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Original Article

ASSOCIATED INJURIES IN MRI-CONFIRMED POSTERIOR CRUCIATE LIGAMENT TEARS: A RETROSPECTIVE STUDY FROM SAUDI ARABIA

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ABSTRACT

Objective: This retrospective study aimed to evaluate concomitant injuries in patients with isolated posterior cruciate ligament (PCL) tears, focusing on fractures, meniscal, chondral, and ligamentous pathologies.

Methods: At King Abdulaziz Medical City, Riyadh, Saudi Arabia (2017–2019), 94 patients with magnetic resonance imaging (MRI)-confirmed isolated PCL tears were analysed. Data included demographics, injury mechanism (traumatic/sports), tear grade (I–III), acuity (acute/chronic), associated injuries, and management. Musculoskeletal radiologists validated MRI findings. Statistical analysis was conducted using Statistical Package for the Social Sciences 20, with χ^2 and Mann–Whitney U tests (significance set at $p < 0.05$).

Results: A total of 94 patients, most of whom were above the age of 50 years (35.1%), were included, with trauma as the primary mechanism (67%). Complete PCL tears (56.4%) predominated. Lateral tibial fractures (22.3%), medial meniscal tears (45.2%), and anterior cruciate ligament (ACL) injuries (37.2%) were common. Complete PCL tears correlated with lateral tibial fractures ($p = 0.002$), while partial tears were associated with lateral meniscal injuries ($p = 0.011$). ACL injuries coexisting with PCL tears were significantly associated with the medial collateral ligament ($p = 0.0001$), lateral collateral ligament ($p = 0.01$), and lateral meniscal injuries ($p = 0.002$). A major limitation of this study is the absence of follow-up data for 86% of patients, which limits the evaluation of long-term outcomes and treatment responses.

Conclusion: The findings of this study underscore the importance of comprehensive assessment for concomitant injuries when evaluating PCL tears. This is the first study in the region to characterize the injury patterns and associations of PCL tears using a local dataset, providing a valuable baseline for future clinical and epidemiological research.

الملخص

الهدف: هدفت هذه الدراسة الرجعية إلى تقييم الإصابات المصاحبة لدى المرضى الذين يعانون من تمزقات معزولة في الرباط الصليبي الخلفي، مع التركيز على الكسور والإصابات الهلالية والغضروفية والرباطية.

الطرق: تمت هذه الدراسة الرجعية في مدينة الملك عبدالعزيز الطبية بالرياض، المملكة العربية السعودية (2017-2019). تم تحليل 94 مريضًا يعانون من تمزقات معزولة في الرباط الصليبي الخلفي مؤكد تشخيصها بالرنين المغناطيسي. شملت البيانات المعلومات التالية: البيانات الديموغرافية، آلية الإصابة (رضحية / رياضية)، درجة التمزق (I–III)، حدة الإصابة (حادة / مزمنة)، الإصابات المرتبطة، وطريقة العلاج. تم التحقق من نتائج الرنين المغناطيسي بواسطة أطباء الأشعة العضلية الهيكلية. تم إجراء التحليل الإحصائي باستخدام برنامج SPSS الإصدار 20، باستخدام اختباري كاي تربيع (χ^2) ومان-ويتني (Mann-Whitney U)، باعتبار $p < 0.05$ ذات دلالة إحصائية.

النتائج: أغلب المرضى كانوا فوق سن الخمسين (35.1%)، وكانت الإصابات الرضّية هي الآلية الأكثر شيوعًا (67%). كان التمزق الكامل في الرباط الصليبي الخلفي هو الأكثر شيوعًا (56.4%). من الإصابات المصاحبة الشائعة: كسور السطح الجانبي من الظنبوب (22.3%)، وتمزقات الغضروف الهلالي الداخلي (45.2%)، وإصابات الرباط الصليبي الأمامي (37.2%). وُجد ارتباطاً بين التمزق الكامل في الرباط الصليبي الخلفي وكسور السطح الجانبي من الظنبوب ($p = 0.002$)، بينما ارتبط التمزق الجزئي في الرباط الصليبي الخلفي بإصابات الغضروف الهلالي الخارجي ($p = 0.011$). كذلك، ارتبط وجود إصابة في الرباط الصليبي الأمامي مع الرباط الصليبي الخلفي بإصابات في الرباط الجانبي الداخلي ($p = 0.0001$)، والرباط الجانبي الخارجي ($p = 0.01$)، وإصابات الغضروف الهلالي الخارجي ($p = 0.002$). أظهرت البيانات نقصًا في المتابعة، حيث لم تتوفر نتائج متابعة لـ 86.2% من الحالات.

