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INVESTIGATION OF MODIFIABLE RISK FACTORS IN PATIENTS WITH PATELLOFEMORAL PAIN SYNDROME

PATELLOFEMORAL AĞRI SENDROMLU HASTALARDA MODİFİYE EDİLEBİLİR RİSK FAKTÖRLERİNİN ARAŞTIRILMASI

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ABSTRACT

AIM: Patellofemoral pain syndrome is a knee problem, especially frequent in physically active young individuals. Patellofemoral pain syndrome is a set of symptoms rather than a specific diagnosis. It adversely affects both the quality of life and the functional activities of the patients. The aim of this study was to provide researchers and clinicians with an information concerning modifiable predictive variables for patellofemoral pain syndrome, to aid the development of preventative interventions.

MATERIAL AND METHOD: A total of 130 patients with complaints of anterior knee pain and subsequently diagnosed as having patellofemoral pain syndrome and 100 healthy individuals without anterior knee pain were included in the study. All individuals were assessed in terms of shortness in soft tissues, muscle weakness, lower extremity alignment disorders, pain levels and functional levels.

RESULTS: The patients with patellofemoral pain syndrome and asymptomatic subjects included in the study were similar in terms of age, gender and body mass index. In the comparison between patients with patellofemoral pain syndrome and asymptomatic subjects, J finding, one-legged hop test positivity, quadriceps atrophy, trendelenburg test positivity, iliotibial band tightness, patellar tilt, patellar hypermobility, patellar edge sensitivity, genu recurvatum, differences in leg length and external tibial torsion findings were significantly higher in patients with PFPS ($p<0.05$).

CONCLUSION: Due to the multifactorial nature of patellofemoral pain syndrome, numerous risk factors may play a role in the development of patellofemoral pain syndrome. While many risk factors have been reported, only some of them may be modifiable. Therefore, we think it makes sense to investigate these modifiable risk factors in patients with patellofemoral pain syndrome and to correct or replace them, if any.

Keywords: patellofemoral pain syndrome, risk factors, kujala score, anterior knee pain

ÖZET

AMAÇ: Patellofemoral ağrı sendromu (PFAS), özellikle fiziksel olarak aktif genç bireylerde sık görülen bir diz problemidir. Hastaların hem yaşam kalitesini hem de fonksiyonel aktivitelerini olumsuz etkiler. Bu çalışmanın amacı, önleyici müdahalelerin geliştirilmesine yardımcı olmak için araştırmacılara ve klinisyenlere PFAS için değiştirilebilir risk faktörleri hakkında bilgi sağlamaktır.

GEREÇ VE YÖNTEM: Çalışmaya ön diz ağrısı şikayeti olan ve ardından PFAS tanısı alan 130 hasta ve ön diz ağrısı olmayan 100 sağlıklı birey dahil edildi. Tüm bireyler yumuşak dokularda kısalık, kas güçsüzlüğü, alt ekstremite dizilim bozuklukları, ağrı düzeyleri ve fonksiyonel düzeyler açısından değerlendirildi.

BULGULAR: PFAS'lı hastalar ve asemptomatik bireyler yaş, cinsiyet ve vücut kitle indeksi açısından benzerdi. PFAS'lı hastalar ile asemptomatik bireyler karşılaştırıldığında, J bulgusu, tek bacaklı atlama testi pozitifliği, kuadriseps atrofisi, trendelenburg testi pozitifliği, iliotibial bant gerginliği, patellar tilt, patellar hipermobilite, patellar kenar duyarlılığı, genu rekurvatum, bacak uzunluk farkı ve eksternal tibial torsiyon PFAS'lı hastalarda anlamlı olarak yüksekti ($p<0.05$).

SONUÇ: PFAS'ın çok faktörlü doğası düşünüldüğünde, hastalığın gelişiminde çok sayıda risk faktörü rol oynayabilir. Birçok risk faktörü rapor edilmiş olsa da bunlardan sadece bazıları değiştirilebilir. Bu nedenle, PFAS'lı hastalarda bu değiştirilebilir risk faktörlerini araştırmanın, eğer varsa bunları düzeltmenin veya değiştirmenin mantıklı olduğunu düşünüyoruz.

