

A Study Of The Special Features Of The Meniscal Tear

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Objectives: Arthroscopic meniscectomy is a treatment with good short-term results. To prevent the long-term adverse effects of meniscal tear injuries, it is necessary to study the unique features, such as the demographic characteristics of the injury, the cause of the occurrence, and the type and location of the tear.

Methods: We conducted the hospital-based prospective study and involved 103 patients who underwent arthroscopic knee surgery at The National Trauma Orthopedic Research Center and Grandmed Hospital in Mongolia between 2020 and 2022. We classified Cooper's classification based on MRI results. Moreover, the type and location of the meniscal tear were finally determined by the diagnosis after arthroscopic surgery.

Results: Out of 103 patients, the mean age of the participants was 34.4 ± 8.6 (18-48 years); males were 61.2% (n=63), and 87.7% (n=93) of tears were located in the medial meniscus, respectively. Among the types of tears, the most frequent were the vertical tears, especially the Radial/Transverse and Vertical/Longitudinal 20% (n=18) tears.

Conclusion: The causes of meniscal tears are mainly injuries. Men are injured more by sports injuries and women by domestic injuries. The type and location of the isolated meniscal tears differ from those of the meniscal tears.

Keywords: Knee, Joint, Meniscus, Arthroscopy, Surgery, Lesion

Introduction

The medial and lateral menisci are anatomically Crescent-shaped fibrocartilaginous structures attached anteriorly and posteriorly to the tibial plateau. The menisci provide many functions, such as eliminating pathological movement, mechanical support and secondary stabilization, localized pressure distribution, lubrication, and proprioception to the knee joint. According to the study, meniscal tears are prevalent orthopedic injuries, affecting patients of various ages and activity levels. Meniscal injury often causes significant pain and physical dysfunction; once clinical symptoms such as catching, locking, and decreased range of motion are present, surgical intervention is required for relief [1]. The menisci are theoretically a non-vascular structure that plays a vital role in protecting the knee joint, and due to injuries and sprains, it is necessary to perform treatment such as meniscectomy [2]. The meniscus of the knee joint is torn due to injuries and degeneration, causing pain and loss of function, requiring treatment such as arthroscopic surgery. It allows us to restore function quickly and without complication [3-4]. When treating a meniscal tear, the priority is to preserve the meniscus as much as possible. Meniscal tears are usually caused by trauma in young people, while in older people, they are often caused by structural degeneration, sometimes for no reason at all. Many studies have been conducted in many foreign countries to investigate the results of arthroscopic meniscectomy surgery [3-7]. According to a survey by Loannas Pengas et al., partial knee meniscectomy is performed 61 times per 100,000 people [8]. Fitzgibbons RE et al. found that meniscal tears are more common in men than women, ranging from 2.5:1 to 4:1.35 [9]. A study from England also reviewed 699 965 arthroscopic meniscectomy cases were done more frequently in men (453 726 [64-82%] cases) than women (246 239 [35-18%] cases) and 40-59 years accounted for 47.25% 10. 14% of meniscal tears (Sonne-Holm et al., 1980) and 31% of meniscal tears (Wynn-Parry et al., 1958) have also been reported to have damaged the lateral meniscus [11].

Also, according to researcher Englund M. et al., the primary location of the tear is on the posterior horn of the medial meniscus, and the prevalence increases with age [12]. The Researcher Ioannis P. Terzidis et al. studied the characteristics of meniscal tears among young athletes; 69.3% were in the medial meniscus, 30.7% were in the lateral meniscus, and

vertical tears accounted for the majority of 77.5%. 23.2% of tears involved the peripheral zones, and tears that extended more into the posterior horn accounted for 75.7%. According to the study, the tear shape between male and female athletes showed no statistically significant differences in the percentage of horizontal, bucket-handle, longitudinal, or radial tears on both sides. The characteristics of isolated meniscal tears differ in sex, tear location, and type from those seen in unstable knees, and knowledge is helpful in knee injury management [13].

In our country, in 2012-2013, out of a total of 193 cases of arthroscopic knee surgery at the National Trauma Orthopedic Research Center in Mongolia, 66,3% (n=128) were men, 33,7% (n=65) were women, the average age was 25 (21-30) and sports and household damage accounted for the most significant cause of damage [14]. According to researcher Munkhsaikhan T. et al.'s 2021 study, 87.6% of knee injuries were registered in the capital, and 71.6% were under 44. The causes of falls and traffic accidents that cause injuries were not statistically significant by gender, but men are more affected by injuries caused by hitting inanimate objects [15]. The main reason for our research is that there needs to be more specialized research on the study of unique features of meniscal tears in our country. Therefore, our research aims to study some features such as demographic characteristics, cause of injury, type, and location of knee meniscal tear, which is essential to prevent the disease and reduce its negative consequences.

