



Research Article | Araştırma Makalesi

ANALYSIS OF THE RELATIONSHIP BETWEEN MENISCAL TEARS AND MEDIAL PATELLOFEMORAL RUPTURE ACCORDING TO THE TREATMENT METHOD AND GENDER

MENİSKÜS YIRTIKLARI İLE MEDİAL PATELLOFEMORAL RÜPTÜR ARASINDAKİ İLİŞKİNİN TEDAVİ YÖNTEMİ VE CİNSİYETE GÖRE ANALİZİ

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ABSTRACT

Objective: The purpose of this study was analysis of the relationship between meniscal tears and medial patellofemoral rupture according to the treatment method and gender.

Methods: This study was planned as retrospective study between January 2010 and January 2021. Magnetic resonance images of 60 individuals (37 knees were left, and 23 were right) were obtained for analysis. Patellar morphology, patellar height and patellar alignment and evaluation lateral and medial meniscus tears were evaluated. Knee MRI protocol including axial T2-weighted turbo spin echo was used.

Results: There was a significant difference patellar height (surgery; 1.21 ± 0.27 and conventional; 0.99 ± 0.16), the congruence angle (surgery; -4.94 ± 4.72 and conventional; 4.93 ± 5.72), the lateral patellofemoral angle (surgery; -35.61 ± 16.62 and conventional; 10.93 ± 15.00), except for age parameter (surgery; 27.06 ± 6.20 and conventional; 27.47 ± 5.33) between the conventional and surgical treatment groups ($p < 0.05$). Moreover, we found that 29 patients of the patients with medial patellofemoral rupture had a lateral meniscus tear, 11 patients had a medial meniscus tear, and 8 patients had both lateral and medial meniscus tears.

Conclusion: We found that relationship between meniscal tears and medial patellofemoral rupture will affect the treatment course. Also, this study will contribute to evaluate the radiological and clinical correlations, patello-femoral positioning in patients who medial patellofemoral rupture.

Keywords: Anatomy, patellofemoral ligament, meniscus tears,

ÖZ

Amaç: Bu çalışmanın amacı menisküs yırtıkları ile medial patellofemoral rüptür arasındaki ilişkinin tedavi yöntemi ve cinsiyete göre incelenmesidir.

Yöntem: Bu çalışma Ocak 2010 ile Ocak 2021 tarihleri arasında retrospektif olarak gerçekleştirildi. Analiz için 60 kişiye (37 diz sol taraf ve 23 diz ise sağ taraf) ait manyetik rezonans görüntüleri alındı. Patellar morfoloji, patellar yükseklik ve patellar hizalama ve lateral, medial menisküs yırtıkları değerlendirildi. Aksiyel T2 ağırlıklı turbo spin eko içeren diz MRG protokolü kullanıldı.

Bulgular: Konvansiyonel ve cerrahi tedavi grupları arasında yaş parametresi hariç (cerrahi tedavi yapılanlarda; $27,06 \pm 6,20$ ve konvansiyonel tedavi yapılanlarda; $27,47 \pm 5,33$), patellar yükseklik (cerrahi tedavi yapılanlarda; $1,21 \pm 0,27$ ve konvansiyonel tedavi yapılanlarda; $0,99 \pm 0,16$), uyum açısı (cerrahi tedavi yapılanlarda; $-4,94 \pm 4,72$ ve konvansiyonel tedavi yapılanlarda; $4,93 \pm 5,72$), lateral patellofemoral açı (cerrahi tedavi yapılanlarda; $-35,61$ ve konvansiyonel tedavi yapılanlarda; $10,93 \pm 15,00$) parametrelerinde anlamlı fark bulundu ($p < 0,05$). Ayrıca medial patellofemoral yırtığı olan hastaların 29'unda lateral menisküs yırtığı, 11'inde medial menisküs yırtığı ve 8'inde hem lateral hem de medial menisküs yırtığı tespit ettik.