Anahtar Kelimeler: patellofemoral ağrı sendromu, risk faktörleri, kujala skoru, ön diz ağrısı

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INTRODUCTION

Patellofemoral pain syndrome (PFPS) is a disorder that commonly affects physically active younger individuals.[1] The prevalence of PFPS was stated as 12.3% in males and 15.3% in females.[2-3] Many terms such as patellofemoral syndrome, patellofemoral arthralgia, extensor mechanism dysplasia, retropatellar pain syndrome, lateral patellar compression syndrome, patellofemoral dysfunction, anterior knee pain and patellofemoral joint syndrome have been used to describe patellofemoral pain; however, these names are not commonly accepted. The pain generally occurs due to flexion or long-term squatting and going up and downstairs, and it affects the around or under the patellar area. Though the basic etiopathogenesis of PFPS has not been fully explained, there are some predisposing factors such as increased femoral anteversion, external tibial torsion, genu valgum, genu recurvatum, soft tissue tightness, muscle strength imbalances.[3] The consensus for the treatment of PFPS that occurs due to a wide etiology is that the treatment is conservative.[4-6] As there are not enough studies researching the etiological causes of PFPS, we planned to investigate the intrinsic factors that can cause PFPS.

MATERIAL AND METHOD

The study included 130 patients who have applied to physical therapy and rehabilitation clinic with anterior knee pain and have been diagnosed with PFPS in clinical examination and 100 healthy individuals without any anterior knee pain. The following are determined as the inclusion criteria: age between 18-65 years, minimum symptom duration of 3 months, absence of knee range of motion, presence of anterior or retropatellar pain in at least three of the six predefined activities (climbing down or up the steps, squatting, running, jumping, prolonged sitting with knees flexed 90°), gradual onset of symptoms with no associated trauma, a minimum pain score of 3 on visual analog scale (VAS) score, and pain in the patellar facet when stepping down a 25-cm step or double leg squatting. Patients with a previous history of knee surgery, meniscal or ligamentous pathology, effusion, Osgood Schlatter syndrome or Sinding Larsen Johansson syndrome, projecting pain in the knee, history of trauma or fracture, and patellofemoral osteoarthritis were excluded from the study.

All the patients included in the study are informed about the objective of the study and signed an informed consent form after obtaining the necessary permissions. The study protocol was approved by the Ankara Training and Research Hospital Ethics Committee (approval date and no: 04 Nov 2015, 2015-5161). The study was conducted in accordance with the principles of the Declaration of Helsinki.
Age, height, weight, body mass index (kg/m2), duration of pain, and dominant and involved extremity were recorded in all patients.

Pain Assessment:

Patients were asked to score the severity of pain on a 0 to 10 cm VAS (0: no pain, 10: intractable pain).

Physical Assessment:

For the leg length measurements, the distance between spina iliaca anterior superior-medial malleolus distance was measured while both legs were parallelly located with a 15-20 cm gap, and the difference between leg lengths was noted as present/absent. For thigh muscle atrophy, circumfemoral measurements were carried out 15 cm above the patella. 0.5 cm and more difference between the two extremities was accepted as atrophy. Gluteus medius muscle weakness was assessed with Trendelenburg test, hamstring tightness with popliteal angle measure, hip flexor tightness with Thomas test, iliotibial band (ITB) tightness with Ober's test, quadriceps tightness with Ely test. For the assessment of gastrosoleus flexibility, the ankle was passively brought to dorsiflexion while the knee was in extension; the test was accepted positive for the cases that are unable to reach a neutral position (90°). Patellar edge sensitivity was considered to be tenderness on palpation at the edges of the patella. Genu valgum was determined as more than 1 cm gap between medial malleolus while the patient was standing with his/her bare knees and feet touching each other gently. Genu varum was determined as more than 1 cm gap between medial condyles while the patient was standing with his/her bare knees and feet touching each other gently. Genu rekurvatum was considered as hyperextension in the evaluation made by looking at the knees from the side while the patient was standing. External tibial torsion (ETT) was assessed by measuring transmalleolar axis angle by a goniometry. While the patient was lying in a prone position with the knees at 90º flexion, the most protruding points of the medial and lateral malleolus were marked with a pencil. ETT was determined as more than a 20° angle between the imaginary line passing through the medial and lateral femoral condyles and the imaginary line passing through the medial and lateral malleolus. J finding was regarded positive that the patella gets out of the trochlear fossa and made a J-shaped movement while moving towards patella proximal. Patellar tilt was assessed while the patient was lying down in a supine position without contracting quadriceps muscle (QM) while the knee was at 20º flexion. While pressing the posterior direction with the first finger from the medial edge of the patient's patella, the lateral edge of the patella was lifted from the femoral condyle with the help of the 2nd finger. Normally, there should be a 0-20º elevation from the horizontal plan, if the lateral edge of the patella cannot be lifted higher than the neutral position, the tension was considered in the lateral structures and the test was considered positive. Patellar mobility was assessed while the patient was lying down in a supine position without contracting QM while the knee was at 20-30º flexion. The patella was divided into 4 equal quarters longitudinally and the patella was moved to the medial and lateral using thumb and forefinger. Patellar hypermobility was defined as the case in which this translocation was more than 2/4. Functional levels of patients were evaluated with the one-legged hop test. The patients were asked to hop onwards as much as possible while their arms were at the back. The test was repeated 3 times per leg. The hopping distance was measured in centimeters (cm). The test was considered positive if there was more than a 15% difference between the two-leg hopping distances. Hallux valgus angle was evaluated by measuring the angle between the long axis of the first metatarsal bone and the long axis of the toe proximal phalanx. More than 15º angle was assessed as an increased hallux valgus angle. Generalized joint laxity was assessed with Beighton and Horan Joint Mobility Index (BHJMI). The patients who scored 5 to 9 were accepted positively in terms of joint laxity.

