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IS ABNORMAL PATELLA HEIGHT A PREDISPOSING FACTOR FOR ISOLATED MENISCAL TEARS?

ANORMAL PATELLA YÜKSEKLİĞİ İZOLE MENİSKÜS YIRTIKLARI İÇİN PREDİSPOZAN BİR FAKTÖR MÜ?

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ABSTRACT

Objective: The relationship between patellar height and knee pathologies has been assessed in the literature. However, the relationship with isolated meniscal tears has not been evaluated. This study aims to evaluate whether or not patellar height is a predisposing factor for isolated medial or lateral meniscal tear.

Material and Methods: The consecutive 411 patients who had magnetic resonance imaging between 2018-2020 were evaluated retrospectively. The patients between 18 and 50 years of age with isolated medial or lateral meniscal tear were included. The patients without any meniscal tear or ligament injury formed the control group. The 160 patients included in the study were divided into three groups: 65 medial meniscus, 30 lateral meniscus, and 65 control group. Patellar height was measured with the Insall-Salvati method by two orthopedic surgeons twice, with an interval of one month.

Results: All of the groups were similar in terms of age and gender (p>0,05). Patellar length (p=0.252), patellar tendon length (p=0.059), and Insall-Salvati ratios (p=0.810) of all groups did not show any significant difference. The abnormal patellar height rates were similar in the medial meniscus and control groups (12.4%-13.9%), while abnormal patella height (33.4%), especially patella baja, was observed more frequently in the lateral meniscus group. However, no statistically significant difference was found. A significant strong correlation was observed between and within the observers' measurements (p=0.000).

Conclusion: Abnormal patella height, especially patella baja, was observed more frequently in the isolated lateral meniscus group. Abnormal patellar height could be a predisposing factor for isolated lateral meniscal tear.

Keywords: Patellar height, isolated meniscal tear, Insall-Salvati

ÖZET

Amaç: Patella yüksekliği ile birçok diz patolojisi arasındaki ilişki incelenmişken izole menisküs yırtıkları ile arasında ilişki olup olmadığı değerlendirilmemiştir. Çalışmamızın amacı diz biyomekaniği üzerinde önemli bir rolü olan patella yüksekliğinin izole medial veya lateral menisküs yırtığı için predispozan bir faktör olup olmadığını araştırmaktır.

Gereç ve Yöntem: Çalışmada 2018-2020 yılları arasında diz problemleri nedeni ile manyetik rezonans (MR) görüntülemesi yapılan 411 hasta retrospektif olarak incelendi. Yaş aralığı 18 ile 50 olan, izole medial veya izole lateral menisküs yırtığı olan hastalar çalışmaya dahil edildi. Menisküs lezyonu ve bağ yaralanması olmayan hastalar kontrol grubunu oluşturdu. Çalışmaya alınan 160 hastanın, 65'i izole medial menisküs, 30'u izole lateral menisküs ve 65'i kontrol grubu olarak üç gruba ayrıldı. Hastaların çekilen diz MR'larında patella yüksekliği Insall-Salvati yöntemine göre ile iki ortopedi uzmanı tarafından bir ay ara ile iki kez ölçüldü.

Bulgular: Her üç grup arasında yaş ve cinsiyet dağılımı anlamlı farklılık göstermemiştir (p>0,05). Ortalama patellar tendon uzunluğu (p=0,059), patella uzunluğu (p=0,252) ve İnsall-Salvati oranları (p=0,810) incelendiğinde gruplar arasında anlamlı fark saptanmamıştır. Gruplardaki anormal patella yüksekliği oranları karşılaştırıldığında medial menisküs ve kontrol grubunda sonuçlar benzer iken (%12,4-%13,9) lateral menisküs grubunda anormal patella yüksekliğinin (%33,4) özellikle de patella bajanın daha sık görüldüğü gözlenmiştir. Ancak istatistiksel olarak anlamlı bir fark bulunmamıştır. Her iki gözlemcinin ölçümleri incelendiğinde ise gözlemciler arası ve gözlemciler içi anlamlı güçlü korelasyon gözlenmiştir (p=0,000).

Sonuç: Çalışmamızda ortalama İnsall-Salvati oranları gruplar arasında benzer bulunmakla beraber izole lateral menisküs grubunda anormal patella yüksekliği özellikle de patella baja daha sık görülmüştür. Anormal patella yüksekliği izole lateral menisküs yırtığı için predispozan bir faktör olabilir.