Sonuç: Menisküs yırtıkları ile medial patellofemoral rüptür arasındaki ilişkinin tedavi sürecini etkileyeceğini bulduk. Ayrıca bu çalışma, medial patellofemoral rüptürü olan hastalarda radyolojik ve klinik korelasyonların, patello-femoral pozisyonların değerlendirilmesine katkıda bulunacaktır.

Anahtar Kelimeler: Anatomi, patellofemoral ligament, menisküs yırtıkları

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Submitted/Başvuru: 20.10.2022

Accepted/Kabul: 14.06.2023

Published Online/ Online Yayın: 30.06.2023

Introduction

Patella dislocations occurs in 3% of all knee injuries. It is common in the young population and women. The incidence of patellar instability is 5.8 per 100,000 and 29 per in the general population.¹ the most important etiology in the development of patellar instability is medial patellofemoral ligament (MPFL) rupture.² The anatomic structures of femur, tibia and the ligaments of the knee are important risk factors to develop patellofemoral instability.³

Patients with MPFL rupture were included in the study. We evaluated these patients according to treatment method (surgical and conventional), anatomical parameters, the presence or absence of lateral and medial meniscus tears, age and gender. Since our study examined MPFL rupture, which is rare condition, and it includes more patients with MPFL rupture than studies in the literature, it will make a significant contribution to the literature. There is no study in the literature evaluating the treatment method and meniscus tears in patients with MPFL rupture. So we think that our study will provide a different perspective on this issue. Because the meniscus structure provides resistance against impacts and also contributes to stabilization on the knee joint. Also, the meniscus is responsible for the lubrication, nutrition, and proprioception of articular cartilage. Moreover, knowing these differences in patellofemoral anatomy will help the orthopedic surgeon to determine the appropriate physical therapy methods and to choose the appropriate treatment by showing the individual mechanism of patellar instability.⁴ Therefore, we think that the addition relationship between meniscal tears and MPFL rupture will affect the treatment course. The aim of our study was analysis of the relationship between meniscal tears and medial patellofemoral rupture according to the treatment method and gender.

Methods

Participants

This study was planned as retrospective study between January 2010 and January 2021. All the test procedures were performed according to the Helsinki Declaration of Principles. Necessary permissions for the study were obtained from Cukurova University Faculty of Medicine, Non-invasive clinical research Ethic Board with conclusion number 105/30. Magnetic resonance images (MRI) of 60 knees (37 knees were left, and 23 were right) were obtained for analysis. The subjects of experimental group were selected patients with operated for patellofemoral ligament rupture and the subjects of control group were selected patients with no operated for patellofemoral ligament rupture. Moreover, exclusion criteria for subjects were history of oncologic, orthopedic and neurological signs.

Evaluation of MRI Images

The slices used for measurements were standardized and performed by the same orthopedist. In addition, although the number of participants provided sufficient statistical power, the number of men and women in our study was similar.

The congruence angle; The angle measured between these two lines like in the Figure 1. If the apex of the patellar joint ridge is lateral to the zero line, then the congruence angle is positive. If it is medial, then the angle is negative.⁵

The lateral patellofemoral angle; measure is calculated as the angle between a horizontal line across the peaks of the 2 femoral condyles and a line along the lateral patellar facet (Figure 1).⁵

Patellar height; we evaluated on lateral radiographs by using Insall-Salvati index (Figure 1).⁶

