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Knee Proprioception and Balance in Turkish Women With and Without Fibromyalgia Syndrome

Fibromyalji Sendromu Tanısı Alan ve Almayan Türk Kadınlarda Propriyosepsiyon ve Denge

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Summary

Objective: The aim of this study was to compare proprioceptive acuity and balance parameters in women with and without fibromyalgia syndrome (FMS).

Materials and Methods: Thirty women with FMS and 30 healthy controls were enrolled in the study. Functional performance by 6-minute walking test (6MWD), proprioceptive acuity by knee joint position sense using an isokinetic dynamometer, balance by the one-legged balance test and the Berg Balance Scale (BBS) were assessed; and number of falls was recorded in all participants. Pain by the visual analogue scale (VAS pain) and disease activity by the Fibromyalgia Impact Questionnaire (FIQ) were evaluated in all patients.

Results: The mean age of the patients and controls were 41±9.20 years and 40.67±9.03 years, respectively. There were significant differences between the patients and controls in 6MWD ($p<0.05$), one-legged balance testing time ($p<0.001$), and BBS scores ($p<0.001$). There was no difference in the number of falls and proprioceptive acuity between the patients and controls ($p>0.05$). VAS pain and FIQ were not correlated with balance tests and proprioceptive acuity; and proprioceptive acuity was not correlated with 6MWD and balance tests in patients ($p>0.05$).

Conclusion: It can be concluded that women with FMS may have poor balance, which is not related to proprioceptive acuity, compared to women without FMS. *Turk J Phys Med Rehab 2013;59:128-32.*

Key Words: Fibromyalgia syndrome, balance, proprioception

Özet

Amaç: Bu çalışmanın amacı, fibromyalji sendromu (FMS) tanısı alan ve almayan kadınlarda propriyosepsiyon ve denge parametrelerini karşılaştırmaktı.

Gereç ve Yöntem: Fibromyalji tanısı olan 30 kadın hasta ve 30 sağlıklı kontrol çalışmaya alındı. Bütün katılımcılarda 6 dakika yürüme testi (6DYT) ile fonksiyonel performans, izokinetik dinamometre ile propriyosepsiyon keskinliği, tek-bacak denge testi ve Berg Denge Skalası (BDS) ile denge değerlendirildi ve düşme sayıları kaydedildi. Hastalarda ağrı vizüel analog skala (VAS ağrı) ile ve hastalık aktivitesi Fibromyalji Etki Anketi (FEA) ile değerlendirildi.

Bulgular: Hastaların ve kontrollerin yaş ortalamaları sırası ile 41±9,20 yıl ve 40,67±9,03 yıldı. Hasta ve kontroller arasında 6DYT ($p<0,05$), tek-bacak denge testi ($p<0,001$) ve BDS ($p<0,001$) için anlamlı fark saptandı. Düşme sayısı ve propriyosepsiyon keskinliği hasta ve kontroller arasında anlamlı olarak farklı değildi ($p>0,05$). Hastalarda; VAS ağrı ve FEA, denge testleri ve propriyosepsiyon keskinliği ile korele değildi ve propriyosepsiyon keskinliği 6DYT ve denge testleri ile korele değildi ($p>0,05$).

Sonuç: Sonuç olarak, FMS'li kadınlar, FMS'li olmayan kadınlarla karşılaştırıldığında, propriyosepsiyon keskinliği ile ilişkili olmayan denge bozukluğuna sahip olabilir. *Türk Fiz Tıp Rehab Derg 2013;59:128-32.*

Anahtar Kelimeler: Fibromyalji sendromu, denge, propriyosepsiyon

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Introduction

Fibromyalgia syndrome (FMS) is a chronic disorder characterized by diffuse musculoskeletal pain, sleep disturbance, fatigue, stiffness, and presence of multiple tender points (1,2). Fibromyalgia affects several subsystems responsible for postural control and is also believed to involve abnormal function of the central nervous system (3,4).

Balance is the equilibrium established by the body in response to proprioceptive information gathered in the brain. The primary sensory inputs which is used for postural orientation in space and for automatic postural response, are somatosensory input from muscle spindles, Golgi tendon organs and superficial and deep cutaneous afferents (5).Balance control is essential in all postures and situations, both static (maintaining an upright posture) and dynamic (in locomotion) (6).

Proprioception is the joint and limb position sense partially derived from neural inputs arising from mechanoreceptors in joints, muscles, tendons, and associated tissue (7). The decreased proprioception is accompanied by the decreased ability to coordinate basic protective reflexes and joint movement, complex balance and postural control (8).