Subjective Functional Assessment

Subjective functional levels of the patients are assessed with Kujala patellofemoral scoring system. It consists of a total of 13 items including limping, loading, walking, climbing up and down the stairs, squatting, running, prolonged sitting with knees flexed, pain, swelling, abnormal and painful patellar movements, groin atrophy, and flexion restriction. Kujala scoring system is scored from 0 to 100 points, 100 points being the best value.[7]

Statistical methodology

Study data were entered into SPSS (Statistical Package for Social Sciences) for Windows 22.0 (SPSS Inc, Chicago, IL) for data analysis. The descriptive statistics were presented with median (minimum-maximum), frequency, and percentage. Categorical variables were analyzed using Pearson's Chi-Square Test and Fisher's Exact Test. The normal distribution of the variables was tested using visual (histograms and probability graphs) and analytic (Kolmogorov Smirnov/Shapiro-Wilk Tests) methods, and not all continuous variables were found to conform to normal distribution. The statistical significance of the difference between the two independent groups was analyzed with Mann Whitney U Test. The association between variables was evaluated using Spearman's Test. The level of statistical significance was set as $p<0.05$.

RESULTS

Of the 230 participants, 130 (56.5%) had PFPS, while the remaining 100 subjects (43.5%) were otherwise healthy. These two groups were referred to as "patients" and "controls", respectively. Except for the dominant extremity, two groups were comparable concerning descriptive statistics (Table 1).

Table 1. Distribution of the Descriptive Characteristics Between Study Groups

	Patient Group (n=130)	Control Group (n=100)	p
Age	33 (18-45)	30.5 (18-44)	0.744*
Gender			
Male	41 (31.5)	26 (26.0)	0.359**
Female	89 (68.5)	74 (74.0)	
Height (cm)	165 (150-181)	165 (155-182)	0.989*
Body weight (kg)	70 (48-110)	70 (48-95)	0.862*
Body mass index (kg/m²)	25.71 (19.03-35.92)	25.74 (18.29-39.54)	0.424*
Dominant Side			
Right	118 (90.8)	72 (72.0)	**<0.001****
Left	12 (9.2)	28 (28.0)	

Constant variates are presented as "median (min -max)", and categorical variates as "number (column percentage).

*Mann-Whitney U Test; **Chi -Square Test

The median duration of pain among patients was 6 months (min 3, max 40 months), with the median VAS score was 70 (min 40, max 90), and the median Kujala score was 56 (min 30, max 80).

The distribution of physical examination findings in the patient and control groups is presented in Table 2.