Materials and Methods

Research design

We conducted the hospital-based prospective study and were involved with 103 patients who underwent arthroscopic knee surgery (with diagnosis by ICD 10; S83.2, M23.2 and did arthroscopic meniscectomy by ICD 9; 80.6, 81.47) at the Grandmed Hospital and National Trauma Orthopedic Research Center in Mongolia from July 2020 to April 2022. 4 cases were excluded from the study. To describe the unique feature of meniscal tears, we evaluated 106 knees in 103 patients (3 with bilateral tears, 2 women, and 1 man) with isolated meniscal lesions. Other concomitant ligament injuries were excluded from our study.

131 Questionnaires with 6 groups were collected from the study participants, and clinical examinations were performed. All patients were given the preoperative diagnosis of meniscal tear by history, clinical interview, physical examination, and confirmatory MRI. Each meniscal tear was prospectively examined according to type and location using Cooper's classification (Figure 1). This system divides the meniscus into 3 radial and 4 circumferential zones. The radial zones are A, B, and C for the medial and D, E, and F for the lateral meniscus. Each zone refers to one-third of the meniscus, with A and F being the posterior third for the medial and lateral meniscus. The 4 circumferential zones are 0,1,2,3: 0-meniscal capsular junction, 1-outer third /O-1 or R-R zone/, 2- middle third or R-W zone, and 3-inner third or W-W zone.

Statistical analysis

Continuous variables were summarized as means, and categorical variables as counts and percentages. Chi-square and Fisher's exact test were used for categorical variables. A critical p-value of < 0.05 was used. SPSS version 27 software (SPSS et al., USA) was used for statistical analyses.

Ethical statement

The study was approved by the Research Ethics Committee of the Mongolian National University of Medical Sciences (No.2020/06-12). All patients provided written informed consent before participating in this study.

Results

1. The Demographic characteristics of participants

Out of 103 patients, the mean age of the participants was 34.4 ± 8.6 (18-48 years); male and female were 61.2% (n=63) 38.8% (n=40), respectively It shows that the majority are 30-39 years old, 92.2% (n=95) were Khalkha ethnic group, 76.7% (n=79) were urban residents, 60.2% (n=62) were university and 46.6% (n=48) were self-employed. For clients under 19, 13.3%, or a higher rate of lateral meniscus tears. Age of 30-39, 49.5% or higher medial meniscus tear. In terms of gender, 2 of the 3 people

with medial meniscus tear are men. Regarding education, 73.4% of medial meniscus tears and 63.7% of lateral meniscus tears are people with higher education. In terms of marriage, 80.2% of medial meniscus tears are more affected by married clients. Radial/Transverse tears of total medial meniscus tears were 35.2% (n=32) in first place, and Horizontal tears were 14.3% (n=13) in second place. Radial/Transverse tears were 46.7% (n=7) of lateral meniscus tears or the majority. There were no statistically significant differences between medial,lateral meniscus and General Demographic Characteristics ($P > 0.05$) (Table 1).

Table 1. General Demographic characteristics according to the medial and lateral compartments

Variables	Medial		Lateral	
	n	%	n	%
Age				
>19	9	9.9%	2	16.7%
20-29	13	14.3%	1	8.3%
30-39	45	49.4%	2	16.7%
<40	24	26.4%	7	58.3%
Gender				
Male	57	62.6%	6	50.0%
Female	34	37.4%	6	50.0%
Education				
Primary education	1	1.1%	0	0.0%
Secondary education	24	26.4%	2	16.7%
Special Secondary/College	8	8.8%	1	8.3%
High education	58	63.7%	9	75.0%
Marital Status				
Never married	15	16.9%	4	28.6%
Married	72	80.9%	10	71.4%
Single living	1	1.1%	0	0.0%
Divorced	0	0.0%	0	0.0%
Widowed	0	0.0%	0	0.0%
Living with Partner	1	1.1%	0	0.0%
Meniscus rupture classification				
Radial/transverse tear	32	35.2%	6	40%
Oblique tear	7	7.7%	2	13.3%
Vertical/Longitudinal tear	18	19.7%	1	6.7%
Horizontal tear	13	14.3%	2	13.3%
Complex/Degenerative tear	2	2.2%	0	0.0%
Bucket-handle tear	8	8.8%	2	13.3%
Discoid meniscus tear	2	2.2%	0	0.0%
Radial/Longitudinal tear	1	1.1%	1	6.7%
Other	8	8.8%	1	6.7%

Data are presented as N (%), indicating the number (percentage) for both the medial and lateral meniscus demographics.