Anahtar Kelimeler: Patella yüksekliği, izole menisküs yırtığı, İnsall-Salvati

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INTRODUCTION

The knee joint has a tendency towards both natural degeneration and trauma. The knee joint is one of the most frequently injured joints (1) and meniscal tears are one of the most common knee problems leading to disability and loss of valuable time, and can increase the risk of developing osteoarthritis (2). The incidence of meniscal tears is 2 per 1000 patients per year in the Netherlands, and partial meniscectomy for the treatment of meniscal tears is the most commonly performed orthopedic surgical procedure in the United States (3, 4). Anatomic risk factors for anterior cruciate ligament (ACL) rupture and concomitant meniscal injuries are commonly assessed in the literature. A narrow femoral intercondylar notch, increased tibial plateau posterior slope, and shallow medial tibial plateau depth and anterior-posterior length of the medial/lateral femoral condyle were found to be related to ACL injury (1, 5).

Only a few studies have investigated the anatomical risk factors for isolated meniscal tears (6, 7). Li et al. investigated the posterior and coronal tibial slope, plateau depth, and notch width as anatomic factors; however, they did not evaluate patellar height as a risk factor.

The relationship between patellar height and knee disorders was evaluated, and abnormal patellar height was found to be related to patellar arthritis, patellar instability, and ACL injury (8-10). However, the relationship with isolated meniscal tears was not investigated. To our knowledge, the effect of patellar height on meniscal tears has only been investigated in one study. Vampertzis et al. found that patellar height could be an etiologic factor for meniscal tears (6). However, the authors did not compare medial and lateral meniscal tears and the control group.

In this study, the relationship between patellar height abnormalities and isolated medial and lateral meniscal tears was investigated using magnetic resonance imaging (MRI) and the reliability of measuring the Insall–Salvati ratio with MRI was assessed. We hypothesized that patellar height abnormalities could be a risk factor for isolated medial or lateral meniscal tears.

MATERIALS AND METHODS

Patient selection

A total of 411 consecutive patients who visited our outpatient clinic for knee problems and underwent MRI between 2018 and 2020 were retrospectively evaluated. Patients between 18–50 years of age with isolated medial or lateral meniscal tears and without any previous knee surgery were included in this study. Patients without meniscal tears or ligament injuries formed the control group. Patients who had previous knee surgery, deformity, tumoral lesion, discoid meniscus, severe arthrosis (grade 3-4), concomitant ligament injury, fracture, or history of rheumatologic disease were excluded. Among the 411 patients reviewed, 160 were included in this study and divided into the following three groups: isolated medial meniscal tears group (n=65), isolated lateral meniscal tears group (n=30), and control group (n=65).

The study was approved by the local ethics committee of Acıbadem MAA University (Date: 11.03.2022, No: 2022-05/04).

Radiological assessment

All patients were examined using a 3.0-T MRI scanner (SIGNA Premier, General Electric Company, Chicago, USA) in the supine position with a 10° knee flexion. Mid-sagittal non-fat-saturated T1-weighted spin echo or proton density sequences were used to perform all measurements. We used the Insall–Salvati method to measure patellar height (11). First, the maximum length of the patella was measured from the proximal pole to the distal pole. Second, the length of the patellar tendon was measured from the distal pole of the patella to the tibial tuberosity (Figure 1). The Insall–Salvati ratio was calculated by dividing the patellar tendon length by the patellar length. Centricity 2006 software (GE Healthcare, Chicago, USA) was used for measurements. Two orthopedic surgeons performed all measurements using MRI in two cycles with a minimum of one month in between. Three groups were defined by the Insall–Salvati ratio values as follows: patella baja <0.8; normal 0.8–1.2; and patella alta >1.2.

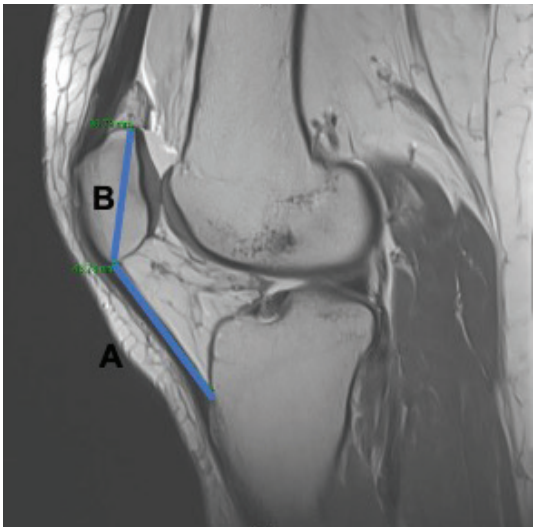

Figure 1: The measurement of patellar tendon length (A) and patella length (B)

Statistical analysis

The mean, standard deviation, median, minimum value, maximum value, frequency, and percentage were used for descriptive statistics. The distribution of variables was analyzed using the Kolmogorov–Smirnov test. The Kru-

skal–Wallis test and Mann–Whitney U test were used to compare quantitative data. The chi-square test was used to compare qualitative data. Intraclass correlation was used for the intra-observer and inter-observer reliability analyses. The SPSS software (v28.0; IBM, Armonk, NY, USA) was used for statistical analyses. Statistical significance was defined as a p-value <0.05.