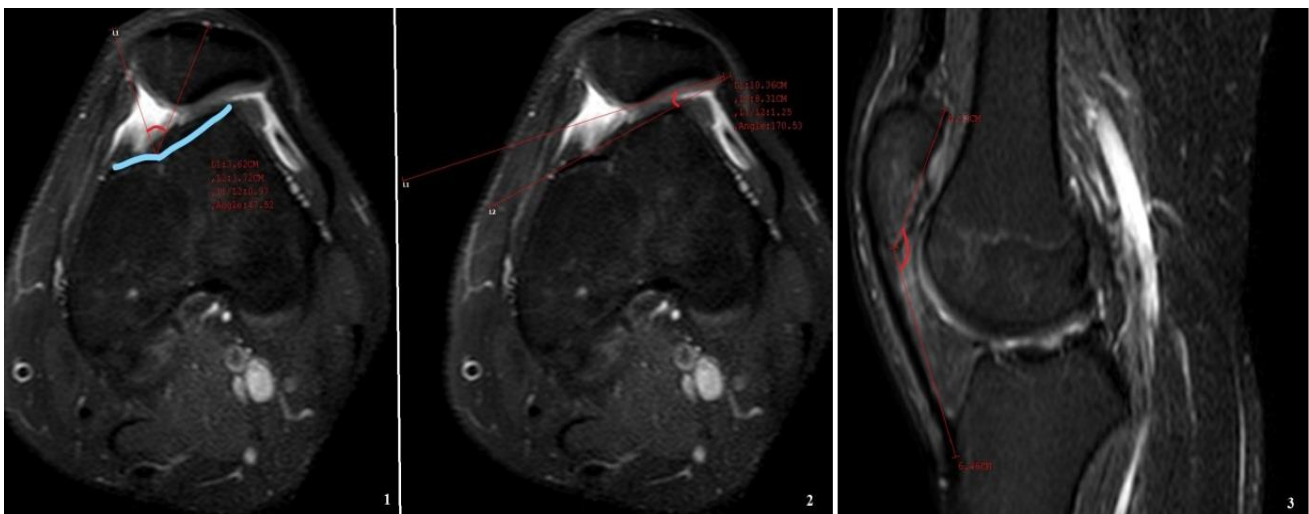


Figure 1. The congruence angle (1), the lateral patellofemoral angle (2) and patellar height (3)

Lateral and medial meniscus tears; Arthroscopic classification of Dorfmann et al. was used for classification.

Grade 1; It is the change in the structure of the meniscus without any deterioration in its integrity. The meniscus is homogeneous but loses its normal appearance. It

becomes darker, its surface becomes irregular and wavy. This type is called meniscosis.

Grade 2; It is characterized by the build-up of calcium inside the body and surface of the meniscus (meniscocalcinosis).

Grade 3; Horizontal cleavage tear.

Grade 4; The radial tear originates from the inner edge of the medial meniscus, with an oblique course at the junction of the meniscus body and the posterior horn.

Grade 5; Existence of unidentified complex lesion. It is rare, but occurs in osteoarthritic knees.

Statistical Analysis

Statistical analysis was performed using the SPSS v.22 package. Furthermore, skewness and kurtosis was used to determine whether the data showed normal distribution or not and to decide which test to use (parametric or non-parametric tests). According to the skewness and kurtosis values, the data showed a normal distribution. Independent Samples T Test was chosen from parametric tests (statistically significant as $p < 0.05$).

Results

The ages of sixty patient with patellofemoral rupture (29 females and 31 males) were 18-36 years over a period of eleven years between January 2010 and January 2021. Patellar height, the congruence angle, the lateral

patellofemoral angle, situation of lateral and medial meniscus tears were measured. The distribution of the assessment parameters of the patients with medial patellofemoral ligament rupture according to conventional and surgical treatment is shown in Table 1. There was a significant difference except for age parameter between the conventional and surgical treatment groups. In addition the evaluation of measurement parameters of patients with medial patellofemoral ligament rupture according to gender is shown in Table 2. A significant difference was found between genders in parameters except age and the lateral patellofemoral angle parameters. Moreover, we found that 29 patients of the patients with medial patellofemoral rupture had a lateral meniscus tear, 11 patients had a medial meniscus tear, and 8 patients had both lateral and medial meniscus tears (Table 3). The distribution of parameters in patients with and without lateral meniscal tear is shown in Table 4. Significant differences were found between both groups except age parameter. In addition, Table 5 shows the distribution of parameters according to whether there is a medial meniscus tear or not. Significant differences were found between groups except for age and the congruence angle parameters. The relationship between those with and without both lateral and medial meniscal tears is given in Table 6. Significant differences were obtained between groups except age and the congruence angle parameters.