In Table 2, we have shown that sports injuries were predominated 44.6% (n=46), household injuries 33.9% (n=35), auto accidents 2.9% (n=3), unknown cause 12.6% (n =13), other injuries

5.82% (n=6), respectively. According to gender, sports injuries prevailed in men, and domestic injuries stayed in women (P<0.001). There was no statistically significant difference in the causes (auto accident, cause unknown, and other) between males and females (p > 0.05) (Table 2).

Table 2. Relationship between meniscal tears cause and gender

Variables	Gender		Total n (%)	P value
	Male n (%)	Female n (%)		
Sports Injury	38(82.6)	8(17.4)	46(44.6)	.0001
Auto Accident	3(4.8)		3(2.9)	.280
Household injury	12(34.3)	23(65.7)	35(33.9)	.0001
Cause unknown	6(46.1)	7(67.9)	13(12.6)	.235
Other	4(66.7)	2(33.3)	6(5.8)	.569
Total	63(61.2)	40(38.8)	103(100.0)	

Data are presented as n (%); p, statistical significance calculated by Pearson’s chi-square test. There was no statistically significant difference in the causes (auto accident, cause unknown, and other) between males and females ($p > 0.05$)

2. The type and location of meniscal tear

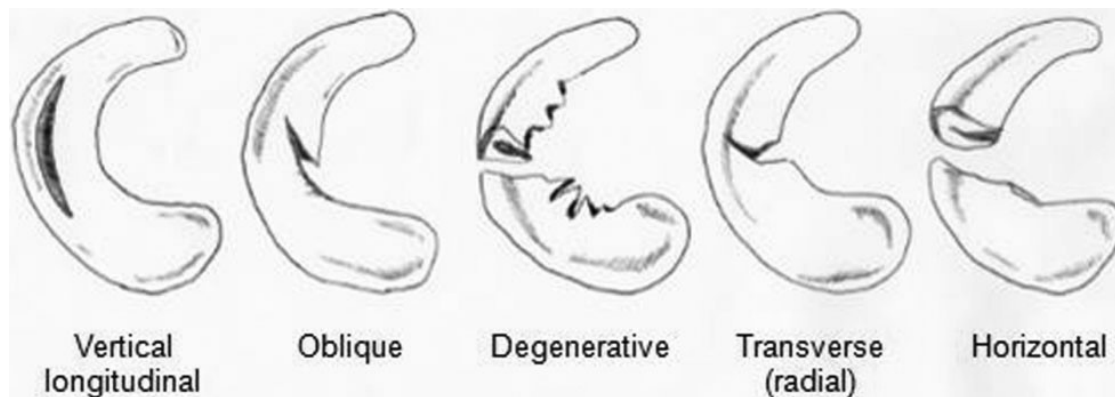


Figure 1. Common patterns of meniscal tears.

Of the 106 tears, 60.3% (n=64) were observed in males, and 39.6% (n=42) were observed in females. The most common tear type was the Radial/Transverse tears on both sides, 35.8% (n=38). The second common tear type was Vertical/Longitudinal

tear 17.9% (n=19). The third common tear type was Horizontal tear 14.2% (n=15). There were no statistically significant differences between meniscus rupture classification and sex ($P>0.05$) (see Table 3).

Table 3. The distribution of tear types according to gender

Meniscus rupture classification	Gender		Total n(%)	P-value
	Male n(%)	Female n(%)		
Radial/Transverse	22(34.4)	16(38.1)	38(35.8)	.696
Oblique	6(9.4)	3(7.1)	9(8.5)	.490
Vertical/Longitudinal	10(15.6)	9(21.4)	19(17.9)	.446
Horizontal	11(17.2)	4(9.5)	15(14.2)	.268
Complex/Degenerative		2(4.8)	2(1.9)	.155
Bucket-handle	8(12.5)	2(4.8)	10(9.4)	.309
Discoid meniscus	1(1.6)	1(2.4)	2(1.9)	.638
Radial/Longitudinal		2(4.8)	2(1.9)	.155
Other	6(9.4)	3(7.1)	9(8.5)	.106
Total	64(100.0)	42(100.0)	106(100.0)	

Data are presented as n (%); p, statistical significance calculated by Pearson’s chi-square test.