RESULTS

The baseline demographic data of the 160 patients were evaluated. Sixty-five patients (40.6%) were in the control group, 30 (18.8%) were in the lateral meniscus tear group, and 65 (40.6%) were in the medial meniscus tear group. The mean age of all patients was 35.6±8.9 years. Seventy-seven patients (48.1%) were female and 83 (51.9%) were male. Sixty-seven right leg knees (41.9%) and 93 left leg knees (58.1%) were analyzed. None of the groups showed any significant differences in terms of age or sex (p>0.05).

The patellar length, patellar tendon length, and Insall–Salvati ratios of all groups did not show any significant difference (p>0.05) (Table 1). A significant and strong correlation was observed between the first and second measurements of the patellar length, patellar tendon length, and Insall–Salvati ratio performed by the first observer. Similarly, a strong correlation was observed between the measurements of all parameters performed by the second observer (Table 2).

Table 1: Measurements of patellar length, patellar tendon length, and Insall-Salvati ratio

		Normal group	Lateral meniscus group	Medial meniscus group	p	
Patellar length (mm)	Mean±sd	41.58±3.98	42.46±4.33	42.70±4.33	0.252	K
	Median	40.98	42.60	42.74		
Patellar tendon length (mm)	Mean±sd	40.16±5.28	41.10±5.66	42.33±5.62	0.059	K
	Median	40.09	40.22	42.68		
Insall-Salvati ratio	Mean±sd	0.97±0.14	0.98±0.16	0.99±0.13	0.810	K
	Median	0.99	0.99	0.99		

[K]Kruskal-Wallis test

Table 2: Intra-observer reliability of the measurements

	Min-Max	Median	Mean±sd	r	P
Observer I					
Patellar length					
First measurement	33.70-53.20	41.85	41.95±4.10	0.992 (0.989-0.994)	***0.000***
Second measurement	33.20-52.70	41.55	41.91±3.99		
Patellar tendon length					
First measurement	29.90-55.90	42.30	42.03±5.67	0.982 (0.975-0.987)	***0.000***
Second measurement	28.60-57.00	42.20	41.74±5.60		
Insall-salvati ratio					
First measurement	0.63-1.34	1.01	1.00±0.15	0.958 (0.943-0.970)	***0.000***
Second measurement	0.62-1.36	1.01	1.00±0.15		
Observer II					
Patellar length					
First measurement	35.58-53.39	42.45	42.67±4.13	0.975 (0.966-0.982)	***0.000***
Second measurement	33.89-54.49	42.18	42.54±4.24		
Patellar tendon length					
First measurement	28.10-56.88	40.89	40.79±5.52	0.941 (0.919-0.957)	***0.000***
Second measurement	28.06-56.36	40.84	40.56±5.94		
Insall-salvati ratio					
First measurement	0.65-1.27	0.98	0.96±0.15	0.918 (0.888-0.940)	***0.000***
Second measurement	0.58-1.32	0.97	0.96±0.15		

Table 3: Inter-observer reliability of the measurements

	Min-Max	Median	Mean±sd	r	p
Patellar length					
Observer I	33.45-52.95	41.68	41.93±4.03	0.958 (0.942-0.969)	***0.000***
Observer II	19.15-53.94	42.43	42.47±4.52		
Patellar tendon length					
Observer I	30.45-56.45	42.20	41.88±5.59	0.951 (0.933-0.964)	***0.000***
Observer II	21.11-56.44	40.89	40.55±5.77		
Insall salvati ratio					
Observer I	0.63-1.35	1.00	1.00±0.15	0.938 (0.916-0.955)	***0.000***
Observer II	0.55-1.27	0.97	0.96±0.15		

Table 4: The distribution of abnormal patella height measurements

Groups	Insall-salvati ratio			
	<0.8	0.8–1.2	>1.2	Total patients
Control	5 (7.7%)	56 (86.1%)	4 (6.1%)	65
Medial meniscus	3 (4.6%)	57 (87.6%)	5 (7.7%)	65
Lateral meniscus	6 (20%)	20 (66.6%)	4 (13.3%)	30

A significantly strong correlation was observed between the patellar length measurements (0.958 (0.942–0.969), p=0.000), patellar tendon length measurements (0.951 (0.933–0.964), p=0.000), and Insall–Salvati ratio measurements (0.938 (0.916–0.955), p=0.000) of the two observers (Table 3).