Table 1. Conventional and surgical treatment evaluations of patients with medial patellofemoral ligament rupture

Parameters	Surgery (n=31) Mean±SD	Conventional (n=29) Mean±SD	p
Age	27.06±6.20	27.47±5.33	0.787
Patellar height	1.21±0.27	0.99±0.16	0.000
The congruence angle	-4.94±4.72	4.93±5.72	0.000
The lateral patellofemoral angle	35.61±16.62	10.93±15.00	0.000

SD: Standard Deviation

Table 2. Evaluations of patients with medial patellofemoral ligament rupture by gender

Parameters	Male (n=31) Mean±SD	Female (n=29) Mean±SD	p
Age	28.32±5.47	26.17±5.90	0.144
Patellar height	1.17±0.27	1.04±0.21	0.046
The congruence angle	2.87±7.19	-3.13±5.88	0.001
The lateral patellofemoral angle	21.58±23.55	25.43±15.80	0.458

SD: Standard Deviation

Table 3. Condition of meniscus tears (lateral/medial) according to gender and treatment method

	Surgery		Conventional		Total
	Male (n)	Female (n)	Male (n)	Female (n)	
Lateral meniscus tears	12	13	0	3	28
Medial meniscus tears	8	0	0	3	11
Total	20	13	0	6	39

Table 4. Distribution of parameters according to whether there is a lateral meniscus tear or not

Parameters	Patients With Lateral meniscus tear (n=29) Mean±SD	Patients Without Lateral meniscus tear (n=31) Mean±SD	p
Age	26.48±5.74	27.97±5.74	0.317
Patellar height	1.20±0.26	1.02±0.20	0.004
The congruence angle	-4.52±4.90	3.94±6.58	0.000
The lateral patellofemoral angle	37.55±14.77	10.72±15.07	0.000

SD: Standard Deviation

Table 5. Distribution of parameters according to whether there is a medial meniscus tear or not

Parameters	Patients With Medial meniscus tear (n=11) Mean±SD	Patients Without Medial meniscus tear (n=49) Mean±SD	p
Age	27.64±5.03	27.18±5.93	0.814
Patellar height	1.30±0.23	1.06±0.23	0.003
The congruence angle	-2.55±2.94	0.46±7.74	0.212
The lateral patellofemoral angle	50.00±11.62	17.64±16.48	0.000

SD: Standard Deviation

Table 6. Distribution of parameters according to whether there is a lateral and medial meniscus tears or not

Parameters	Patients With Lateral and Medial meniscus tears (n=8) Mean±SD	Patients Without Lateral and Medial meniscus tear (n=52) Mean±SD	p
Age	29.75±4.17	26.89±5.88	0.191
Patellar height	1.42±0.12	1.06±0.22	0.000
The lateral patellofemoral angle	53.75±11.57	18.91±16.82	0.626
The congruence angle	-1.25±2.31	0.09±7.66	0.000

SD: Standard Deviation

Discussion

The young active population is the most affected by patellar instability and is an important source of morbidity.⁷ It is necessary to have precise and accurate information about the anatomy and morphometry of the patellofemoral joint for the understanding, correct diagnosis and treatment of anomalies in the joint. There are many studies in the literature describing the relationship of patellofemoral instability with anterior knee pain, patellar dislocation, patellofemoral osteoarthritis and patellar chondromalacia. However, studies evaluating the relationship between morpho-radiological measurements of the joint between gender and meniscus tears are limited.

