Scientific Research Publishing

Open Journal of Applied Sciences, 2024, 14, 1625-1636
https://www.scirp.org/journal/ojapps
ISSN Online: 2165-3925
ISSN Print: 2165-3917

The Prevalence Type of the Meniscus Tear in Patients with Anterior Cruciate Ligament (ACL) Injury, in Abu Arish General Hospital, Jazan, KSA

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How to cite this paper: Bakri, E.G.A. (2024) The Prevalence Type of the Meniscus Tear in Patients with Anterior Cruciate Ligament (ACL) Injury, in Abu Arish General Hospital, Jazan, KSA. *Open Journal of Applied Sciences*, **14**, 1625-1636.
https://doi.org/10.4236/ojapps.2024.147106

Received: June 7, 2024
Accepted: July 1, 2024
Published: July 4, 2024

Abstract

Background: The anterior cruciate ligament (ACL) is the main structure that prevents the forward movement of the tibia about the femur Meniscus tear which is a common finding in patients with anterior cruciate ligament (ACL) injury. **Aim:** To investigate the prevalence of types of meniscus tears in patients with Anterior Cruciate Ligament (ACL) Injury. **Methods:** A retrospective study was conducted among inpatients. Clinical evaluation included side-to-side difference in anterior tibial translation (ATT) as measured by a KT-1000 arthrometer (MEDmetric Corp) and a grade of pivot-shift test at final follow-up in all patients. Subsequent meniscal tear was defined by symptoms of joint line pain and/or locking or joint effusion requiring surgical treatment. **Results:** Most of patients were males (92.6%). The patients were categorized into 5 groups according to age with a mean of age 32.8 ± 10.6. The most common causes of ACL injury were falling down (43.2%), trauma (38.1%) or knee torsion (18.8%). Medial meniscal tear was found in 92 knees (55.7%), while lateral meniscal tear was found in 19 knees (10.8%) and the most common type was the longitudinal tear that was found in 31 knees (17.6%). Similarly, 66.7% of the meniscal flap tears and half of the meniscal bucket-handle tears were significantly associated with loose body ($P < 0.001$). However, most types of the meniscus tears were characterized with no root injury ($P < 0.001$). **Conclusion:** The present study demonstrated that meniscus tears are more common in individuals with chronic ACL rupture. The main factors contributing to ACL injury were classified as falls, trauma, and knee torsion. Gender was identified as a critical determinant in the etiology of ACL injury. The occurrence of a ramp lesion was associated longitudinal meniscal tears, whereas chodoral injury was associated with the majority of me-

niscal flap tears and meniscal bucket-handle tears.

Keywords

Prevalence, Type, Meniscus, Tear, Anterior Cruciate Ligament, ACL, Injury

1. Introduction

The anterior cruciate ligament (ACL) is the main structure that prevents the forward movement of the tibia about the femur. The ligament originates from the back and inner side of the outer bony prominence of the thigh bone, known as the lateral femoral condyle, within the space between the two bony prominences of the thigh bone. It extends to the front side of the bony prominence of the thigh bone, called the intercondylar eminence of the shin bone, and restricts forward movement of the shin bone about the thigh bone. Additionally, it enhances knee rotational stability in both the frontal and transverse planes due to its unique alignment [1].

Generally, one of the most prevalent and catastrophic knee injuries nowadays is damage to the ACL, which is mainly experienced as a result of sports engagement. ACL injuries manifest many symptoms, including joint effusion, altered mobility, muscular weakness, and diminished functional performance [2]. ACL injuries are mostly linked to other simultaneous joint injuries. They can lead to a higher likelihood of developing post-traumatic osteoarthritis within 10 to 15 years after the injury (up to 80% in some cases), particularly when there is damage to the meniscus [3].

ACL injuries are quite prevalent worldwide, with research indicating that the incidence of ACL reconstructions ranges from 32 to 78 instances per 100,000 individuals each year [4]. Furthermore, some research has demonstrated a notable rise in instances conducted in recent years. ACL damage frequently occurs in young, physically active persons, particularly sports. ACL injuries frequently occur in highly energetic sports such as basketball, football, and soccer, where athletes frequently engage in jumping and pivoting movements compared to other sports. Neglecting a ruptured ACL may result in more knee damage [5].

The co-occurrence of meniscus tear and anterior cruciate ligament (ACL) damage has been documented to range from 51.9% to 63% [6] [7]. Previous research has indicated that the occurrence of meniscus tear in cases of acute and chronic ACL tear ranges from 16% to 40% and exceeds 96%, respectively [8].