Table 2. Distribution of the Physical Examination Findings of Patient and

	Patient (n=130) Number (% #)	Control (n=100) Number (% #)	p*
J Finding	11 (8.5)	0	-------
One-legged Hop Test	88 (67.7)	10 (10.0)	**<0.001**
Quadriceps Muscle Atrophy	24 (18.5)	0	-------
Quadriceps Tightness	15 (11.5)	5 (5.0)	0.081
Hip Flexor Tightness	16 (12.3)	6 (6.0)	0.107
Hamstring Tightness	48 (36.9)	25 (25.0)	0.054
Iliotibial Band Tightness	23 (17.7)	6 (6.0)	**0.008**
Gastrosoleus Tightness	13 (10.0)	6 (6.0)	0.275
Trelendelenburg Test	16 (12.3)	0	-------
Leg-Length Difference	6 (4.6)	0	-------
Patellar Tilt	49 (37.7)	5 (5.0)	**<0.001**
Patellar Hypermobility	42 (32.3)	8 (8.0)	**<0.001**
Patellar Hypermobility Direction (n=50)			
Lateral	37 (88.1)	8 (100)	-------
Medial	5 (11.9)	0	
Patellar Edge Sensitivity	130 (100)	0	-------
Genu Varum	13 (10.0)	6 (6.0)	0.275
Genu Valgum	20 (15.4)	7 (7.0)	0.063**
Genu Recurvatum	7 (5.4)	0	-------
External Tibial Torsion	97 (74.6)	11 (11.0)	**<0.001**
Hallux Valgus	25 (19.2)	15 (15.0)	0.401
Generalized Joint Laxity	10 (7.7)	4 (4.0)	0.246

#Column percentage; *Chi -Square Test; **Fisher's exact test

Control Groups

In the patient group, J finding, one-legged hop test, QM atrophy, ITB tightness, Trendelenburg test, leg length difference, patellar tilt, patellar hypermobility, external tibial torsion, genu recurvatum and patellar edge sensitivity were significantly higher than the control group and there was a statistically significant difference between the two groups ($p < 0.05$).

The female individuals with PFPS and female individuals in the control group were similar in terms of descriptive characteristics except for the dominant extremity. There was no statistically significant difference between the men in the patient and control groups in terms of age, BMI and dominant side (Table 3).

Table 3. Distribution of the Descriptive Characteristics in Patient and Control Groups Concerning Gender

		n	Patient	n	Control	p
MALE	**Age**	41	31 (18-45)	26	26 (18-44)	0.116*
	Body mass index (kg/m²)	41	27.68 (19.59-34.60)	26	25.77 (20.96-29.75)	0.562*
	Dominant Side					
	Right		35 (85.4)	20 (76.9)		0.515**
	Left		6 (14.6)	6 (23.1)		
FEMALE	**Age**	89	34 (18-45)	74	32 (18-44)	0.524*
	Body mass index (kg/m²)	89	25.59 (19.03-35.92)	74	25.71 (18.29-39.54)	0.455*
	Dominant Side					
	Right		83 (93.3)	52 (70.3)		**<0.001*****
	Left		6 (6.7)	22 (29.7)		

Constant variates are presented as "median (min -max)", and categorical variates as "number (column percentage).

*Mann-Whitney U Test; **Chi -Square Test

The distribution of the physical examination findings of patient and control groups concerning gender is presented in Table 4.

Table 4. Distribution of the Physical Examination Findings of Patient and Control Groups Concerning Gender

DISCUSSION

	MALE			FEMALE		
	Patient (n=41) Number (%#)	Control (n=26) Number (%#)	p*	Patient (n=89) Number (%#)	Control (n=74) Number (%#)	p*
J Finding	3 (7.3)	0	-------	8 (9.0)	0	-------
One-legged Hop Test	34 (829)	2 (7.7)	**<0.001**	54 (607)	8 (108)	**<0.001**
Quadriceps Atrophy	11 (268)	0	-------	13 (146)	0	-------
Quadriceps Tightness	9 (220)	1 (3.8)	0.075**	6 (6.7)	4 (5.4)	0.998**
Hip Flexor Tightness	5 (122)	0	-------	11 (124)	6 (8.1)	0.377
Hamstring Tightness	17 (415)	7 (269)	0.226	31 (348)	18 (243)	0.145
Iliotibial Band Tightness	9 (220)	3 (11.5)	0.343**	14 (157)	3 (4.1)	**0.015**
Gastrosoleus Tightness	6 (146)	1 (3.8)	0.234**	7 (7.9)	5 (6.8)	0.787
Trelendelenburg Test	5 (122)	0	-------	11 (124)	0	-------
Leg-Height Difference	0	0	-------	6 (6.7)	0	-------
Patellar Tilt	19 (463)	0	-------	30 (33.7)	5 (6.8)	**<0.001**
Patellar Hypermobility	12 (293)	0	-------	30 (337)	8 (108)	**0.001**
Patellar Hypermobility Direction						
Lateral	10 (833)	0	-------	27 (900)	8 (100)	-------
Medial	2 (167)	0		3 (100)	0	
Genu Varum	5 (122)	0	-------	8 (9.0)	6 (8.1)	0.842
Genu Valgum	5 (122)	3 (11.5)	0.998**	15 (169)	4 (5.4)	**0.023**
Genu Recurvatum	3 (7.3)	0	-------	4 (4.5)	0	-------
External Tibial Torsion	29 (707)	2 (7.7)	**<0.001**	68 (764)	9 (122)	**<0.001**
Hallux Valgus	11 (268)	4 (15.4)	0.273	14 (157)	11 (149)	0.879
Generalized Joint Laxity	3 (7.3)	0	-------	7 (7.9)	4 (5.4)	0.756**