الاستنتاج: وُجد ارتباط ذو دلالة إحصائية بين التمزق الكامل للرباط الصليبي الخلفي وكسر الظنبوب الجانبي، وبين التمزق الجزئي للرباط الصليبي الخلفي وإصابة الغضروف الهلالي الخارجي. كما بينت الدراسة أن الإصابات المشتركة مابين الرباط الصليبي الأمامي والخلفي ارتباطاً مع إصابات الرباط الجانبي الداخلي والرباط الجانبي الخارجي وإصابات الغضروف الهلالي الخارجي.

Keywords: Injuries, Posterior Cruciate, Ligament Tears, Meniscal, Chondral, Ligamentous Pathologies

1. INTRODUCTION

The posterior cruciate ligament (PCL) is a structurally robust ligament whose main role is to restrict posterior knee translation. [1-3] The PCL is composed of functional anterolateral and posteromedial bundles that originate from the medial femoral condyle and attach to the posterior tibial plateau. [4,5] It appears on magnetic resonance imaging (MRI) as a diffuse low signal on T1- and T2-weighted images (T1WI and T2WI); in contrast to the anterior cruciate ligament (ACL), the PCL may appear normal even when it is PCL-deficient. [1-7] As a normal variant, the configuration and MRI appearance of the PCL bundles may be mistaken for a double PCL sign indicative of injury. [8] The absence or hypoplasia of the PCL and its association with lower limb length discrepancy have been reported. [9] Most PCL injuries are related to car accidents and sports-related activities. [2,10-12] In complete tears, the PCL fibres are not visualised, with high signal intensity on T2WI. Conversely, partial tears show abnormal signal intensity on T2WI, with some fibres remaining intact. [1] PCL injuries are graded as follows: Grade I: Partial tear with 1–5 mm posterior tibial translation, Grade II: Complete isolated tear with 6–10 mm posterior tibial translation and without any other injuries, Grade III: Complete PCL tear with ligamentous and/or capsular injuries and tibial translation of more than 10 mm. [13] The acute manifestations of PCL injury include limping, pain, or joint effusion, while patients with chronic injury may present with difficulty walking up stairs or inclines. Clinically, the most accurate test to perform for PCL injuries is the posterior drawer test. MRI is the preferred imaging modality for diagnosing PCL injuries. [13,14] There are few studies reporting the associated injuries with PCL injuries. Hamada et al. reported that 52% of PCL injury cases exhibited articular cartilage lesions, while 28% showed meniscal tears. [15] In addition, D. Ringler et al. reported that 25% had meniscal injury, 23% had focal cartilage injury, and 12.5% had associated fractures. [16]

In a study by B. Geissler, 12% of patients with acute PCL injury showed chondral injuries, and 27% demonstrated meniscal injuries. [17]

Isolated acute PCL injuries are usually treated conservatively. Operative management is considered in patients with acute PCL injury demonstrating

posterior translation of more than 12 mm, those with chronic symptoms, and patients with combined injuries. [18]

Regarding local data on PCL injuries in the Kingdom of Saudi Arabia (KSA), there is limited information available on PCL injuries and their concomitant injuries. In two general studies on knee injuries conducted in Arar and Riyadh, KSA, an incidence of 8.5% and 12.5%, respectively, of PCL injury was reported, with sports injuries identified as the most common cause. However, there was no mention of the degree of injury or detailed assessment of concomitant injuries. [19,20] To our knowledge, no prior study in the region has specifically examined the pattern, severity, and co-existing injuries of isolated PCL tears using MRI. This represents a significant gap in the literature, as accurate diagnosis and effective treatment planning depend heavily on recognising associated injuries. As such, this study aims to establish baseline local data on PCL injuries in the Saudi Arabian population, providing a detailed evaluation of the epidemiology and associated injuries (including fractures, meniscal, chondral, and ligamentous injuries), as well as the injury mechanism and the type of management adopted. As the treatment of PCL injuries depends on several factors, including whether there are combined injuries, careful MRI evaluation by radiologists is crucial for optimal recovery and management.

2. METHODS

This is a retrospective study conducted at King Abdulaziz Medical City, Riyadh, Saudi Arabia. All patients with electronic MRI reports indicating isolated PCL tears were identified from January 2017 to December 2019. Musculoskeletal imaging consultants with more than 10 years of experience reviewed and approved the reports. The following parameters were collected and analysed: patient age, mechanism of injury (sports-related or traumatic), grade of injury (Grade I, II, or III), duration since injury (acute or chronic), associated injuries (fractures, meniscal, ligamentous, and chondral injuries), and the management of the posterior cruciate ligament injury.