Previously it was shown that FMS is associated with balance problems and increased fall frequency (3,9-11). In a study by Jones et al., the relationships of balance deficits with poor strength, proprioception and lower-extremity myofascial trigger points, FMS symptoms, dyscognition, balance confidence, and medication use have been analyzed; but association between balance and proprioception has not been specially mentioned (5). To the best of our knowledge, at present, no published reports have specifically reported the proprioceptive acuity and its relationship with balance parameters in patients with FMS. The aim of this study was to compare balance and proprioceptive acuity in women with and without FMS.

Material and Methods

The study was conducted in the Department of Physical Medicine and Rehabilitation at Ondokuz Mayis University Medical Faculty. Local ethics committee approved the study protocol. Thirty patients, who met the 1990 American College of Rheumatology (ACR) criteria for FMS (1) as group 1, and thirty age- and sex-matched healthy controls as group 2, were enrolled in the study.

All participants were questioned about age, sex, body mass index (BMI), working status, educational level, falls history, medical comorbidities, and current medications. Disease duration in the patients was also reported. Exclusion criteria included surgery or medical condition within the last one year that would cause balance deficits or proprioception deficits (e.g., stroke or knee replacement or vestibular disorder) and use of medications that may affect balance tests.

Clinical Assessments

The following outcome measures were included in each evaluation:

Measurement of Pain Severity

The global pain in the patients was assessed by a 10-cm visual analogue scale (VAS); the score 0 indicates no pain and 10 indicates very severe pain (12).

Fibromyalgia Impact Questionnaire

The Fibromyalgia Impact Questionnaire (FIQ) is widely used in patients with FMS to evaluate both the clinical severity of the disease and the efficacy of different treatments (13). The FIQ is a self-administered questionnaire and consists of VAS and questions regarding limitations of daily living activities over the previous week. The total score ranges from 0 to 80; a higher score indicates a more negative impact. It was found to be a reliable and valid instrument in Turkish female FMS patients (14).

Functional Performance

The 6-min walk distance (6MWD) test was used as a test of objective assessment of functional performance and endurance (15). The subjects completed this test on a 42.6 m walkway. The subjects were given the same standard verbal instructions before each test and were instructed to walk their maximum distance in a 6-min period. The total distance covered in meters during the 6-min of walking was used as the score for each session.

One-Legged Balance test with Eyes Open

Static balance was evaluated by one-legged balance test with the subjects' eyes open. Each participant was asked to stand on his or her preferred leg with arms folded across the chest. They raised one foot, bending the knee about 45 degrees, and stopwatch was started. The test was performed for 30 seconds. If any use of the arms or the contralateral leg for support occurred, stopwatch was stopped and the time was noted. 3 trials were allowed and the best result was used (16,17).

The Berg Balance Scale

The Berg Balance Scale (BBS) was originally developed for the assessment of postural control, and is widely used in many fields of the rehabilitation (18). The BBS was performed by using a five-point ordinal scale to score subjects performing 14 functional activities. The maximum score on the BBS is 56; a score below 40 indicates a fall risk of nearly 100% (19). The reliability and validity of the Turkish form of the BBS was performed by Sahin et al. (18).

Proprioceptive Acuity Assessment

Knee joint position sense was measured by the isokinetic dynamometer (Cybex Humac NORM). From the initial position of 0° of knee flexion (neutral position), the resistance arm of the dynamometer passively flexed the subjects' leg at an angular velocity of 10° s^{-1}, until reaching the target angles (30° and 60° flexion) and then, maintained for 5 s. The participants were instructed to remain relaxed and to focus on this position. Later, the assessed limb was returned to the starting position and the dynamometer was changed from the passive mode to allow active repositioning. Immediately afterwards, the subjects actively flexed their knees by pushing the dynamometer lever arm and, when they believed to have reached the target angle, they activated the device's lock button. The angle reproduced by the participants was registered by a positional sensor of the dynamometer and the absolute errors (differences between the target and the measured angles). Three repetitions were carried out for each target angle and the mean values at each angle were considered for analyses. The tests were conducted in a quiet room, by the same researcher who always

employed standardized verbal commands. During this test, the participants were blindfolded, thus, visual cues were eliminated. Prior to testing, the Cybex dynamometer was calibrated as a part of the regular schedule for maintenance of the equipment used for this testing device (20).

