

Patterns of Meniscus Tears Associated with Posterior Cruciate Ligament Lesions

Abstract

Purpose: The aim of this study was to assess the incidence and patterns of meniscus tear accompanying the posterior cruciate ligament (PCL) lesion.

Method: 81 patients with a diagnosis of chronic PCL tear that underwent PCL reconstruction surgery were included in the study. The patients' files were reviewed. The location and grade of cartilage damage, the location and pattern of meniscus tears, the interval between diagnosis and surgical procedure, and the treatment method were collected.

Result: The average interval between the incidence of trauma and surgery was 16.73 ± 33.1 months. The interval between the incidence of trauma and surgery in patients with meniscal tear was 24.6 ± 4.86 months and in patients without meniscal tear was 12.76 ± 2.1 months. Meniscal tear was detected in 27 patients (33.3%). It was in medial meniscus in 19 (23.5%) and in lateral menisci in eight (9.9%) patients. The most common site of meniscal tear was root tear and mostly avulsion of meniscus root. Of these, 6 patients had posterior root avulsion of medial menisci. Cartilage lesions were detected in 14 patients (17.3%).

Conclusion: Based on the present study. The most common pattern of meniscal tear in cases of PCL tear is posterior medial meniscus avulsion tear. Such a tear deteriorates overtime.

Keywords: Posterior cruciate ligament, posterior cruciate ligament reconstruction, meniscal injury, Cartilage lesions, Arthroscopy

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Introduction

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The incidence of Posterior cruciate ligament (PCL) tears is less than 20% of knee ligament injuries⁽¹⁾. Although PCL tear is less common than anterior cruciate ligament (ACL) tears, the grade III PCL tears can cause more instability in the knee in comparison with grade III ACL tears⁽²⁾. Injuries that tear the PCL often damage some of the other ligaments or cartilage in the knee, as well. In addition, patients with grade III PCL tears have posteromedial or posterolateral knee injuries^(3,4).

The relationship between PCL injuries and meniscal tears regarding clinical data are very limited. Pearsall et al. showed that strain on the meniscus increases with complete PCL injury. After PCL reconstruction this strain is decreases⁽⁵⁾. Evidence about the biomechanical changes in PCL injury and its impact on meniscus is scarce. In PCL the resultant force on medial meniscus is significantly elevated and it may result into higher rates of osteoarthritis in medial compartment of the knee or may increase risk of medial meniscus tear⁽⁵⁾.

Some literature studies evaluated the patterns of meniscal tears or chondral injuries that accompany ACL tears^(6,7); however, studies that assess the patterns of meniscal tear associated with PCL tear are limited.

The current retrospective study aimed at evaluating the incidence of PCL tear associated with injuries, such as meniscus tears (incidence, pattern, and location) and chondral damages. The patients' demographic data were also assessed.

Methods

Total of 81 patients with a diagnosis of chronic PCL tear that underwent PCL reconstruction surgery in Taleghani Hospital (affiliated to Shahid Beheshti University of Medical Sciences, Tehran, Iran) from 2014 to 2019 were included in the study. The tear of PCL was diagnosed based on posterior drawer test and posterior sag sign confirmed by magnetic resonance imaging (MRI). All the patients had PCL tear grade II or III; in addition, the diagnosis was confirmed with posterior stress view in subjects with doubtful grade of tear. All the patients were treated by a single surgeon attending in Taleghani Hospital.

The patients' files were reviewed and required data, including the location and grade of cartilage damage based on the International Cartilage Repair Society Classification (ICRS), the location and pattern of meniscus tears, the interval between diagnosis and surgical procedure, and the treatment method were collected.

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

Statistical analysis

For quantitative data with normal data T student and for abnormal distributions Mann-Whitney U test, and Chi-Square test for qualitative variables were used. $P < 0.05$ was set as the level of significance. SPSS version 25 was used for the analysis of measurements.