Overall, 87.7% (n=93) of tears were located in the medial meniscus, and 12.3 % (n=13) in the lateral meniscus (Table 4). On the medial side, A, B, and C zones were 58.1% (n=54), 36.5% (n=34), and 5.4% (n=5), respectively. On the lateral side, 7.7% (n=1) of the tears involved the posterior horn (zone D), 53.8% (n=7) involved the middle (zone E), and 38.5% (n=5) were present in the anterior horn (zone F). When both menisci are considered together, a total of 51.8% of the tears were

located in the posterior horn, 38.6% were located in the middle body, and only 9.43% were located in the anterior horn. The most common tear patterns were radial/transverse 35,5 % (n=32), vertical/Longitudinal 20 % (n=18), horizontal 14,4 % (n=13), bucket-handle 8.9 % (n=8) tears were the most frequent on the medial side, whereas radial/transverse 54.5 % (n=6), oblique 18,1 % (n=2) tears were the most frequent on the lateral side (see Table 4).

Table 4. The type and location of meniscal tear according to the medial and lateral compartments

Meniscus rupture classification	Cooper's classification							
	Medial			Total	Lateral			Total
	A n (%)	B n (%)	C n (%)		D n (%)	E n (%)	F n (%)	
				n (%)				n (%)
Radial/Transverse	16 (50.0)	14 (43.8)	2 (6.3)	32 (100)		4 (66.7)	2 (33.3)	6 (100)
Oblique	4 (57.1)	2 (28.6)	1 (14.3)	7 (100)	1 (1.1)	1 (50.0)		2 (100)
Vertical/Longitudinal	14 (77.8)	4 (22.2)		18 (100)			1 (100)	1 (100)
Horizontal	7 (50.0)	7 (50.0)		14 (100)			1 (100)	1 (100)
Complex/Degenerative		1 (50.0)	1 (50.0)	2 (100)				
Bucket-handle	6 (66.7)	2 (22.2)	1 (11.1)	9 (100)		1 (100)		1 (100)
Discoid meniscus	1 (50.0)	1 (50.0)		2 (100)				
Radial/Longitudinal	1 (100.0)			1 (100)			1 (100)	1 (100)
Other	5 (62.5)	3 (37.5)		8 (100)		1 (100)		1 (100)
Total	54 (58.1)	34 (36.5)	5 (5.4)	93 (100)	1 (7.7)	7 (53.8)	5 (38.5)	13 (100)

Data are presented as n (%) of the meniscal tear types and location of the medial, and lateral sides of the meniscus.

3. Circumferential Zone

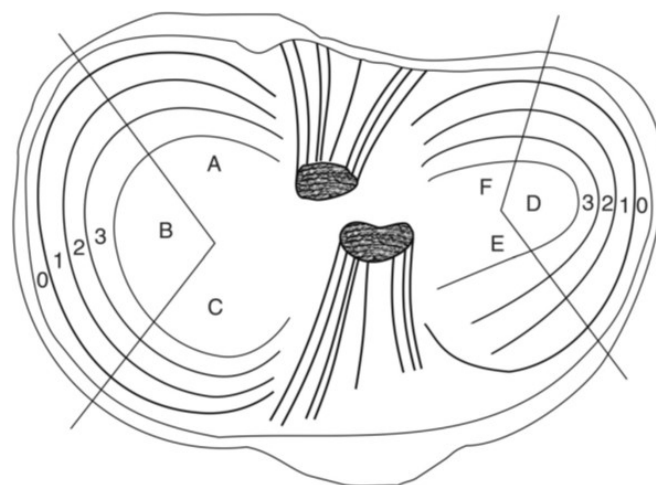


Figure 2. Cooper's classification of meniscal tears: Radial zones are divided into areas A, B, and C for the medial meniscus (from posterior to anterior) and into areas D, E, and F for the lateral meniscus (from anterior to posterior). The 4 circumferential zones are 0 for the menisco capsular junction, 1 for the outer third, 2 for the middle third, and 3 for the inner third.

Tears that extended into the peripheral zones 0-1 or (R-R) zones accounted for 16.9% (n=18), in the middle third 2 or (R-W) zone 55.6% (n=59) and in inner third 3 or (W-W) zone 27.3% (n=29) In the medial meniscus, peripheral tears 0-1 or (R-R) accounted for 18.3 %, and in the lateral meniscus 7.7%. The most common

tear locations were in zones 2 (R-W), with 59.1% of tears occurring in the medial and 30.8% in the lateral meniscus. Isolated tears in zone 3 (W-W) accounted for only 22.6% of the medial meniscus and 61.5% of the lateral meniscus. Three (2.8%) tears extended to more than 2 zones (see Table 5).