Abnormal patellar height was found in 8 (12.4%), 10 (33.4%), and 9 (13.9%) patients in the medial meniscus, lateral meniscus, and control groups, respectively. Although abnormal patellar height seemed to be more frequent in lateral meniscal group, statistically, difference was not found among all groups (p=0.083). The distribution of the abnormal patellar height measurements is summarized in Table 4.

DISCUSSION

The anatomical position of the patella plays a critical role in knee biomechanics. The effects of abnormal patellar height are reported to be related to patellar instability, chondromalacia patella, patellofemoral arthrosis, and ACL injury (8-10). Meniscal injuries are very common, and the link between the anatomical characteristics of the knee joint and meniscal injuries has been analyzed in several studies (6, 7, 12). However, the relationship between patellar height and isolated meniscal injuries has not yet been assessed with MRI evaluation. We hypothesized that an abnormal patellar height could be a risk factor for isolated meniscal tears. Our results showed similar Insall–Salvati ratios for all groups. However, abnormal patellar height was found more frequently in the lateral meniscal group than other groups and patellar height abnormalities showed similarity between medial meniscus and control groups.

The only study that evaluated the relationship between patellar height and isolated meniscal injuries was conducted by Vampertzis et al. (6). They evaluated patellar height using the Insall–Salvati method in knee radiographs of 100 patients with meniscal tears and found that 20% of the patients with meniscal tears had an abnormal patellar height, whereas 16% and 4% of the patients had abnormal patella alta and patella baja ratios, respectively. In addition, 75% of the patients had medial meniscal tears, 20% had lateral meniscal tears, and 5% had bilateral tears (6). They did not compare the meniscal tear side between the groups and did not include any control group. In our study, abnormal patellar height was similar in the control and medial meniscus groups (13.9% and 12.4%, respectively). In contrast, in the lateral meniscus group, 33.6% of the patients had an abnormal patellar height. Although there was no statistical difference between all of the groups, the lateral meniscus group was more likely to have an abnormal patellar height, especially patella baja (20%). Therefore, we considered that an abnormal patellar height could be a predisposing factor for lateral meniscal tears.

Several different methods have been defined for patella height. The most popular of these are the Insall-Salvati, Caton–Deschamps, modified Insall–Salvati, patellotrochlear index, and Blackburne–Pell methods. (11,13-16). These measurements can be measured with MRI as well as radiography. Inter-observer and intra-observer reliabilities of these techniques have been assessed in several studies (17-19). Verhulst et al. compared these measurement methods by using them on conventional radiography (CR), computed tomography (CT), and MRI, and observed that the Insall–Salvati ratio showed better intra-and inter-observer reliabilities than other measurement methods. The Insall–Salvati measurements have acceptable correlation between CR and MRI analyses and normal CR values have been declared suitable for Insall–Salvati ratio analyses on MRI. (18). Therefore, we used the Insall–Salvati method for the MRI measurements and considered values between 0.8–1.2 to be the normal Insall–Salvati ratio values. Our study also showed excellent intra-and inter-observer reliabilities for the Insall–Salvati measurements on MRI (>0.90).

This study has several limitations. First, the study population, especially the lateral meniscal group, was relatively small. However, it has been shown that the incidence of medial meniscal tears is four times higher than lateral meniscal tears (20). Isolated lateral meniscal tears were observed less frequently than medial meniscal tears. Therefore, the number of patients in the lateral meniscal group was lower than the other groups. Furthermore, if we could extend the study population, especially the lateral meniscal group, the statistical results could change. The second limitation was the determination of the MRI slice on which the measurements were performed. This may vary depending on the examiner performing the measurement. However, our measurements showed excellent intra-observer and inter-observer reliabilities. Another limitation was that this study used only the Insall-Salvati method for measuring patellar height. Although the Insall-Salvati method was the most commonly used measurement method in the literature, we could use another method such as Caton-Deschamps to increase the effect of the study. Finally, meniscal tears are multifactorial, however this study assessed only patellar height as a risk factor and did not evaluate other anatomic factors, such as tibial slope, femoral notch width, and tibial plateau depth.

CONCLUSION

Although the mean Insall–Salvati ratios of the meniscal tear and control groups were similar, abnormal patellar height, especially patella baja, was found more frequently in the lateral meniscal tear group. This study indicated that an abnormal patellar height could be a predisposing factor for lateral meniscal tears.

Ethics Committee Approval: This study was approved by Acıbadem University Ethics Committee (Date: 11.03.2022, No: 2022-05/4).

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