Ethical considerations

This retrospective Cross-Sectional study was conducted according to the declaration of Helsinki. This study was approved by the ethical committee of Shahid Beheshti University of Medical Sciences with the Registration code of: IR.SBMU.MSP.REC.-1396.868. Due to the lack of intervention and interaction with the patient, patient's consent was not required. All patients with primary and

posterior cruciate ligament injuries from 2014 to 2019 records were reviewed and people with vascular lesions were excluded.

Results

In the current study, a total of 81 patients who underwent PCL reconstruction from 2014 to 2019 in Taleghani Hospital were evaluated, of which 71 subjects were male (87.7%) and 10 female (12.3%). The mean age was 30.64 ± 8.68 years ranged. The mean weight was 76.10 ± 10.84 Kg ranged from 40 to 106 Kg. The average interval between the incidence of trauma and surgery was 16.73 ± 33.1 months (ranged from 20 days to 15 years). The demographic characteristics of all patients were compared among the three groups (Table 1).

The mechanism of trauma was motor car accident in 35 (43.2%) patients, car accident in 25 (30.9%), sport injury in 10 (12.3%), motor accident in 6 (7.4%) and falling in 5 (6.2%) subjects. Right knee was involved in 44 (54.3%) patients and left knee in 37 (45.7%).

Meniscal tear was detected in 27 patients (33.3%), while it was in medial meniscus in 19 (23.5%) patients and in lateral menisci in 8 (9.9%) subjects. The most common site of meniscal tear was root tear (Chart 1) and the most common pattern of meniscal tear was root avulsion ($n=10$) (Chart 2). Of these, 6 patients had posterior root avulsion of medial menisci. The second pattern of meniscal tear was longitudinal tear (7.4%) most commonly in middle third of the medial meniscus and the third pattern was radial tear (4.9%), most commonly in lateral meniscus. In 21 patients, menisci were repaired and in six subjects partial meniscectomy was performed.

Cartilage lesions were detected in 14 patients (17.3%). Based on ICRS classification, two patients had grade I, 10 (12.3%) patients had grade II, one patient had grade III, and one patient had grade IIII cartilage lesions.

Anterior cruciate ligament rupture with the incidence of 46.9% was the most common

concomitant ligament lesion, followed by Lateral Collateral Ligament rupture (42%), and Ligament rupture (33.3%).

There was significant difference between meniscal tear and body weight (Mann-Whitney U-test, $p=0.04$), and a significant correlation was observed between the incidence of meniscal tear and interval between the incidence of trauma and surgery (t-test with $P=0.02$). The interval between the incidence of trauma and surgery in patients with meniscal tear was 24.6 ± 4.86 months and in patients

without meniscal tear was 12.76 ± 2.1 months (Mann-Whitney U-test, $p=0.74$).

The correlation between the time of trauma and meniscal tear also was assessed by two cut-off points in six months and one year; however, no significant difference was observed between patients with and without meniscal tear (Tables 2 and 3).

There was no significant correlation between the incidence of meniscal tear and other ligament ruptures in the knee (MCL, LCL, ACL, and PLC).

