:** The incidence and severity of chondral injuries among 6 groups

Time range (months)	# of athletes	No chondral lesion		Low grade chondral lesion		High grade chondral lesion		Total chondral lesion	P value
		#	%	#	%	#	%		
		0-3	209	189	37.9	3	10.7		
3-6	62	56	11.1	2	7.1	4	4.5	6	0.980
6-9	41	31	6.2	4	14.3	6	6.7	10	0.008
9-18	95	77	15.4	5	17.9	13	14.6	18	0.022
18-36	75	57	11.4	5	17.9	13	14.6	18	0.002
After 36	134	89	17.8	9	32.1	36	40.4	45	0.000
Total	616	133	100	28	100	89	100	117	

**Table 4:** Incidence of meniscal tears in the 6 groups

Group	# of athletes	No med. meniscus tear		Med. meniscus tear		P value	No lat. meniscus tear		Lat. meniscus tear		P value	Both sides tear	
		#	%	#	%		#	%	#	%		#	%
		A	209	110	52.6		99	47.4		150		71.8	59
B	62	23	37.1	39	62.9	0.032	48	77.4	14	22.6	0.379	6	9.6
C	41	14	34.1	27	65.9	0.030	31	75.6	10	24.4	0.615	4	9.7
D	95	32	33.7	63	66.3	0.002	69	72.6	26	27.4	0.877	15	15.7
E	75	23	30.7	52	69.3	0.001	52	69.3	23	30.7	0.690	11	14.6
F	134	21	15.7	113	84.3	0.000	88	65.7	46	34.3	0.232	38	28.3
Total	616	223	36.2	393	63.8		438	71.1	178	28.9		98	15.9

surface. They found an increased incidence of both medial and lateral meniscal tears when the operation was postponed beyond 3 months. Due to the fact that most of the elite players are expected to continue their participation in competitions of the league despite of their injury, serious rehabilitation will be achieved for their recovery. Therefore, after rehabilitation process and reducing their pain and effusion, pseudo well-being and self confidence will occur. These athletes believed that the recovery of ACL tearing was completed and they could continue their playing without any treatment for their knee. But, unfortunately, this type of estimation will increase the chance of severe injury, especially meniscal tear.

The incidence of chondral lesion among our population increased as the interval between injury and reconstruction was >6 months. Church and Keating<sup>[10]</sup> reviewed 187 patients and found a significant increase in degenerative changes of grade 1 to 4 (31.3% vs 10.7%) and also in the overall incidence of meniscal tears among those who had undergone late reconstruction (after >12 months of injury). Based on our findings, significant changes in the articular surface of the injured knee starts in less than a year.

It has been suggested that patients with ACL deficiency dispose to the development of chondral injuries in weight bearing activities due to excessive anterior tibial translation and rotational instability in their injured knee.

In a similar study conducted by Murell *et al.*,<sup>[20]</sup> the injuries to the medial condyl of femur were more prevalent than other parts of condyls.

It is believed that the increased shear stresses on the meniscus and the application of greater weight-bearing loads on the articular surface (unconditioned cartilage region), which was not previously functionally loaded, may account for the abnormal translation and rotational motions following ACL injury.<sup>[21,22]</sup> Moreover, opposite to the constantly changing, contact points of the tibio-femoral articulation in a normal knee (rollback), the femur in an ACL-deficient knee may remain in contact with a section of the articular surface of tibia, resulting in point-loading with non-physiological loads, leading to degeneration process and chondral damage.<sup>[23]</sup> Andriacchi *et al.*, in their finite element analysis of the kinematic changes related to ACL deficiency, confirmed this hypothesis.<sup>[22]</sup> Barker *et al.*,<sup>[1]</sup> found that the relative

internal rotation of the tibia secondary to ACL injury results in an increased cartilage loss especially in the medial compartment of the injured knee. This finding is believed to be secondary to a shift of load bearing to the thinner regions of articular cartilage.

Despite the increased risk of chondral injuries secondary to a delay of >6 months in the time of surgery, there was a peak of high-grade chondral lesion among athletes operated in the first 3 months. This could be contributed to the severity of injuries at the time of damage. Acute chondral injuries have been reported in 20% of ACL tears; however, many authors believe that the common pattern of bone bruise, known as post-traumatic bone marrow lesions, represent occult damage to the cartilage secondary to the compressive force imposed on the joint surface at the time of the ACL tear.<sup>[24-26]</sup>

One of our limitations include low number of female athletes in the study. As the number of professional female athletes is lower than in some other countries, there are not many high-level competitions; similarly, international competition is subject to considerable limitation. Therefore, we could not compare our results about women's sports to that in other studies.

## CONCLUSION

In conclusion, based on our findings, in order to reduce the chance of the occurrence of instability induced medial meniscal tears and chondral lesions, reconstruction should be performed before 6 months after injury. It is recommended that surgical reconstruction should be performed instantaneously after conduction of intensive rehabilitation program, psychological preparation, and economical support. Due to the fact that the return to play is one of the most imperative and challenging subjects in sports medicine field, identifying the best time for reconstruction of ACL deficiency is of high importance. It seems that time preparation to improve patients' compliance to surgery takes between 3 weeks to 3 months.

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