Eligibility criteria: All patients presenting initially with PCL injury between January 2017 and December 2019.

Exclusion criteria: History of prior knee surgery or history of knee dislocation.

Data analysis: All data were analysed using the Statistical Package for the Social Sciences version 20 for Windows (evaluation version). In addition, $\chi 2$ tests were used for categorical variables, and the Mann–Whitney U test was used for continuous variables; $P < 0.05$ was considered statistically significant.

This study was ethically approved from King Abdullah International Medical Research Center (KAIMRC), IRB No. 00000151025. 30, March 2025.

3. RESULTS

This study included 94 patients. The largest proportions were older than 50 years, with 33 patients (35.1%) in this category. Trauma was the major mechanism of injury, accounting for 63 cases (67%). Less than one-half, 44 patients (46.8%), presented with acute injury, whereas more than one-half, 53 patients (56.4%), had a complete PCL tear (Figure 1).

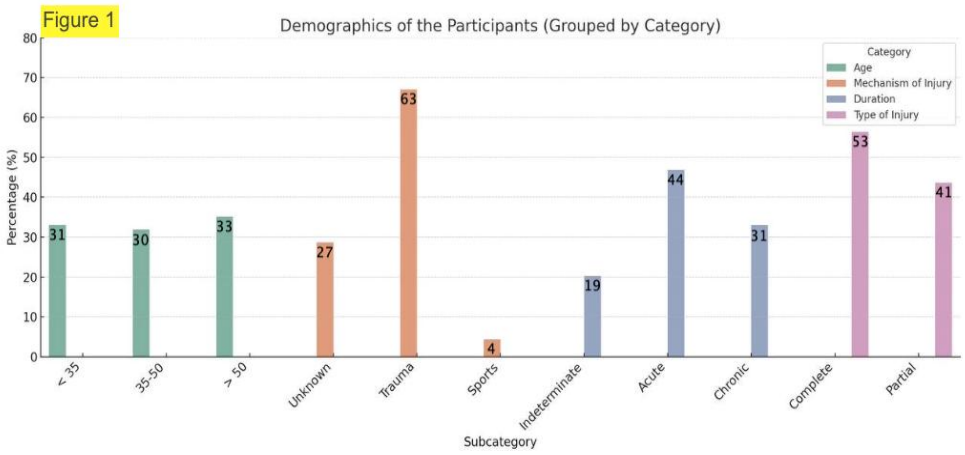

Figure 1: Demographics of the participants

In this study, 12 patients (12.7%) had isolated PCL injuries. The majority of patients had at least one co-existing injury. The most common fracture was a lateral tibial fracture, reported in 21 patients (22.3%), whereas the least common fracture was a patellar fracture, found in 2 patients (2.1%). Regarding soft tissue injuries, the most common was a medial meniscal tear, observed in 42 patients (45.2%), followed by anterior cruciate ligament (ACL) injuries in 35 patients (37.2%). The least common injury was a medial tibial cartilage lesion, reported in 9 patients (9.6%) (Table 1).

Table 1: Fractures and Injuries Among the Participants

Variable	No. (%)	Variables	No. (%)
Medial femoral fracture	4 (4.3)	Medial tibial cartilage injury	9 (9.6)
lateral femoral fracture	3 (3.2)	Patellar cartilage injury	18 (19.1)
Medial tibial fracture	10 (10.6)	Medial collateral ligament injury	22 (23.4)
Lateral tibial fracture	21 (22.3)	lateral collateral ligament injury	15 (16)
Patellar fracture	2 (2.1)	Medial meniscal injury	42 (45.2)
Fibular fracture	5 (5.4)	Lateral Meniscal injury	15 (16.0)
Medial femoral cartilage injury	14 (14.9)	ACL injury	35 (37.2)
Lateral femoral cartilage injury	0 (0.0)	Lateral tibial cartilage injury	0 (0.0)

There were 79 patients (84.0%) without a displaced avulsed fragment, whereas the remaining cases were divided into those with displacement of 5 mm or less (8 patients; 8.5%), and those with displacement of more than 5 mm (7 patients; 7.4%) (Figure 2).