Tables & Charts

Chart 1. Location of meniscus injury

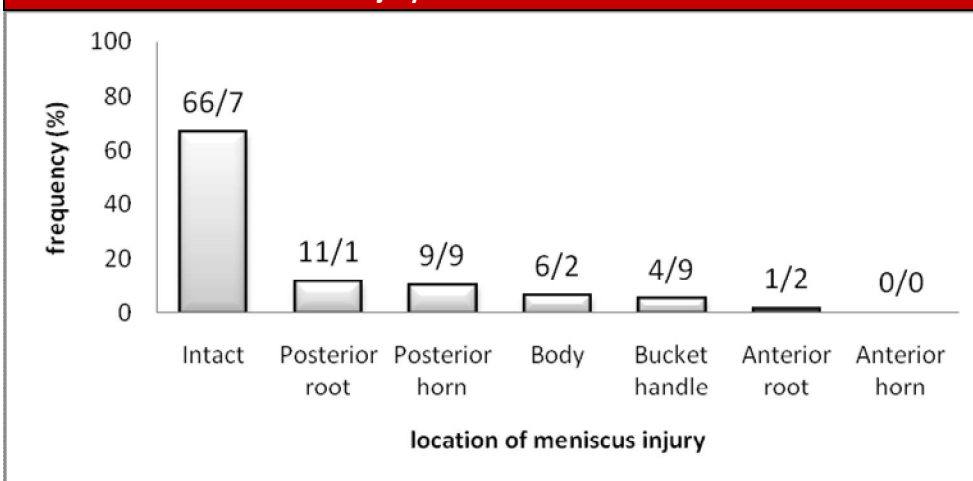


Chart 2. Patterns of meniscus injury

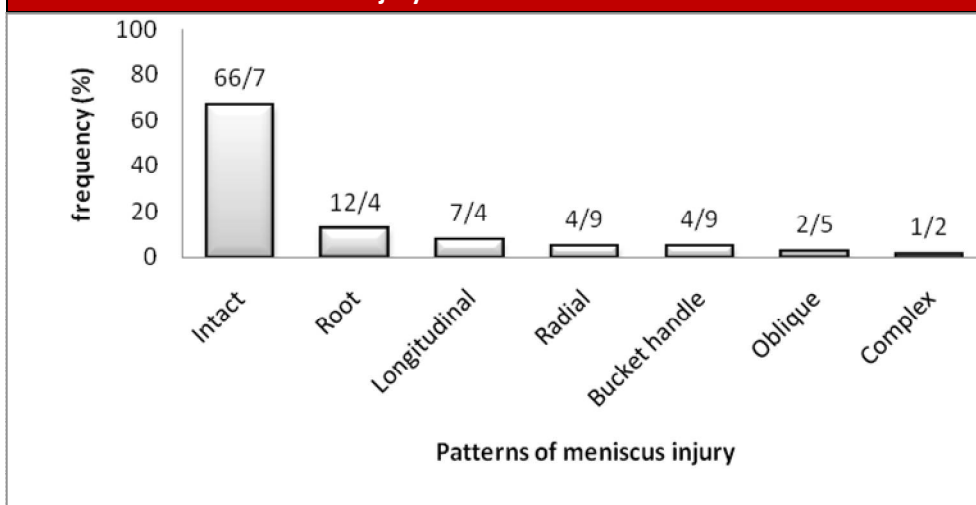


Table 1- Demographics among the groups				
Demographic		Meniscal tear		p value
		Yes (n=27)	No (n=54)	
Gender	Male	24 (88.9)	47 (87)	0.811
	Female	3 (11.1)	7 (13)	
Age (years)		30.3 ± 9.14	30.8 ± 8.52	0.726
Weight (KG)		76.81 ± 10.3	75.7 ± 11.2	0.591

Table 2. Correlation between time of trauma and meniscal tear in six months				
Meniscal tear		Time between Trauma and surgery		p value
		< 6 months (n=32)	surgery >= 6months (n=49)	
Yes		11(34.4%)	16 (32.7%)	0.872
No		21(65.6%)	33(67.3%)	

Table 3. Correlation between time of trauma and meniscal tear in one year				
Meniscal tear		Time between trauma and surgery		p value
		< 12 months (n=55)	surgery >= 12 months (n=26)	
Yes		18 (32.7%)	9 (34.6%)	0.866
No		37 (67.3%)	17 (65.4%)	

Discussion

This study was to assess the incidence and patterns of meniscus accompanying the posterior cruciate ligament lesion. According to the results of the study, meniscal tear was detected in 33.3% of patients: medial meniscus in 23.5% and lateral menisci in 9.9% patients. The prevalent site and pattern of meniscal tear was root tear. 2 (2.5%) patients grade I, 10 (12.3%) patients had grade II, 1 patient (1.2%) had grade III, and 1 patient (1.2%) had grade IIII cartilage lesions. Cartilage lesions were observed in 14 patients (17.3%).