In knee mechanics, the source of stabilizing power of the knee is 50-60% MPFL. In rare cases of MPFL rupture, anatomical MPFL reconstruction is commonly used.^{8,9} It is also applied in conservative treatment for MPFL rupture. However, it has been reported in the literature that patellar dislocation recurs at a rate of 15 to 44% as a result of conservative treatment.¹⁰⁻¹² In general, there is no study in the literature comparing the surgical and conservative treatment procedures of medial patellofemoral ligament reconstruction.¹³ The principles of surgical methods for patellofemoral instability are

based on releasing tense contracted tissues, transferring or strengthening medial stabilizing structures, and changing the attachment site of the patellar tendon. The meniscus is vital for the continuation of knee functions. Meniscus has a supportive effect on joint stability, shock absorption effect, effect on balanced load transmission by increasing femur and tibia joint surface compatibility, effects on deep sense and positive effects on cartilage nutrition. Meniscus tears can be classified according to different features such as the localization of the tear, the shape of the tear, and the duration of the injury. The right approach to the treatment of meniscal tears is possible by understanding the types of meniscus tear. For example, longitudinal tears are usually accompanied by anterior cruciate ligament damage. Oblique, longitudinal and degenerative tears are more common; radial, horizontal tears are less common.^{14,15}

In our study, 31 patients with medial patellofemoral rupture received surgical treatment, while 29 patients received conventional treatment. When the anatomical factors affecting the treatment method were examined, we concluded that the congruence angle and the lateral patellofemoral angle factors affected the treatment method. When the patients in our study were evaluated in terms of meniscal tears, it was found that 29 patients (12 male and 16 female) had lateral meniscus tears and 11 patients (8 male and 3 female) had medial meniscus

tears. While 13 of the female patients who underwent surgery had a lateral meniscus tear, 3 female patients received conventional treatment. While 12 male patients who underwent surgery had a lateral meniscus tear, 8 male patients had a medial meniscus tear. In addition, 26 of the patients with medial patellofemoral rupture who underwent surgery had a lateral meniscus tear, while 3 of the patients with patellofemoral rupture who received conventional treatment had a lateral meniscus tear. It was determined that 8 patients with medial patellofemoral tears had both lateral and medial meniscus tears. In female patients with lateral meniscus tear, 7 patients had a grade 4 tear, while 6 patients had a grade 3 tear and 6 patients had a grade 5 tear. It was found that 2 of the patients with medial meniscus tears were grade 4 and 6 of them were grade 3. While 6 of the patients had grade 3 lateral meniscus tear, 6 of the patients had grade 5 lateral meniscus tear and 14 of the patients had grade 4 lateral meniscus tear treated in underwent surgery, 3 of the patients treated with conventional treatment had grade 4 lateral meniscus tears. In addition, 2 of the patients who underwent surgery had a grade 4 and 6 of the patients who underwent surgery had a grade 3 medial meniscus tear, while 3 of the patients receiving conventional treatment had a grade 4 medial meniscus tear. These results reveal that lateral meniscal tears are more common in patients with medial patellofemoral rupture. Thus, we can say that the situations in which the lateral meniscus is overloaded and the gender factor produce a risk for the predisposition to rupture of the medial patellofemoral ligament. Another important factor is patellofemoral alignment. The patella slides outward as it moves in the femoral groove. With this shift, one side of the cartilage under the patella is exposed to more pressure. Over time, this abnormal pressure can damage the articular cartilage. Thus, patellofemoral alignment is damaged. There were also measures describing the relationship between the lateral patellofemoral angle, congruence angle. These measures have all been used in previous studies to assess patellar alignment. We evaluated the congruence angle (patellofemoral compliance) and lateral patellofemoral angle (patellar inclination) parameters in our study as an indicator of patellofemoral alignment. In our study, when we made a comparison according to the treatment method, it was found that patellofemoral compliance was significantly lower in those who underwent surgery, while patellar inclination was found to be significantly higher (Table 1). Moreover, when we compared the genders, patellofemoral compliance fit was found to be significantly higher in men, while patellar inclination was found to be significantly lower in our study (Table 2). In addition, patellofemoral compliance was found to be significantly lower in patients with lateral and medial meniscal tears, while patellar inclination was found to be significantly higher (Table 6). At the same time, we evaluated patellar inclination with the lateral patellofemoral angle parameter. The lateral patellofemoral angle is also important in determining the treatment method. If the