Statistical Analyses

Statistical analyses were performed using SPSS version 16.0 for Windows. Descriptive data were presented as mean ± standard deviation (SD) or minimum-maximum (median). The Shapiro-Wilk test was used to analyze normal distribution assumption of the quantitative outcomes. To compare the two groups, the Mann-Whitney U test was used, because the data were not normally disturbed. The correlations were investigated by using Spearman correlation analysis. The sociodemographic characteristics (education, occupation) of the groups were evaluated by the chi-square test. A p value of less than 0.05 was considered statistically significant. The sample size was planned according to data (FIQ total score of group 1 [n:34]=59.26±17.85 and of group 2 [n:32]=6.16±8.11) from a previous study (3). In order to have statistical power of 0.99, and $p<0.05$, the minimum number of patients to be enrolled in each group would be 30.

Results

The mean age of the patients and healthy controls were 41±9.20 years and 40.67±9.03 years, respectively. Table 1 provides the clinical and demographic data of the participants. There were no statistically significant differences in sociodemographic data between the groups ($p>0.05$).

There was a significant difference between the patients and controls for 6MWD ($p<0.05$) (Table 1). The mean one-legged balance testing time was 19.93±8.79 seconds in patients and 28.5±3.06 seconds in controls, and statistically significant differences were found between the groups ($p<0.001$) (Table 1). The mean BBS score was 53.10±3.17 for patients and 55.87±0.34 for controls, and there was a significant difference between the groups ($p<0.001$) (Table 1). There was no significant difference in the number of falls and proprioceptive

Table 1. The clinical and demographic data of the participants.

Characteristics	FMS (n= 30)	Control (n=30)	p
	Mean±SD Median (min-max)	Mean±SD Median (min-max)	
Age (years)	41±9.20 42 (23-58)	40.67±9.03 42 (22-58)	0.953
BMI (kg/m^2)	26.03±3.45 25 (20-32)	27.34±5.14 25 (18-35)	0.807
Occupation (n)			
housewife	13	15	0.871
working	16	14	
retired	1	1	
Education (n)			
literate	1	0	0.789
primary education	11	11	
secondary education	9	10	
college	9	9	
6MWD (m)	491.83±90.34 491 (336-654)	554.47±71.80 564 (444-720)	0.010
One-legged balance test (s)	19.93±8.79 20 (5-30)	28.50±3.06 30 (20-30)	0.001
BBS score	53.10±3.17 54 (47-56)	55.87±0.34 56 (55-56)	0.001
Number of falls	0.33±0.54 0 (0-2)	0.10±0.30 0 (0-1)	0.051
Proprioceptive acuity			
30^0 Knee flexion	4.57±3.22 4 (1-12)	4.74±4.52 4 (1-19)	0.750
60^0 Knee flexion	6.94±4.53 6 (0-19)	5.95±2.88 6 (2-13)	0.539
Disease duration (months)	2.83±2.23 2 (1-10)		
VAS pain score	7.80±1.44 8 (5-10)		
FIQ score	61.6±1.59 61 (35-88)		

Mean±SD: mean±standard deviation, median (min-max): median (minimum-maximum), BMI: body mass index, VAS: visual analogue scale, FIQ: fibromyalgia impact questionnaire, 6MWD: 6-min walking distance, BBS: Berg balance scale, p value is significant when <0.05.

Table 2. Correlations between VAS pain scores and FIQ scores, with 6MWD, one-legged stance test, BBS, and proprioception acuity in FMS patients.

	VAS pain		FIQ	
	r	p	r	p
6MWD	-0.077	0.686	-0.152	0.423
One-legged stance test	-0.103	0.587	0.095	0.617
BBS score	-0.288	0.123	-0.011	0.955
Proprioceptive acuity	-0.074	0.697	-0.205	0.277
30^0 Knee flexion	-0.111	0.559	-0.057	0.765
60^0 Knee flexion				

VAS: visual analogue scale, 6MWD: 6-min walking distance, BBS: Berg balance scale, FIQ: fibromyalgia impact questionnaire
r: spearman's correlation coefficient
p value is significant when <0.05

Table 3. Correlations between proprioception acuity and 6MWD, one-legged stance test, BBS in FMS patients.