Prior research has already documented the significance of the meniscus, particularly the medial meniscus, in maintaining knee stability in individuals with chronic ACL damage [9]. However, some forms of meniscus tears, such as root, full radial, and bucket-handle tears, are associated with a higher likelihood of causing biomechanical difficulties. Prior research has examined the impact of the medial meniscus on decreasing the forward movement of the tibia [10].

Proper treatment of the meniscus tears in these instances might avert degenerative alterations like osteoarthritis [11]. Research has indicated that some meniscus tears, such as those occurring in the posterior horn of the medial meniscus, are occasionally undetected during diagnosis. Failure to manage such injuries might result in knee instability and heightened stress on the ACL graft [11].

Several research studies have examined meniscus tears' features in individuals with ACL tears, resulting in significant information [6] [7]. Based on these findings, it appears that an acute anterior cruciate ligament (ACL) injury is linked to a tear in the lateral meniscus. In contrast, a chronic ACL injury is related to a tear in the medial meniscus [12]. Furthermore, based on our current understanding, this specific group of patients needs more suitable data about root rips. In addition, no research has been conducted on the specific site of the meniscus damage according to the Cooper classification [13].

Nevertheless, research revealed that 75% of medial meniscus rips in individuals with ACL abnormalities occur in the posterior horn's peripheral area. This finding has been corroborated by additional studies [14] [15]. Our objective is to examine the prevalence of different types of meniscus tears in patients with Anterior Cruciate Ligament (ACL) Injury in Saudi Arabia. Furthermore, we will examine if a postponed ACL restoration procedure might impact the attributes of the meniscus tear.

Despite the abundance of research, there remains a need for a better understanding of ramp and root injuries, particularly in Saudi Arabia. Moreover, the prior investigations were limited by factors such as focusing on a single meniscus (either medial or lateral) or neglecting to examine the specific pattern of meniscus tear. The nature and location of the meniscus tear are crucial factors in selecting the appropriate intervention and predicting the treatment outcome. The extended duration between ACL tear and surgery aggravates the meniscus tear and diminishes the likelihood of successful repair [16]. Therefore, the present study investigates the prevalence of types of meniscus tears in patients with Anterior Cruciate Ligament (ACL) Injury in Saudi Arabia.

2. Study Objectives

1. Determine the prevalence of meniscus tears among patients diagnosed with anterior cruciate ligament (ACL) injuries.

2. Identify the types of meniscus tears occurring in individuals with anterior cruciate ligament (ACL) injuries.

3. Investigate potential correlations between the type of meniscus tear and the severity or mechanism of anterior cruciate ligament (ACL) injury.

3. Methods

A retrospective study was conducted among inpatients in Abu Arish general

Hospital, Saudi Arabia. All patients with ACL injury admitted to Abu Arish general Hospital, Saudi Arabia in the past three months were included. Patient sex, age, and body mass index (BMI) were obtained. Clinical evaluation included side-to-side difference in anterior tibial translation (ATT) as measured by a KT-1000 arthrometer (MEDmetric Corp) and a grade of pivot-shift test at final follow-up in all patients. Patients underwent postoperative magnetic resonance imaging (MRI) to evaluate ACL injury and meniscus. Subsequent meniscal tear was defined by symptoms of joint line pain and/or locking or joint effusion requiring surgical treatment. Time to subsequent meniscal surgery was defined as the interval between the index ACL reconstruction and subsequent meniscal repair or meniscectomy.

4. Inclusion Criteria

All patients admitted to Abu Arish general Hospital with ACL injury.

5. Exclusion Criteria

1) Patients with multi-ligament injury, periarticular fracture, previous history of meniscal injury, perigenicular fracture, and knee surgery.

2) Patients with revision ACLR.

6. Ethical Consideration

The study design was approved by the ethics committee of Abu Arish general Hospital, Saudi Arabia.

7. Statistical Analysis

All variables were expressed as means and standard deviations. Age, BMI, time from injury to surgery were compared using the Mann-Whitney *U* test. Meniscal tear types (longitudinal, bucket-handle, etc.) and meniscal treatment technique (inside-out repair, all-inside repair, partial meniscectomy, no treatment) were compared using chi-square tests. Multivariate analysis with binary logistic regression was performed to determine which factors were significant in predicting the subsequent meniscal surgery after ACL reconstruction: age at surgery, sex, BMI, type of graft (BTB or hamstring tendon), femoral tunnel-drilling technique (transtibial or transportal), time from injury to ACL reconstruction, location including meniscal tear (medial meniscus [MM], lateral meniscus [LM], or MM + LM). All statistical analyses were performed with SPSS Version 26. Significance was defined as $P < 0.05$.