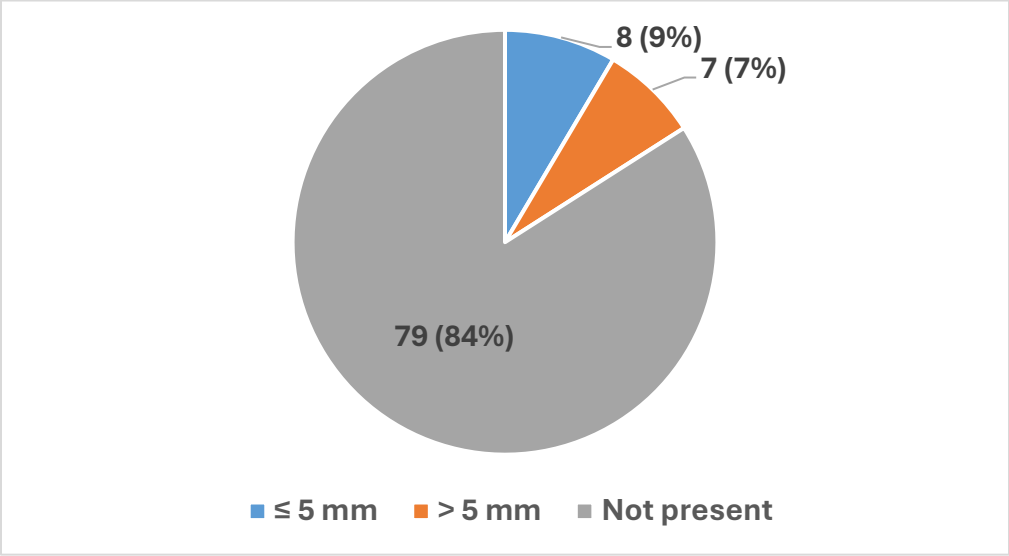

Figure 2: Distance (mm) of the avulsed fragment

Regarding management, 59 patients (62.8%) were managed conservatively, 17 (18.0%) underwent surgery, and 18 (19.2%) had no follow-up. Subsequently, 81 patients (86.2%) had no follow-up data available, while 7 (7.4%) showed improvement and 6 (6.4%) remained stable (Table 2).

Table 2: Follow-up and management

Type of management	No. (%)	Follow-up outcome No. (%) (n=94)	
Conservative	59 (62.8%)	No follow-up	50 (53.2%)
		Stable	6 (6.4)
		Improved	3 (3.2)
		Worsened	0 (0.0)
Surgery	17 (18%)	No follow-up	13 (13.8)
		Stable	0 (0.0)
		Improved	4 (4.3)
		Worsened	0 (0.0)
No follow-up recorded		18 (19.2%)	

The correlation between ACL injury among patients with PCL injury and their demographic characteristics showed no statistically significant association (Table 3). There was no significant correlation between PCL injury and any of the following variables: age group (p = 0.9), mechanism of injury (p = 0.8), duration (p = 0.9), or injury type (p = 0.9).

Table 3: Relationship between ACL injury and other variables in patients with PCL injury

Variable	ACL injury		
	Yes	No	P-value
Age			
< 35 years	12 (34.3%)	19 (32.2%)	0.978
35-50 years	11 (31.4%)	19 (32.2%)	
> 50 years	12 (34.3%)	21 (35.6%)	
Mechanism of injury			
Unknown	10 (28.6%)	17 (28.8%)	0.871
Trauma	24 (68.6%)	39 (66.1%)	
Sports	1 (2.9%)	3 (5.1%)	
Injury duration			

Indeterminate	7 (20%)	12 (20.3%)	0.961
Acute	17 (48.6%)	27 (45.8%)	
Chronic	11 (31.4%)	20 (33.9%)	
Type of PCL injury			
Complete	20 (57.1%)	33 (55.9%)	0.909
Partial	15 (42.9%)	26 (44.1%)	

There were significant correlations between complete PCL tears and lateral tibial fractures (p = 0.002), and between partial PCL tears and lateral meniscal injuries (p = 0.011). There were no significant correlations between PCL injury and other types of fractures or soft tissue injuries (Table 4).

Table 4: Association between type of PCL injury and other variables

Variable	**Type of injury**		
	Complete	**Partial**	**P-value**
lateral tibial fracture	18 (34.0%)	3 (7.3%)	**0.002**
Lateral meniscal injury	4 (7.5%)	11 (26.8%)	**0.011**
Other tested variables*	-		> 0.05

*Other tested variables include: medial and lateral femoral fractures, medial tibial fracture, patellar fracture, fibular fracture, medial and lateral femoral cartilage injuries, medial and lateral tibial cartilage injuries, patellar cartilage injury, medial and lateral collateral ligament injuries, medial meniscal injury, and ACL injury.

In contrast, the correlations between patients with PCL injury and concomitant ACL injury and various types of fractures and soft tissue injuries are shown in Table 5. There were significant correlations between ACL injury and three additional types of injury: medial collateral ligament injury (p = 0.0001), lateral collateral ligament injury (p = 0.01), and lateral meniscal injury (p = 0.002).