	Proprioception 30^0		Proprioception 60^0	
	r	p	r	p
6MWD	0.195	0.301	0.194	0.304
One-legged stance test	-0.045	0.813	0.006	0.977
BBS score	-0.059	0.755	0.082	0.655

6MWD: 6-min walking distance, BBS: Berg balance scale
r: spearman's correlation coefficient
p value is significant when <0.05

acuity between the patients and controls (p> 0.05) (Table 1).

In FMS patients, VAS pain and FIQ were not significantly correlated with 6MWD, one-legged balance test, BBS, and proprioceptive acuity (Table 2). Proprioceptive acuity did not significantly correlated with 6MWD, one-legged balance test, and BBS (Table 3).

Discussion

Balance is a very complex task that involves the integration of multiple sensory inputs to execute appropriate neuromuscular activity needed to maintain balance (3). In a study by Jones et al., it was proposed that FMS affects dynamic balance control because of altered somatosensory inputs to the central nervous system and multiple pain processing dysfunctions may lead to poor balance in FMS (5). It was also suggested that balance disorders in FMS may be associated with specific clinical and demographic findings (e.g. increasing age, obesity, reduced muscle strength and impaired cognition, sensory or motor deficits, or lower-extremity myofascial trigger points) (5). Among these factors, proprioceptive acuity and its relationship with balance parameters in FMS are not well known.

Balance is impaired in FMS based on both objective and subjective data (3). It was shown that FMS patients have reduced postural balance compared with healthy controls (1,5,10,21). Similarly in this study, compared with controls, FMS patients scored more poorly on all balance which was assessed by one-legged balance test and BBS. Vestibular and proprioceptive sensory information is considered essential for stable balance (22). It was reported that deficits in lower limb proprioception and muscle strength may be a cause of impaired balance in knee osteoarthritis (23). Contrary to expected, in the current trial, proprioceptive acuity was similar in both FMS patients and controls, and proprioceptive acuity was not associated with balance measurements. There are many factors which have potential impact on postural stability such as, strength, flexibility, sensation, comorbidities, or medications; and it is not still clear if the balance deficits are related to secondary causes or are inherent to the pathophysiology of FMS (9). Proprioception is just one of these factors and it has been shown to decline with age (7). Since the study population was made up of middle-aged women, FMS patients' proprioceptive acuity might not be different from healthy subjects and balance might not be influenced by proprioceptive acuity.

Balance and postural stability during gait requires more attention, and slowing of walking can be anticipated in patients with poor balance. In the current trial, functional performance, measured by 6MWD, was found to be decreased in FMS patients compared to healthy controls. It was suggested that FMS patients are fearful of movement and activity (9,24). This may cause gait abnormalities which were reported in FMS patients previously (3). In the current study, proprioception was not impaired in FMS patients, thus, proprioceptive acuity might not be associated with functional performance in these patients.

Increased fall frequency due to balance problems in FMS has not been shown previously (3,5,9). Although FMS patients had poor balance scores than healthy controls, number of falls in FMS patients did not differ from control subjects in this study. It is known that the risk for falls increases dramatically with age (25). In this trial, study population was middle-aged women, and it seems that balance problems may not affect falls in middle-aged FMS patients. The relationship between symptom severity and balance has been studied previously and it was reported that FMS patients with high FIQ score had poor balance and poor gait performance (5). On the contrary, in the current trial, no association was found between disease activity and balance measurements. In this study, the mean FIQ score was calculated. If the patients were classified as having moderate or severe FMS, balance parameters could be correlated with symptom severity.

The present study has some limitations requiring further discussion. The major limitation of the study is the limited number of patients who were all middle-aged women, thus, results cannot be generalized to general FMS population. Future studies should include larger populations and both sexes. It is known that balance and proprioception are impaired in older people, therefore, clinical trials evaluating the relationship between balance and proprioception in older FMS patients should be planned. Since systemic problems such as Vitamin B12 deficiency, Vitamin D deficiency, or iron deficiency can cause balance problems, future studies including the assessment of balance with these factors in FMS patients are needed. There are some measurements assessing balance objectively such as computerized dynamic posturography. Despite their

objectivity, these measurements are time-consuming and they require special equipment. Balance tests used in the current trial are useful and easy to administer tool for balance assessment in routine clinical examination.

According to the results of this study, it can be concluded that women with FMS may have poor balance, which is not related to proprioceptive acuity, compared to women without FMS. This situation needs to be considered in the clinical assessment of patients with FMS, the patients should be informed, the necessary measures should be taken, and balance training should be included in FMS treatment if necessary.

Conflict of Interest

Authors reported no conflicts of interest.

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