8. Results

The study included 176 patients with ACL injury who admitted to Abu Arish general Hospital, Saudi Arabia. Most of patients were males (92.6%). The patients were categorized into 5 groups according to age with a mean of age 32.8 ± 10.6 (as shown in Table 1).

Table 2 shows that the most common causes of ACL injury were fall down (43.2%), trauma (38.1%) or knee torsion (18.8%). Medial meniscal tear was found in 92 knees (55.7%), while lateral meniscal tear was found in 19 knees (10.8%). The bucket-handle tear was found in 14 knees (8.0%), the radial tear was found in 15 knees (8.5%), the complex tear was observed in 23 knees (13.1%), flap tear was found in 6 knees (3.4%), the horizontal tear was found in 22 knees (12.5%), and the most common type was the longitudinal tear that was found in 31 knees (17.6%).

Table 3 shows the characteristic of the meniscus tear among ACL injury patients. The majority of the meniscus tears were found in the chronic cases (63.1%). Most of the meniscus tears were with no ramp lesion (88.1%) or root injury (96%). The majority of the meniscus tears were with neither chodoral injury (68.2%) nor loose body (86.4%).

Table 4 shows the relation of mechanism of ACL injury with age and sex. The mechanism of ACL injury has no significant association with the age (P = 0.311) of patients. However, the gender was a significant factor (P = 0.039) associated with the mechanism of ACL injury.

Table 5 shows that the lateral and medial meniscal tear were significantly (P < 0.001) associated with chronic ACL injury. Additionally, the different types of themeniscal tear were more common (P < 0.001) in the chronic ACL injuries as compared to the acute injuries.

Table 1. Age and sex characteristics of the studied patients.

		N	%
Age	<=20	23	13.1%
	21 - 30	61	34.7%
	31 - 40	55	31.3%
	41 - 50	22	12.5%
	> 50	15	8.5%
	Mean (SD)	32.8 (10.6)	
Gender	F	13	7.4%
	M	163	92.6%

Table 2. Characteristics of lesions.

		Count	N %
Mechanism of injury	Fall down	76	43.2%
	Knee torsion	33	18.8%
	Trauma	67	38.1%
Side of injured knee	LT	78	44.3%
	RT	98	55.7%
Meniscus bear (medial or lateral)	Lateral	19	10.8%
	Medial	92	52.3%
	No	65	36.9%

Continued

Types of meniscul tear	No	65	36.9%
	Bucket-handle	14	8.0%
	Complex	23	13.1%
	Flap	6	3.4%
	Horizontal	22	12.5%
	Longitudinal	31	17.6%
	Radial	15	8.5%

Table 3. Characteristic of themeniscus tear among ACL injury patients.

Acute or chronic ACL tear	Acute	65	36.9%
	Chronic	111	63.1%
Ramp lesion	No	155	88.1%
	Yes	21	11.9%
Root injury	No	169	96.0%
	Yes	7	4.0%
Chodoral injury	No	120	68.2%
	Yes	56	31.8%
Loose body	No	152	86.4%
	Yes	24	13.6%

Table 4. Relation of mechanism of ACL injury with age and sex.

		Mechanism of injury						P value
		Fall down		Knee torsion		Trauma		
		N	%	N	%	N	%	
Age in years	<=20	7	9.2%	7	21.2%	9	13.4%	0.311
	21 - 30	24	31.6%	9	27.3%	28	41.8%	
	31 - 40	23	30.3%	12	36.4%	20	29.9%	
	41 - 50	14	18.4%	2	6.1%	6	9.0%	
	>50	8	10.5%	3	9.1%	4	6.0%	
Gender	F	10	13.2%	1	3.0%	2	3.0%	**0.039**
	M	66	86.8%	32	97.0%	65	97.0%	

Table 5. Relation of type of lesion acute or chronic with injury type.

