Avens Publishing Group
J Orthopedics Rheumatol
February 2014 Vol.:2, Issue:1

Open Access Research Article

Journal of Orthopedics & Rheumatology

Patterns of Meniscal Damage Associated with Acute ACL Rupture

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Submission: 02 January 2014
Accepted: 20 February 2014
Published: 24 February 2014

Reviewed & Approved by: Bashir A. Zikria, Assistant Professor, Johns Hopkins Department of Orthopaedics, Division of Sports Medicine, USA

Keywords: Anterior cruciate ligament; Tear; Meniscus; Rupture; Patterns

Abstract

Background / Aim: Meniscal injuries commonly occur in conjunction with ACL tears. This study was conducted to determine the patterns of meniscus damage associated with ACL rupture and identify the commonest type of meniscus damage in our population that is associated with ACL tear.

Methods: a retrospective chart review of patients with ACL rupture seen at the Orthopedics Department, King Khalid University Hospital, Riyadh, Saudi Arabia. Data collection included the presence or absence of meniscal tear, the type of meniscal tear diagnosed by MRI or arthroscopy, the time of the initial ACL injury and the time of meniscal tear, the duration between ACL rupture and reconstruction surgery, age, gender and level of sports activity performed.ACL tears associated with meniscal tears were diagnosed by MRI.

Results: Of 294 patients, 175 (59.7%) had medial meniscal tear, 91 (30.9%) had lateral meniscal tear and 28 patients (9.5%) with both medial and lateral tear. Mean age of patients was 27.98 ± 6.8 years. Patients who had medial tears were significantly older (29.10 ± 7.0 years) compared to lateral (26.24 ± 5.9 years) and both (26.61 ± 6.7 years), p=0.002. There were no significant differences in the height, weight and BMI, level of sport and mode of injury in between the three groups.

Conclusion: Tears to the medial meniscus appeared to be the more common in ACL cases in our setting. The preponderance of the injury to the medial meniscus is associated to the older age of the patients at presentation.

Introduction

Anterior cruciate ligament (ACL), as a primary stabilizing structure of knee is the most common disrupted ligament in acute trauma in the US every year [1,2]. On the other hand, the menisci play a crucial role in the dynamics of the knee. Their shape, attachment, and material properties contribute substantially to joint alignment and load transmission by distributing both tensile and compressive forces. Damage to the menisci can influence proprioception, stability, and mobility of the knee [3,4]. Risk factors for meniscal tears include prolonged or repeated deep knee bending, obesity, and sports [5]. Acute injury, as seen in alpine sports, involves complex dynamics, which can damage singular or multiple tissue structures of the knee [5,6]. Meniscal tears are typically thought to be initiated by coupled compression and twisting movements [7,8] which can accompany high-energy maneuvers such as cutting, jumping, and landing during sporting events [9].

Meniscal injuries commonly occur in conjunction with ACL tears. A numerous studies have examined the occurrence of these injuries, with their presence being reported as 16% to 82% in knees with acute ligament tears and as high as 96% in knees with chronic ligament tears [10-14]. Magnetic resonance imaging (MRI) is valuable tool, preferred than diagnostic arthroscopy in most patients with ligamentous and meniscal tears because it avoids the surgical risks of arthroscopy, with better accuracy in medial and lateral meniscus and ACL [15].

Lateral meniscal tears (LMTs) occur slightly more frequently than medial meniscal tears (MMTs) in knees with acute ACL injuries, 56% lateral versus 44% medial. [10,12]. MMTs however, are more common in chronic ACL deficiency [10,12,14]. This difference in tear occurrence is usually attributed to the anatomic and functional differences that exist between the two menisci, especially in the ACL deficient knee, the lateral meniscus relatively loosely attached to the tibial plateau which allows it to be quite mobile, whereas the medial meniscus, is firmly attached to the tibia, especially at the posterior horn [12,16,17]. This firm attachment allows the medial meniscus to act as a knee stabilizer, a significant restraint to anterior tibial translation in the ACL deficient knee [18-21]. The loss of ACL function increases tibial translation, allowing the meniscus to “engage” the femoral condyle and act as a wedge against the tibia [22,23], while others have suggested that mechanical trauma causes the MMTs in this setting [12,18,20]. Several studies have explored the relationship between ACL injury and meniscal tear [24-30]. Some showed preponderance of the LMTs in the acute setting and in osteoarthritis [24,25], others suggested the MMTs especially in acute reconstructions [26-29].

This study was conducted to determine the patterns of meniscus damage associated with ACL rupture and identify the commonest type of meniscus damage in our population that is associated with ACL tear.