Table 5. The circumferential zone distribution of meniscal tears in the medial and lateral compartments

Meniscus rupture classification	Medial				Lateral			
	0-1 (R-R) n (%)	2 (R-W) n (%)	3 (W-W) n (%)	Total n (%)	0-1 (R-R) n (%)	2 (R-W) n (%)	3 (W-W) n (%)	Total n (%)
Radial/Transverse	3(9.4)	19(59.4)	10(31.3)	32(100)	1(16.7)	2(33.3)	3(50.0)	6(100)
Oblique		7(100)		7(100)		1(50.0)	1(50.0)	2(100)
Vertical/Longitudinal	7(38.9)	8(44.4)	3(16.7)	18(100)		1(100)		1(100)
Horizontal	2(14.3)	9(64.3)	3(21.4)	14(100)			1(100)	1(100)
Complex/Degenerative		1(50.0)	1(50.0)	2(100)				
Bucket-handle	3(33.3)	4(44.4)	2(22.2)	9(100)			1(100)	1(100)
Discoid meniscus		1(50.0)	1(50.0)	2(100)				
Radial/Longitudinal		1(100)		1(100)			1(100)	1(100)
Other	2(25.0)	5(62.5)	1(12.5)	8(100)			1(100)	1(100)
Total	17(18.3)	55(59.1)	21(22.6)	93(100)	1(7.7)	4(30.8)	8(61.5)	13(100)

Data are presented as n (%). There are circumferential three zones: (R-R), Red–Red; (R-W), Red–White and (W-W), White–White in this table, 19(59.4%) radial/transverse tears in the medial meniscus were located in zone 2.

Discussion

Arthroscopic knee surgery is effective, less harmful, and less complicated and has been steadily increasing in recent years in all countries [10,16]. Arthroscopic treatment of meniscal injuries has become one of the most common surgical procedures in the United States. The American Academy of Orthopedic Surgeons estimates knee arthroscopy procedures totaled 636,000 cases annually in 1999. Many of these procedures are arthroscopic partial meniscectomies, representing up to 10% to 20% of all surgical cases at some centers. They are the fifth most common ambulatory procedure in the United States [1].

In the United States, 67.2% of cases were men, and the mean age of both sexes was 49.3 ± 10.76 years (16-80 years) [17]. Another study in Denmark found that the mean age was slightly younger, 36 (range 3-83), and the incidence of knee meniscal tears was 9.0 per 10,000 in men and 4.2 in women. In 77% of men and 64% of women, the onset of tear symptoms was associated with a knee injury, and 73 percent were medial and 27 percent were lateral. In men, bucket-handle lesions tears were more prevalent, and in women, a preponderance of peripheral detachments were more prevalent. According to the research,

sports injuries were responsible for 38 percent of meniscal tears and 52 percent of those caused by any knee injury [18].

The mean age of the participants in our study was 34.4±8.6 (18-48 years old), and 30-39 years old prevailed, which was similar to the results of Adam Hede [18] et al.'s study in 2017 that the mean age was 36 (range 3-83) years old. The Research Ioannis P. Terzidis et al. [13] described the meniscal tear pattern in the stable knee; there were 285 (78.3%) male and 79 (21.7%) female athletes with a mean age of 22.3 years (range, 16-32 years) was slightly different from the results of the study. Because only athletes were included in this study, the average age may be lower than in our study. The majority of men occupy 61.2%, lower than the research conducted by researchers Fitzgibbons RE and Shelbourne KD [9] in the United States in 1995 that the ratio of male to female sex was 2.5:1 to 4:1.35. Also, the results of our research are similar to those of Simon G. F. Abram and Andrew Judge [10] in 2018, who found 64-82% were male; Peter D. Fabricant and Patricia H. Rosenberger [17] in 2008 in the United States that 67.2% of the cases were male and the results of National Trauma and Orthopedic Research Center, Ulaanbaatar,

Mongolia [14] that men accounted for 66.3% of the total 193 cases of arthroscopic surgery in 2012-2013. Also, 76.7% of the participants in our study were citizens of the capital. According to the 2021 study of T. Munkhsaikhan et al. [15] in the 2021 study, 87.6% of knee injuries were registered in the money, and 71.6% were under the age of 44, which is similar to the results of our study.