angle is greater than 16 degrees, surgical treatment may be preferred since the probability of recurrence will be very high.¹⁶ This study reported the average lateral patellofemoral angle to be 35.61 ± 16.62 in patients with surgical treatment and 10.93 ± 15.00 in patients with conventional treatment (Table 1). Moreover, while there is a significant difference ($p=0.000$) in the lateral meniscus tear, there is no significant difference ($p=0.212$) was found in the medial meniscus tear for the congruence angle parameter (Table 4-5). However, a significant difference ($p=0.000$) was obtained in the congruence angle parameter compared to groups with/without both medial and lateral meniscus rupture (Table 6). We think that this is due to the fact that the number of patients with only medial meniscus rupture is 11 people. When the literature is examined, Indelli et al., in their study found that patellar congruence angle was -3° (range, -11° to $+9^\circ$) with respect to an average pre-operative value of 10.3° (range, $+1.5^\circ$ to $+25.5^\circ$) ($p<0.05$).¹⁷ In another study, Kan et al., found that subjects with patellar dislocation had laterally deviated congruence angles (20° (SD 28°)), while control subjects had slightly medially deviated congruence angles (-9° (SD 12°)) ($p=0.04$).¹⁸ Aksu et al., found the congruence angle parameter to be 10.94 ± 10.15 with patellar tendinopathy and 14.99 ± 6.72 with patellar tendinopathy in their study on professional dancers. They also found the congruence angle as 13.78 ± 5.44 with quadriceps tendinopathy and 10.80 ± 11.12 with quadriceps tendinopathy.¹⁹ Yang et al., in their study, they found that the mean congruence angle was 43.30 ± 11.04 before the operation and 16.64 ± 9.98 after the operation.²⁰ In another study, Grimm et al., found a significant difference between the ages, but they didn't find a significant difference between the genders ($p=0.81$ for sex, $p=0.06$ for age).²¹ In one study, Lullini et al. demonstrated that all measures of patellofemoral stability and alignment were more consistent in weight-bearing cone-beam computed tomography than in conventional computed tomography in MPFL rupture reconstruction.²²

We used to measure patellar height is Insall-Salvati index. Ergun's study showed that there was a strong correlation between female gender and advanced age. The results of the study revealed that female gender and advanced age were high patellar height, which predisposes to patellofemoral malalignment.²³ In the study by Arun and Ganesan in 200 people (100 male and 100 female), they found the patellar height to be 1.41 on average in men and 1.28 in women. They stated the general mean as 1.34.²⁴ Leung et al., found that in the Southern Chinese population, the position of the patella is 15% to 20% higher than in western populations. They stated that a patella alta index of >3.4 is considered abnormal in this population.²⁵ In our study, patellar height was found to be higher in male and patients with lateral and medial meniscus tears. In addition, our study was revealed that patellar height was higher in patients with surgical treated. This result supported the literature that high patellar height factor is a risk factor for patellar instability.

Conclusion

Clinical studies have shown that non-anatomical MPFL reconstruction is closely related to postoperative complications.²⁶ Different patello-femoral designs in total knee arthroplasty is important for orthopedists and prosthetic manufacturers. We think that this study will contribute to implant design and modern femoral implants. Also, this study will contribute to evaluate the radiological and clinical correlations, patello-femoral positioning in patients who medial patellofemoral rupture.

There were several limitations in the present study. Since our study includes a wide time period, surgeons who perform surgical operations and surgical methods are different. Therefore, an evaluation could not be made according to surgical methods. For this reason, we recommend performing studies that evaluate parameters according to surgical methods.

Compliance with Ethical Standards

Ethical approval was obtained from Cukurova University, Non-invasive clinical research Ethic Board with conclusion number 105/30.

Conflict of Interest

There are no conflicts of interest.

Author Contribution

AGK: Study idea, hypothesis, study design; AGK, MGB and VTT: Material preparation, data collection and analysis; AGK and MGB: Writing the first draft of the article; AGK, MGB and VTT: Critical review of the article finalization and publication process.

Financial Disclosure

None.

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