Methods

Medical records of patients with ACL rupture covering a period

ISSN: 2334-2846

of 16 years (January 1996 to December 2012) seen at the author's institute were retrospectively reviewed. The collected data included the presence or absence of meniscal tear, the type of meniscal tear diagnosed by MRI or arthroscopy, the time of the initial ACL injury and the time of meniscal tear, the duration between ACL rupture and reconstruction surgery, age, gender, mode of injury and level of sports activity performed, height, weight.

BMI is calculated according to the Patient's height and weight, patient is considered obese if the BMI is above 30 according to the World Health Organization [31].

Sports level was classified as: professional athletes: (practicing a sport activity as a job, e.g. member of a team), recreational Athlete (considered a person, who is practicing a sport activity that is involving running and pivotal movements at least once in a week not professionally), non athlete (a person who is not practicing any kind of sport), patients with no clear statement regarding their level of sport are considered as missing data.

Mode of Injury is classified as direct (Injury was caused be a direct trauma to the patent, e.g. hit by another player, felt on his knees or road traffic accident) or non direct (Injury was caused without trauma, e.g. over rotating the knee while exercising).

Patients who were diagnosed with ACL rupture using MRI within 3 months of the injury, underwent primary arthroscopic ACL reconstruction at our institution and found to have meniscal damage diagnosed by MRI or arthroscopy were included in the study. Patients who had a chronic ACL tear or had undergone prior ipsilateral knee arthroscopy or surgery, those with osteoarthritis, with rheumatoid arthritis and patients who had undergone ACL rupture revision were excluded from the study. All images were obtained by routine knee MRI.

Types of Meniscal Tears were obtained from the reports of the MRI and Arthroscopy and were classified as (longitudinal, Degenerative, flap, radial, complex) as according to Tandogan et al. [32], De Smet [33].

Data collected were entered and coded systematically into a Microsoft Excel worksheet and were imported to a Predictive analysis software (PASW) program version 18 (SPSS, IBM, Chicago, Illinois, USA). Oneway analysis of variation (ANOVA) was used to compare means between the three groups (LMTs, MMTs and both). Pearson correlation was conducted to determine the relationship between the outcome variables (age, gender and sport levels). Independent sample t -test was done to identify differences between the mean values of continuous variables. Chi square test was done to determine associations between categorical variables. A test result considered statistically significant if $p< 0.05$.

Results

A total of 294 patients satisfied the inclusion criteria of the current study from 1996 to 2012. Of these patients, 175 (59.5%) had MMTs, 91 (31%) had LMTs and 28 patients (9.5%) with both MMT and LMT (Table 1).

There were no significant differences in the height, weight, and BMI, level of sport and mode of injury in between the three groups (MMTs, LMTs and both) (Table 2). Types of meniscal tears are shown in Table 3.

Discussion

In our study, the patients who had medial meniscal tearing were significantly older than those who had only lateral meniscal tear, and those who had both medial and lateral meniscal tears. No such relationship was significant between age and lateral meniscal tear. Our findings are in concordance with the findings of the

Table 1: Demographic characteristics of all patients with ACL rupture with meniscus injury.

Variables	
Age in years, mean (SD)	27.98 (6.8)
Weight in kg, mean (SD)	80.80 (17.1)
Height in cm, mean (SD)	170.73 (7.7)
BMI in kg/cm^2, mean (SD)	27.68 (5.6)
Mode of injury	
Direct injury, n (%)	125 (42.5)
Non-direct injury, n (%)	169 (57.4)
Sports level	
Professional athletes, n (%)	5 (1.7)
Recreational athletes, n (%)	196 (66.7)
Non-athlete, n (%)	28 (9.5)
No available data, n (%)	65 (22.1)

Patients who had MMTs were significantly older (29.10 ± 7.0 years) compared to lateral (26.24 ± 5.9 years) and both (26.61 ± 6.7 years), p=0.002.

Table 2: Comparison between MMT, LMT and both in 294 patients who had ACL tear.

Variables	MMT n=175	LMT n=91	Both n=28	p values
Age in years, mean (SD)	29.10 (7.0)	26.24 (5.9)	26.61 (6.7)	0.002^
Weight in kg. mean (SD)	82.38 (17.5)	79.14 (16.4)	76.87 (16.3)	0.165^
Height in cm, mean (SD)	170.40 (8.1)	171.42 (6.6)	170.49 (8.1)	0.602^
BMI, mean (SD)	28.34 (5.6)	26.83 (5.6)	26.43 (5.2)	0.062^
Obesity, n (%)	56 (32.0)	22 (24.2)	7 (25.0)	0.294*
Type of ACL tear				
Direct ACL tear, n (%)	68 (38.9)	32 (35.2)	9 (32.1)	0.425*
Indirect ACL tear, n (%)	65 (37.1)	30 (33.0)	8 (28.6)	
Level of sports				
Recreational athlete, n (%)	105 (60.0)	67 (73.6)	22 (78.6)	0.144*
Professional athlete, n (%)	3 (1.7)	2 (2.2)	1 (3.6)	

Note: ^ by ANOVA, * by Chi-square test

Table 3: Types of meniscal tears by MRI & Arthroscopy.