In our study, Table 2, sports injuries predominated 44.6% (n=46), household injuries 33.9% (n=35), auto accidents 2.9% (n=3), unknown cause 12.6% (n =13), other injuries 5.82% (n=6), respectively. According to Adam Hede [18], in 2017, 77% of men and 64% of women had an injury, which was slightly lower than our study. Our study was the same as the results conducted at the National Trauma and Orthopedic Research Center [14] in 2012-2013, which stated that sports and household injuries accounted for the most significant percentage. When looking at injuries by gender, 49.2% (n=31) of sports injuries prevailed in men, and 47.5% (n=19) of domestic injuries prevailed in women (P<0.001) statistically significant p-value. Men were 4.7 times more likely than women to have sports injuries, 4.8 times more likely to have car accidents, two times more likely to have other injuries, and 1.9 times less likely to have household injuries. There was no statistically significant difference in the causes (auto accident, cause unknown, and other) between males and females (p > 0.05). According to T. Munkhsaikhan et al.'s [15] 2021 study of registered knee injuries by jurisdiction, 87.6% were registered in the capital, and 71.6% were under 44. The causes of falls and traffic accidents that lead to injuries do not differ by gender but by damages caused by being hit by inanimate objects. Our study is similar to the study's results in that men are more affected.

In our study, 87.7% of tears were located in the medial meniscus, which was higher than the results of Adam Hede et al.'s [18] 73% were found in the medial meniscus, and Ioannis P. Terzidis et al.'s [13] 69.3% were located in the medial meniscus. Ioannis P. Terzidis's study wrote that the higher percentage of medial meniscal tears can be explained because the medial meniscus is firmly attached to the tibia, especially at the posterior horn. The researcher hypothesized that this tight attachment may expose the medial meniscus to different forces and mechanisms of injury compared to the lateral meniscus. Also, he explained that the lateral meniscus is relatively loosely attached to the tibial plateau, which allows it to be quite mobile and performs little or no stabilizing function in the knee [13].

Tears were described by the appearance of the meniscus using similar terms that several authors used. Concerning the radial zones, a total of 75.7% of tears involved the posterior horn by Ioannis Terzidis [13], compared with 87% reported by Metcalf and Barrett [19] in stable knees and 93.9% written by Smith and Barrett [20] in unstable knees, which were slightly higher than our study. The maximum difference was on the lateral side. We found only 36.2% of Terzidis et al., The American Journal of Sports Medicine tears involved the posterior horn on the lateral side versus 55% in the findings of Metcalf and Barrett [19] and 87.8% in the study of Smith and Barrett [20], also which was slightly higher than our study. In the study by Metcalf and Barrett [19], in the medial meniscus, 98% of the tears were posterior, 28% were in the midportion, and 1% were in the anterior horn. For the lateral meniscus, the percentages were 55%, 59%, and 24%, respectively. By researcher Ioannis P. Terzidis's [13] study, on the medial side, 93.1% of the tears involved the posterior horn, 51.5% involved midportion tears, and 2.2% involved the anterior horn, and on the lateral side, 36.2% involved the posterior horn, 78.4% involved the midportion, and 8.6% involved the anterior horn. The results of these studies differed. In our study, on the medial side, 58.1% of the tears involved in the posterior horn were present in zone A, 36.5% expanded in zone B, and 9.67% expanded to the whole length (bucket handle). On the lateral side, 7.7% of the tears involved the posterior horn (zone D), 53.8% involved the middle (zone E), and 38.5% were present in the anterior horn (zone F). Compared to these studies, in the medial meniscus, the posterior horn had the highest percentage, the midportion tears had the moderate rate, and the anterior horn had the lowest percentage. Different results were obtained in the lateral meniscus, with the highest percentage of midportion tears, a moderate portion of the posterior horn, and the lowest percentage of the anterior horn. In our study, a total of 51.8% of the tears were located in the posterior horn, 38.6% were found in the middle body, and only 9.43% were located in the anterior horn, which is similar according to researcher Englund M [12], the central position is located on the posterior horn of the meniscus.

In our study, the most common tear patterns were radial/transverse 35.5 % (n=32), vertical/Longitudinal 20 % (n=18), horizontal 15 % (n=14), bucket-handle 9.6 % (n=9), other 8.9 % (n=8), discoid meniscus 2.2 % (n=2), oblique 7.7 % (n=7) tears were the most frequent on the medial side. In contrast,

radial/transverse 54.5 % (n=6), diagonal 18.1 % (n=2), vertical/longitudinal 9% (n=1), horizontal 9% (n=1), bucket-handle 9% (n=1), and other 9% (n=1) tears were the most frequent on the lateral side (Table 4).