#Column percentage; *Chi-Square Test; **Fisher's exact test

Witvrouw et al8 followed 282 students for 2 years and during this period, PFPS developed in 24 students. They reported that quadriceps tightness, vastus medialis dysfunction and the hypermobile patella may lead to PFPS. Piva et al1 compared 30 patients with PFPS and 30 healthy individuals and they reported that patients with PFPS had more tightness in the gastrocnemius, soleus, quadriceps and hamstring muscles than in healthy individuals. Furthermore, there observed no difference between the two groups in terms of iliotibial band tightness and hip abductor strength. Haim et al9 compared 61 soldiers with PFPS and 25 healthy individuals. Patellar tilt was significantly higher in patients with PFPS. They reported that the physical examination findings are more valuable than radiography in the diagnosis of PFPS. Liporaci et al10 examined 19 Patients with PFPS and 20 healthy individuals and found the Thomas test positive in 15.75% of patients with PFPS. None of the patients with PFPS had ITB tightness, whereas it has been detected in 10% of the healthy individuals. Moreover, they reported the ETT rate as 84% in patients with PFPS and 45% in asymptomatic individuals. Kwon et al11 examined 14 patients with PFPS and 42 healthy individuals and reported a relationship between hamstring tightness and PFPS.

J finding indicates a pathological sliding on early patellar flexion, thus patellar instability. The imbalance between the forces that pull the patella to the medial and lateral, tightness in lateral retinaculum, and bone-related defects lead to the J finding in terminal knee extension.12,13 In our study, we observed J finding in patients with PFPS by 11.5%, while we did not observe in healthy individuals. This may be related to the increased patellar tilt, increased ITB tightness and decreased QM strength in the patient group.

One of the most important structures in patellar stabilization is the QM. Especially vastus medialis obliquus (VMO) is the most important dynamic medial stabilizer of the patella. While VMO pulls the patella in the medial direction, vastus lateralis pulls the patella towards the lateral direction. Weakness of VMO muscle may cause PFPS due to lateral patellar shift and pressure increase in the lateral patellar facet. Pattyn et al14 have demonstrated that patients with PFPS have VMO atrophy. Collado et al15 have reported that the QM strength is significantly lower in PFPS diagnosed knees compared to healthy knees, according to isometric dynamometer measurements. In two studies, it has been reported that QM weakness is not associated with PFPS.16,17 One-legged hop test, which is a functional test commonly used to measure the QM strength is demonstrated as a reliable method to show the isokinetic patellar extensor peak torque.18 In our study, a decrease in QM strength and atrophy in the QM were found in patients with PFPS. However, it is not clear whether the decrease in QM strength causes PFPS or whether it develops secondary to PFPS. Further prospective research using validated measurement methods is required to determine whether quadriceps weakness and atrophy is a predisposing factor for PFPS.

Hip muscles play a key role in lower extremity kinetics. Previous studies have shown that the weakness in hip abductors may cause PFPS.19,20 Insufficiency in hip abduction creates hip adduction, causing an increase in Q angle, enhancing the burden on the lateral patellar facet and thus forms a basis for PFPS.21 Though the studies have mostly utilized an isometric dynamometer to measure the muscle strength, we have utilized the Trendelenburg test, which is an easy and practical method to assess the hip abduction in patients with PFPS because isometric dynamometer is not very common and not much practical to use. Our study has demonstrated in harmony with the literature that the decrease of hip abduction strength was frequently seen in PFPS. Many studies have suggested that a decrease in hip abduction strength can cause PFPS. This argument is also supported by randomized controlled trials that show that strengthening of the hip abduction muscle in PFPS improves both symptoms and function. However, such studies are not sufficient to demonstrate hip weakness as the cause of PFPS. Rather than statically detected muscle weakness; hip abductor muscle performance during dynamic tasks and hip abductor muscle endurance may be a separate risk factor for PFPS.