Table 5: Association between ACL injury and other variables in patients with PCL injury

Variable	**ACL injury**		
	Yes	**No**	**P-value**
Medial collateral ligament injury	16 (45.7%)	6 (10.2%)	**0.0001**

Lateral collateral ligament injury	10 (28.6%)	5 (8.5%)	**0.01**
Lateral meniscal injury	11 (31.4%)	4 (6.8%)	**0.002**
Other tested variable*	-		>0.05

*Other tested variables include: medial and lateral femoral fractures, medial and lateral tibial fractures, patellar fracture, fibular fracture, medial and lateral femoral cartilage injuries, medial and lateral tibial cartilage injuries, patellar cartilage injury, and medial meniscal injury.

4. DISCUSSION

This study of 94 patients, of whom the majority were over 50 years old (35.1%), found trauma to be the leading mechanism of injury (67%), with over half (56.4%) presenting with complete PCL tears. Lateral tibial fractures (22.3%) and medial meniscal injuries (45.2%) were the most common associated findings. Most patients (84%) had no avulsed fragment displacement, and only a few (13.8%) received follow-up. Complete PCL tears were significantly correlated with lateral tibial fractures, while partial PCL tears were associated with lateral meniscal injuries. Concurrent ACL injuries were strongly associated with medial and lateral collateral ligament injuries, as well as lateral meniscal injuries.

Isolated PCL injuries are relatively uncommon, with a reported incidence of 7.5%, and lower-grade injuries (Grades I and II) show a higher likelihood of healing. Other studies have reported an incidence of 15.3% for isolated PCL injuries, with the majority attributed to bony avulsion (69.2%). [20-23] In the current study, the prevalence of isolated PCL injury was similarly reported as 12 (12.7%). Logan et al. reported that among 2,285 players, PCL injury occurred in only 3%. [24]

In this study, trauma was the leading cause of injury, and the largest proportion of affected individuals were older adults. Acute and full-thickness PCL tears represented the majority of cases. In a previous study, most injuries (78.8%) were attributed to traffic accidents. [21] A higher proportion (81.5%) was also reported to result from high-energy trauma. [25]

In a systematic review, PCL reconstruction has been reported to result in more satisfactory and consistent stability when compared to conservative treatment. [26] More than half of the patients in this study were managed conservatively; however, the majority had no follow-up data, and it was not possible to determine their clinical improvement. Additionally, avulsion injury was not identified in most patients' reports (84%).

It has been reported that PCL injuries are frequently associated with other ligamentous injuries, as well as a high prevalence of meniscal and cartilage damage. [27,28] A significant proportion—close to 60%—of PCL injuries coexist with damage to surrounding structures, including the coronary ligament, lateral collateral ligament (LCL), and popliteus tendon. [29,30]

In the current study, lateral tibial fracture was the most frequent fracture. Regarding soft tissue injuries, the most common were medial meniscal injury and ACL injury, with ACL injury being the second most prevalent injury among patients.

A previous retrospective study reported that the most commonly associated injuries with PCL tears were ACL injuries, followed by LCL and posterolateral corner (PLC) injuries (48.2% and 22.4%, respectively). Fractures were more frequently observed in cases involving combined PCL and LCL/PLC injuries, while they were not reported in combinations involving PCL with medial collateral ligament (MCL) and posteromedial corner injuries. [22] In a separate study, Logan et al. found that concomitant injuries included the MCL in 42% of cases and the ACL in 11.6%. [24]

A major limitation of this study is the absence of follow-up data for 86% of patients, which limits the evaluation of long-term outcomes and treatment responses. While this restricts conclusions regarding prognosis, the study provides valuable epidemiological insight into isolated PCL injuries and their associated injury patterns. Further prospective studies incorporating clinical and functional outcome measures are strongly recommended.

5. CONCLUSION

In conclusion, trauma emerged as the predominant mechanism of injury leading to PCL tears. The majority of cases were of acute onset, and more than half demonstrated full-thickness PCL tears. A significant correlation was found between complete PCL tears and lateral tibial fractures, as well as between partial PCL tears and lateral meniscal injuries. Furthermore, combined ACL and PCL injuries were associated with MCL injuries, LCL injuries, and lateral meniscal damage. These findings underscore the importance of comprehensive assessment for concomitant injuries when evaluating PCL tears. To our knowledge, this is the first study in the region to characterise the injury patterns and associations of PCL tears using a local dataset, providing a valuable baseline for future clinical and epidemiological research.

6. CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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