According to the researcher, Ioannis P. Terzidis, Avraam Ploumis, etc, the most common tear patterns were bucket handle (23.1%), longitudinal (18.2%), horizontal (17.4%), and oblique (16.4%) longitudinal (22.1%), bucket-handle (32.4%), and diagonal (16.8%) tears were the most frequent on the medial side, whereas radial (32.7%) and horizontal (25.8%) tears were the most frequent on the lateral side. There were statistically significant differences between the medial and lateral sides in flat ($P < .01$), bucket handle ($P < .001$), longitudinal ($P < .01$), and radial ($P < .001$) tears [13]. To compare our study with others in the literature, bucket-handle, longitudinal, oblique, and radial tears were grouped as vertical tears, and those described as horizontal and flaps (superior and inferior) were grouped as flat. In the study by Dandy [21], 75% of the medial meniscal tears were vertical and 23% horizontal, with vertical tears occurring most often in the fourth decade and horizontal tears in the fifth decade of life. Poehling et al. [22] described 6039 meniscal tears from multiple centers and found 56% vertical and 42% horizontal. Metcalf and Barrett Field [19], in a prospective evaluation of 1485 meniscal tears in patients with stable knees, found 40% of tears to be vertical and 60% to be horizontal.

In our study, 72% of the tears were vertical in the medial meniscus, and 15.05% were horizontal; in the lateral meniscus, the percentage was 84.6% and 7.7%, respectively. Comparing these results, vertical tears were close to Dandy's [21], lower than Poehling's [22], and higher than Metcalf and Barrett's [19]. In our study, tears that extended into the peripheral zones 0-1 (R-R) accounted for 16.9% (n=18), in middle third 2 or (R-W) zone 55.6% (n=59) and inner third 3 or (W-W) zone 27.3% (n=29). In the medial meniscus, peripheral tears 0-1 (R-R) accounted for 18.3 %, and in the lateral meniscus, 7.7%. The most common tear locations were zones 2 (R-W), with 59.1% of tears occurring in the medial and 30.8% in the lateral meniscus. Isolated tears in zone 3 (W-W) accounted for only 22.6% of the medial meniscus and 61.5% of the lateral meniscus. In stable knees, Metcalf and Barrett [19] found that 39% of the tears involved the peripheral zones (0 and 1), with no difference between the circumferential zones involved in medial and lateral tears. In researcher Ioannis P. Terzidis's study [13], only 23.3% were peripheral, primarily in

those present in the medial meniscus. Poehling et al. [22] defined peripheral tears as occurring within 3 mm of the meniscal synovial junction and found 26% of the incisions to be peripheral, similar to our results.

87.7% (n=93) of tears were located in the medial meniscus. 51.8% of the tears were found in the posterior horn of radial zones and the middle third 2 (R-W) of circumferential zones. The most frequent were the vertical tears, mainly the Radial/Transverse and vertical/Longitudinal 20% (n=18) tears. The location (vascular or avascular zone) of the meniscal lesion influences the type of therapy. Knowledge of the class and the location of the meniscal lesion is helpful in surgeons for predicting the most likely therapeutic procedure (partial meniscectomy or repair).

The limitation of our study was that arthroscopic knee surgery was beginning to develop in our country, and the study was conducted using a hospital-based prospective method for a relatively short period (1 year and 9 months). In the future, it is necessary to increase the number of participants in the study and study the treatment results in cohort studies after 2 years, 5 years, and 10 years, as in other countries.

Conclusion

The mean age of the participants was 34.4 ± 8.6 (range, 18-48 years). The majority are male, 30-39 years old. In this age, the common tear was the medial meniscus tear. The causes of meniscal tears are mainly injuries; men are injured more by sports injuries and women by domestic injuries. The type and location of the isolated meniscal tears differ from those of the meniscal tears, and this knowledge is helpful for the prevention of injuries and for predicting the most likely surgical procedure.

Conflict of Interest

The authors declare that they have no conflict of interest concerning this study.

References

1. Fabricant P, Clinical and Demographic Predictors of Short-term Recovery From Arthroscopic Partial Meniscectomy (2009). Yale Medicine Thesis Digital Library. 405. <http://elischolar.library.yale.edu/ymtdl/405>.