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Tightness of muscles around the knee is generally associated with PFPS. It is stated that muscle tightness is not an etiological factor but observed along with PFPS.22,23 In our study, we have detected that the tightness of quadriceps, hip flexor, hamstring and gastroselous muscles were higher in patients with PFPS than those of healthy individuals; however, this difference was not significant except for ITB tightness. While some studies associate muscle tightness with PFPS, others state no association. These contradicting results may have caused by the limited number of patients included in the studies.

The role of patellar hypermobility in PFPS etiology is disputable. Some authors claim that the increase of the patellar mobility causes increased pressure in the patellofemoral joint by changing the position of the patella in the trochlear fossa. Conflicting studies have been published on this subject.8,9,24,25 We correlated the high rate of lateral patellar hypermobility in our study with the fact that we found less ITB tightness in our patient group compared to other studies.

The latest researches have shown that patellar mobility disorder may cause PFPS development.26,27 Many factors causing PFPS indirectly trigger patellar mobility disorders. Patellar tilt limits the medial mobility of the patella; decreases the patellofemoral contact surface; and may cause PFPS by causing increased pressure on the lateral facet of the patella.28 Haim et al9 stated that the patellar tilt test is 92% specific and 43% sensitive for PFPS. It is indicated that there is a significant increase in a patellar tilt with knee flexion in patients with PFPS.29,30 In our study, there observed 37.7% patellar tilt in the patient group and 5% in the control group. We believe that the patellar tilt test is useful and practical to determine PFPS in patients with knee pain.

Genu valgus increases Q angle, while genu varus increases the pressure in the medial region of the patellofemoral joint. Witrouw et al8 and Haim et al9 argued that varus or valgus deformities in the knee would not lead to PFPS. In our study, we could not find a significant difference between patients with PFPS and asymptomatic individuals in terms of both genu valgus and genu varus. Though we have demonstrated that genu valgus detected in a static position is not associated with PFPS, further research is required regarding the role of genu valgus that occurs during dynamic mobility in PFPS etiology.

It is asserted that external tibial torsion is associated with PFPS.31 Increased tibial rotation may cause increased pressure in the patellofemoral joint. In a study carried out by Liporaci et al10, it is found that ETT was 84% in patients with PFPS and 45% in asymptomatic individuals. In our study, the ETT was found 74.6% in patients with PFPS and 11% in healthy individuals. The main reason for reporting different results in studies is the difference in the measurement methods of tibial torsion angles. There is no consensus on how tibial torsion should be measured. Moreover, it is also stated that the measurements carried out by different researchers on the same knee are not reliable.32 Due to these reasons, we have concluded that ETT assessment for patients with PFPS is not useful and practical.

Genu recurvatum may be one of the reasons creating a basis for PFPS. Gastrocnemius tightness, quadriceps tightness or hamstring weakness can cause genu recurvatum, increases the load on the patellofemoral joint and may eventually lead to PFPS development. In a case series, genu recurvatum was detected in 20% of patients with PFPS.33 In our study, the prevalence of genu recurvatum was 5.4% in patients with PFPS, but we could not detect genu recurvatum in asymptomatic individuals.

In the limited number of studies in literature, it is asserted that the leg length discrepancy (LLD) may be a potential factor to cause PFPS development. In two studies, the authors argued that LLD may lead to PFPS.34,35 As support to these limited studies, we determined the LLD in patients with PFPS at a rate of 4.6%.

Nonetheless, there are limitations to our study. Our study has failed to demonstrate any causality due to its cross-sectional design. Another limitation of this study is that the reliability results found may be an overestimate compared to real clinical practice. Many factors may have influenced the measurements collected during this research. The fact that the tests performed are based on a physical examination may lead to different results in the clinic.

CONCLUSION

Though many factors are accused in PFPS etiology, the etiopathogenesis of the syndrome has not been fully explained. Considering the multifactorial nature of the problem, the entire lower extremity should be examined independently.

In this study, we investigated the common findings in PFPS. We think that these findings have an important place in the diagnosis and treatment of patients with

PFPS. We believe that it is more correct and economical to detect these findings independently and the treatments to correct these findings in the treatment of PFPS.

This study is one of the rare studies in the literature that many factors are evaluated together regarding PFPS. Further comprehensive and prospective studies with a greater number of patients are needed to clarify the etiology of PFPS.

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