Types of Meniscal Tears	Medial	Lateral	Total
Longitudinal Tears	152(75%)	86 (72%)	238(74%)
Degenerative Tears	16(8%)	10 (8%)	26 (8%)
Radical Tears	8 (4%)	9(7%)	17(5%)
Complex Tears	6(3%)	2(2%)	8(2.5%)
FLAP	6(3%)	5(4%)	11(3.5%)
N/A	15(7%)	7(7%)	22(7%)
Total	203	119	322

ISSN: 2334-2846

study that was conducted in Turkey by Tandogan et al. [32], which showed preponderant injury to the medial meniscus than the lateral meniscus, they also found that the mean age of the patients with medial meniscal tears was 27.0 ± 7.6 years, significantly older than those who had no medial meniscal tearing (25.4 ± 6.7 years). Our patient's mean age who had medial meniscal tearing was 29.10 ± 7.0 years, significantly older than 26.61 ± 6.7 years in those who did not have medial meniscal tearing. Sports level was not significantly correlated to the parameters we have studied or to the site of meniscal tear. This is probably because most of our patients (66.8%) were just recreational athletes.

Our study was in contrast to the findings of Bellabarba et al. [10] ,Thompson et al. [12], Melissa [34] wherein they found that LMTs are more frequently encountered than MMTs, and that MMTs on the other hand are more common in chronic injuries. Our study showed more frequent MMTs than LMTs, of patients with acute ACL injuries. Again, this is probably due to the older age of our patients, which was significantly correlated with MMTs.

Obesity, Mechanism of injury, Sport level as a risk factors of meniscal tear didn't show any significance in determining a common pattern, which goes with the same results that was found in Kluczynski et al. [34] where different risk factors have been examined prospectively to see their effect on meniscal tears and chondral changes.

The sensitivity of MRI in detecting meniscal pathology has been proven in several studies [10]. However, Oei in 2003 [35] pointed out the low sensitivity of MRI in detecting lateral meniscal pathology compared to detecting medial meniscal pathology with a sensitivity difference by as much as 14% (93.3% versus 79.3%), in an adult population, more so in the presence of ACL tears [36]. This window would probably explain the differences between the frequencies of LMTs and MMTs, more so in our findings, another point which could also explain our findings; is the common presentation of knee varus malalignment in Saudi population. In a comparison study between Saudi Arabian and Canadian cohorts by the same group, it was clearly found that in knee osteoarthritis patients Saudis had more varus alignment, showed by the Hip-Knee-Ankle angle parameter used to diagnose knee alignment disorders [37].

A study addressing the Knee alignment in the Saudi Population Comparing the means of Tibiofemoral angle (TFA) of different age groups in Saudi population to those of corresponding age groups in Japanese and Australian Caucasians showed a statistically significant lower TFA difference in all age groups. Comparison of the means of TFA of different age groups in Saudi population to those of corresponding age groups in Japanese and Australian Caucasians showed a statistically significant difference in all age groups, also Comparison of the means of TFA of Saudi males and females to those of Europeans, Chinese and American Caucasians showed a significant difference from all of them [38].

Genuvarus can result in added contact stresses on the medial compartment of the knee and possibly lead to accelerated wear and damage to the articular cartilage.

Another explanation for the significant association of older age to MMTs is the association of the medial meniscus posterior horn with severity of the chondral lesion and arthritic changes according to the K-L radiographic score. There is usually accompanied chondral damage in MMTs [39].

Secondary medial meniscal tears are considered as the main reason of osteoarthritis followed by ACL deficiency [40]. The aim of this study is to alert the surgeons about the existence of this common finding in order to decrease future osteoarthritis. There were a few limitations in the study mainly because of its retrospective nature; a lot of the patient's X-rays were not found in order to study the alignment of the knees. In addition we were not able to obtain detailed information about the chondral lesions in the MRI reports to augment our significant findings of MMTs among our older-aged population.

Conclusion

The higher occurrence of medial meniscal tear in acute anterior cruciate tears could be attributed to the age related arthritic changes as well as to the common varus deformity in our population; this finding should be considered by the surgeons in order to decrease future osteoarthritis.

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