		Acute or chronic ACL tear				P value
		Acute		Chronic		
		N	%	N	%	
Mechanism of injury	Fall down	24	31.6%	52	68.4%	0.06
	Knee torsion	9	27.3%	24	72.7%	
	Trauma	32	47.8%	35	52.2%	
Side of injured knee	LT	33	42.3%	45	57.7%	0.187
	RT	32	32.7%	66	67.3%	
Meniscus tear (medial or lateral)	Lateral	5	26.3%	14	73.7%	<0.001
	Medial	21	22.8%	71	77.2%	
	No	39	60.0%	26	40.0%	

Continued

Types of meniscal tear	No	40	61.5%	25	38.5%	<0.001
	Bucket-handle	3	21.4%	11	78.6%	
	Complex	3	13.0%	20	87.0%	
	Flap	1	16.7%	5	83.3%	
	Horizontal	8	36.4%	14	63.6%	
	Longitudinal	7	22.6%	24	77.4%	
	Radial	3	20.0%	12	80.0%	

Table 6. Relation of types of meniscal tear with its characters.

		Types of meniscal tear														p value
		Bucket -handle		Complex		Flap		Horizontal		Longitudinal		No		Radial		
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	
Ramp lesion	No	12	85.7%	23	100.0%	6	100.0%	22	100.0%	12	38.7%	65	100.0%	15	100.0%	<0.001
	Yes	2	14.3%	0	0.0%	0	0.0%	0	0.0%	19	61.3%	0	0.0%	0	0.0%	
Root injury	No	14	100.0%	23	100.0%	6	100.0%	17	77.3%	29	93.5%	65	100.0%	15	100.0%	<0.001
	Yes	0	0.0%	0	0.0%	0	0.0%	5	22.7%	2	6.5%	0	0.0%	0	0.0%	
Chodoral injury	No	6	42.9%	12	52.2%	1	16.7%	13	59.1%	24	77.4%	55	84.6%	9	60.0%	<0.001
	Yes	8	57.1%	11	47.8%	5	83.3%	9	40.9%	7	22.6%	10	15.4%	6	40.0%	1
Loose body	No	7	50.0%	19	82.6%	2	33.3%	18	81.8%	29	93.5%	65	100.0%	12	80.0%	<0.001
	Yes	7	50.0%	4	17.4%	4	66.7%	4	18.2%	2	6.5%	0	0.0%	3	20.0%	

Table 6 shows that 61.3% of the longitudinal meniscal tear was significantly associated with ramp lesion ($P < 0.001$), while the other types of meniscal tear had no ramp lesion association. The majority of meniscal flap tears (83.3%) and 57.1% of the meniscal bucket-handle tears were significantly associated with chodoral injury ($P < 0.001$). Similarly, 66.7% of the meniscal flap tears and half of the meniscal bucket-handle tears were significantly associated with loose body ($P < 0.001$). However, most types of the meniscus tears were characterized with no root injury ($P < 0.001$).

9. Discussion

Several surgeons have examined the frequency of meniscus tears in patients with ACL injuries and attempted to identify any potential connection between the duration of ACL injury and various characteristics of meniscus tears. Determining the presence of a meniscus tear is crucial as it might impact the prognosis and influence treatment decisions. Studies have demonstrated that when patients who have undergone ACL reconstruction also have a concurrent meniscus rupture that is treated with repair or meniscectomy, there is an elevated likelihood of developing knee osteoarthritis [17]. Nevertheless, due to the absence of comparable research and limitations in prior studies, such as an inadequate number of participants, the present study was undertaken.

The present study comprised 176 individuals with ACL damage who were hospitalized to Abu Arish General Hospital in Saudi Arabia. The primary etiolo-

gies of ACL damage were categorized as follows: 43.2% resulted from falls, 38.1% from trauma, and 18.8% from knee torsion. A total of 92 knees (55.7%) were diagnosed with a medial meniscal tear, while 19 knees (10.8%) had a lateral meniscal tear. Among these, the most prevalent kind was the longitudinal tear, which was observed in 31 knees (17.6%). Most of the meniscus tears were observed in the chronic instances, accounting for 63.1% of the cases. The gender showed a statistically significant association with the mechanism of ACL damage. The presence of a ramp lesion was shown to be substantially linked with 61.3% of longitudinal meniscal tears, while no such connection was observed with other forms of meniscal tears. Chodoral damage was substantially related with the majority of meniscal flap tears (83.3%) and 57.1% of the meniscal bucket-handle rips. Moreover, loose body was shown to be strongly linked with 66.7% of meniscal flap rips and 50% of meniscal bucket-handle tears. However, the majority of meniscus tears were identified as lacking root damage.