PCL is the main posterior stabilizer of the knee ⁽¹⁾. PCL tear has different outcomes on the knee based on the degree of PCL tear and concomitant ligament injuries ^(8,9). The grade III PCL tear may cause degenerative changes to the medial compartment and patellofemoral compartment of the knee ^(10,11). After one year of PCL injury, the risk of medial femoral cartilage lesions increase three-fold (13.6% vs 39.1%) early and after one year, respectively ⁽¹²⁾.

According to literature review, there are many studies on the meniscal tears with ACL ruptures. In a study by Sajjadi et al. meniscal

injury was detected in 227 (67.7%) out of 335 patients with ACL rupture. Among patients with meniscus injury, the most frequent site was the posterior horn of medial meniscus (59.63%). The most prevalent pattern of meniscus tear during arthroscopy was the bucket-handle type (39.3%), and the risk of meniscal tears increases if delay in surgery is more than three months⁽¹³⁾.

Another study conducted by Hagino et al⁽¹⁴⁾, on 549 patients from 2006 to 2014 concluded that ACL tears occur mostly due to the sports injuries; however, the prevalence of meniscus tear was 79% (72.7% in <8 weeks and 84.8% in >8 weeks).

There was also a stronger relationship between lateral meniscus tear and the acute phase of ACL tear as well as medial meniscus tear and the chronic phase of ACL tear⁽¹⁴⁾. However, the results of PCL ruptures and meniscal tears are limited and most of such studies are the biomechanical analyses. Gao et al. showed that in load less than 200N at 0° flexion PCL transection did not increase medial meniscus strain; however, they showed that after PCL transection medial meniscus strain increased at 30°, 60°, and 90° of flexion.⁽¹⁵⁾ Castle et al. assessed static squatting in patients with PCL deficiency. He showed that in high angle squats (70°-90° flexion) a mean increase in posterior translation of 7.4 mm occurred compared to 2.1 mm for low-flexion squats (32°-50° flexion)⁽¹⁶⁾. Pearsall et al., showed that in complete PCL injury meniscal strain increased and returned to normal after PCL reconstruction. Based on that study posterior cruciate ligament reconstruction may play an important role in reducing meniscal strain and subsequent degenerative changes of the knee⁽⁵⁾.

In a study by Greis et al, posterior or anterior translation of medial femoral condyle at the 0-30° flexion resulted in tear of body of the medial meniscus⁽¹⁷⁾.

When flexion of the knee is more than 60° there is more constrain force on the posterior horn of the medial meniscus⁽¹⁸⁾.

In a study by Anderson et al, the center of the anterolateral bundle of PCL in tibial attachment site is located 6.1 mm from the shiny white fibers of the posterior medial meniscus root⁽¹⁹⁾. It may describe posterior root tear of medial meniscus with PCL tear from tibial site in acute phase. Our study showed that 33.3% of patients with PCL tear had meniscal tear but the most common pattern of meniscal tear was posterior root tear (avulsion) of medial menisci and tears of the posterior horn of medial meniscus was the second site. Of course, we did not detect the femoral or tibial site of PCL rupture. This finding confirmed the results of Pearsall that complete transection of PCL can increase the strain of posterior root or posterior horn of medial menisci. No cutoff point could be found for PCL tear and meniscal tear. However, the interval between the incidence of trauma and surgery in patients with and without meniscal tear was 24.6 ± 4.86 and 12.76 ± 2.1 months respectively and there was a significant difference between the two groups.

The study also had some limitations. The subjects were not pure PCL tear cases and also had some other knee ligament tears. Moreover, in the current study no correlation was found between the incidence of meniscal tear and other ligament ruptures in the knee. To provide more conclusive data to drive this hypothesis, further retrospective studies with larger sample sizes are required.

Conclusion

Based on the present study, the most common pattern of meniscal tear in patients with PCL tear is posterior root tear avulsion in medial meniscus, which might deteriorate over time.

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