2. Javidan P, Ahmed M, Kaar SG. Arthroscopic release of the deep medial collateral ligament to assist in exposure of the medial tibiofemoral compartment. *Arthrosc Tech*. 2014;3(6):e699701. doi:10.1016/j.eats.2014.09.002
3. Rai MF, McNulty AL. Meniscus beyond mechanics: Using biology to advance our understanding of meniscus injury and treatment. *Connect Tissue Res*. 2017;58(3-4):221-224. doi:10.1080/03008207.2017.1312921
4. Rubman MH, Noyes FR, Barber-Westin SD. Arthroscopic repair of meniscal tears that extend into the avascular zone. A review of 198 single and complex tears. *Am J Sports Med*. 1998;26(1):87-95. doi:10.1177/03635465980260013301
5. Donald H. Operative arthroscopy. 4th ed. Lippincott Williams & Wilkins; 2016.
6. Suh CY, Lee YJ, Shin JS, et al. Analysis of medical service use of knee osteoarthritis and knee meniscal and ligament injuries in Korea: a cross-sectional study of national patient sample data. *BMC Musculoskelet Disord*. 2017;18(1):438. doi:10.1186/s12891-017-1795-7
7. Laprell H, Stein V, Petersen W. Arthroscopic all-inside meniscus repair using a new refixation device: a prospective study. *Arthroscopy*. 2002;18(4):387-93. doi:10.1053/jars.2002.30639.
8. Pengas I. Meniscectomy and osteoarthritis. Dissertation. University of Dundee; 2012. <https://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.585492>.
9. Fitzgibbons RE, Shelbourne KD. "Aggressive" nontreatment of lateral meniscal tears seen during anterior cruciate ligament reconstruction. *Am J Sports Med*. Mar-Apr 1995;23(2):156-9. doi:10.1177/036354659502300205.
10. Abram SGF, Judge A, Beard DJ, Price AJ. Adverse outcomes after arthroscopic partial meniscectomy: a study of 700 000 procedures in the national Hospital Episode Statistics database for England. *Lancet*. 2018;392(10160):2194-2202. doi:10.1016/S0140-6736(18)31771-9
11. Sonne-Holm S, Fledelius I, Ahn NC. Results after meniscectomy in 147 athletes. *Acta Orthop Scand*. Apr 1980;51(2):303-9. doi:10.3109/17453678008990803
12. Englund M, Guermazi A, Gale D, et al. Incidental meniscal findings on knee MRI in middle-aged and elderly persons. *N Engl J Med*. 2008;359(11):1108-15. doi:10.1056/NEJMoa0800777
13. Terzidis IP, Christodoulou A, Ploumis A, Givissis P, Natsis K, Koimtzis M. Meniscal tear characteristics in young athletes with a stable knee: arthroscopic evaluation. *Am J Sports Med*. 2006;34(7):1170-5. doi:10.1177/0363546506287939
14. Togtmol M. Results of arthroscopic surgery. Presented at: Combination is Key to the Future; 2015; Ulaanbaatar, Mongolia.
15. Togtmol M. Results of knee joint injury and its arthroscopic surgery. Ach Medical University; 2021.
16. Ebrahimi N, Jalaie S, Salsabili N, Ansari NN, Naghdi S. Knee Injury and Osteoarthritis Outcome Score in patients with isolated meniscus injury; Validity and reliability. *J Res Med Sci*. 2017;22:55. doi:10.4103/jrms.JRMS_941_16
17. Fabricant PD, Rosenberger PH, Jokl P, Ickovics JR. Short-term recovery predictions differ from long-term outcomes after arthroscopic partial meniscectomy. *Arthroscopy*. Jul 2008;24(7):769-78. doi:10.1016/j.arthro.2008.02.015
18. Hede A. Treatment of meniscal lesions in the knee. Epidemiological, clinical, and experimental aspects. *Dan Med Bull*. Jun 1993;40(3):317-31.
19. Metcalf MH, Barrett GR. Prospective evaluation of 1485 meniscal tear patterns in patients with stable knees. *Am J Sports Med*. Apr-May 2004;32(3):675-80. doi:10.1177/0095399703258743.
20. Smith JP, 3rd, Barrett GR. Medial and lateral meniscal tear patterns in anterior cruciate ligament-deficient knees. A prospective analysis of 575 tears. *Am J Sports Med*. Jul-Aug 2001;29(4):415-9. doi:10.1177/03635465010290040501
21. Dandy DJ. The arthroscopic anatomy of symptomatic meniscal lesions. *J Bone Joint Surg Br*. Jul 1990;72(4):628-33. doi:10.1302/0301-620X.72B4.2380218
22. Poehling GG, Ruch DS, Chabon SJ. The landscape of meniscal injuries. *Clin Sports Med*. Jul 1990;9(3):539-49.