The prevalence of meniscus tear in patients who underwent ACLR has been documented to range from 51.9% to 63% [6] [7]. Nevertheless, studies have shown that the occurrence of a tear in either the medial meniscus or lateral meniscus, as well as the simultaneous rupture of both menisci, ranges from 13.9% to 29%, 19% to 24.9%, and 9% to 15%, respectively [6] [7]. Similar to the present investigation, a few researches have substantiated that professional athletes had a greater likelihood of experiencing a complicated meniscus tear compared to non-athletes [6]. Despite generating controversy, it has been documented that the longitudinal tear is the prevailing kind of meniscus rupture among individuals with ACL injuries [18]. According to another study, the most frequent types of meniscal injuries were single longitudinal vertical split tears, followed by flap tears and radial tears. The prevalence of ramp injury in earlier investigations ranged from 9.6% to 40% (with reported values of 20% and 30%). Moreover, in comparable research, the prevalence of posterior root tear of the lateral meniscus ranged from 3.5% to 5.2% [9] [19].

The frequency of medial and lateral meniscal tears is influenced by several processes, such as lower limb alignment, stress distribution, and delayed intervention. The prevalence of LM tears remained essentially stable over time, but MM tears exhibited a progressive rise. The MM functions as a supplementary stabilizer of the knee, preventing the tibia from moving forward in cases of ACL injury. It is also exposed to anteroposterior shear pressures. Conversely, the LM that is more mobile is less prone to experiencing these shear stresses [20]. This hypothesis might potentially explain the elevated prevalence of MM tears; however, more investigations are required to substantiate this conjecture.

Various variables are shown to heighten the likelihood of meniscal tears in individuals with ACL deficiency. The factors that contribute to this include advanced age, male sex, higher body mass, duration after the injury, and repeated tasks [21] [22] [23]. A study conducted by Mansori *et al.* (2018) discovered that as individuals age, there is a higher likelihood of developing tears in the inner part of the meniscus, but not in the outside part, regardless of where the tear is lo-

cated. The age distribution appeared uniform across various lesion types [24]. Feucht *et al.* discovered a greater likelihood of LM rips in younger individuals [25], but other researchers have not established any connection between age and meniscal damage [26].

The literature commonly asserts a significant impact of aging on the menisci. The impacts may encompass alterations in blood vessels, modifications in metabolic processes, and deterioration of tissues [27].

In addition, Mansori *et al.* (2018) found a higher incidence of meniscal damage in male patients across all groups [24]. Male patients exhibited a greater occurrence of damage in the body and posterior horn of both menisci and displayed a larger number of vertical and peripheral tears compared to females. The observed pattern of damage can be attributed to a lower level of ACL resilience in women, resulting in ACL rupture at lower pressures and with less accompanying meniscal injuries [26]. Alternatively, the observed patterns may be attributed to the presence of less durable meniscal tissue and variations in muscular contraction between the quadriceps and hamstring muscles in males [28].

In addition, Mansori *et al.* (2018) found that there is a correlation between higher BMI and a higher occurrence of MM tears [24]. In general, obesity has a negative impact on the knee joint. In the past, both BMI and weight were equally effective in predicting meniscal damage [29]. Zhang *et al.* [22] found a strong association between meniscal tear and higher BMI. Chen, however, did not discover any connection between BMI and meniscal or chondral damage. Chen proposed that patients with greater BMI may be less physically active, and so have a lower probability of sustaining more injuries [30]. There is a possible biomechanical reason for the connection between BMI and meniscal tears. As BMI increases, the torque in the knee joint during rotation may also increase, potentially leading to more meniscal injuries [30].

The present study, like any other investigation, also encountered certain limitations. Two significant limitations of our study were the lack of patient follow-up and the inability to evaluate the impact of treatment (repair or meniscectomy) on the patients' clinical and functional condition, including knee discomfort. Another limitation particularly in patients with chronic conditions was the lack of accurate recollection of the time period between the injury and operation. Instead, patients provided an approximate amount of time.

10. Conclusion

The present study demonstrated that meniscus tears are often observed in individuals with chronic ACL rupture. The main factors contributing to ACL injury were classified as falls, trauma, and knee torsion. Gender was identified as a critical determinant in the etiology of ACL injury. The occurrence of a Ram lesion was associated longitudinal meniscal tears, whereas chondral injury was associated with the majority of meniscal flap tears and meniscal bucket-handle tears. There was a significant association between loose body and meniscal flap rips

and meniscal bucket-handle tears.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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