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Distribution of plantar pressure in fibromyalgia patients

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Abstract
Fibromyalgia is a disease in which postural control and balance is impaired and tendency to falls increases. The aim of this study is to detect the presence of plantar loading impairment and to evaluate the relationship between potential plantar pressure changes and clinical signs in fibromyalgia syndrome patients. Thirty-eight female fibromyalgia patients and age and gender-matched 33 healthy controls were included in the study. Diagnosis of fibromyalgia was done based on ACR criteria. Visual Analogue Scale(VAS) and the Fibromyalgia Impact Questionnaire(FIQ) were used to determine the clinical condition of the patients. Static baropodometric measurements were performed to determine the distribution of plantar pressure. Statistically significant differences were not found between two groups regarding static baropodometric measurements ($p>0.05$). Inferior peak pressures in forefoot and hindfoot were associated with higher FIQ and VAS scores ($p<0.05$). Baropodometer may be used for assessment of the distribution of plantar pressure in fibromyalgia patients.

Keywords: Fibromyalgia, baropodometer, postural balance, plantar pressure

Introduction

Fibromyalgia (FMS) is a disease characterized by widespread pain accompanied by sleep disorder, chronic fatigue, emotional disorders and functional dysfunctions [1]. Studies have revealed that postural control and balance are impaired [2] and imbalance, tendency to falls are common in FMS patients [3]. Because FMS is not limited to musculoskeletal system and is primarily a central nervous system disease.

Abnormal pain process is considered to lead to impairment in proprioceptive input to central nervous system from muscles, increased pain and fatigue and sleep disorder-related postural instability [4,5].

Imbalance may be associated with age, obesity, fatigue, decreased muscle power, cognitive disorders, sensory and motor deficit and symptom severity in FMS patients [3,6].

Baropodometric measurement evaluates the interactions between foot and support surface and may be used for biomechanic analysis of posture. Plantar foot pressure measurements may yield data about postural control because foot provides support and elasticity for weight distribution [7].

Many studies revealed the decrease in postural control and frequency of falls in FMS patients [3]. However, no studies are available evaluating plantar pressure with baropodometric measurement.

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The aim of this study is to detect the presence of plantar loading impairment and to evaluate the relationship between potential plantar pressure changes and clinical signs in fibromyalgia syndrome (FMS) patients.

Material and Methods

Thirty-eight women aged between 20 and 50 years, diagnosed with primary FMS comprised the study group while the control group was composed of thirty three healthy, age-matched subjects.

FMS diagnosed according to the criteria of the American College of Rheumatology (ACR) [8]. Demographic (Body Mass Index, age) and laboratory variables were recorded for all patients and controls.

Exclusion criteria for both fibromyalgia and control groups were chronic inflammatory rheumatic disorders, ear disease, the use of antidepressant, opioid, or sedative drugs, previous or current vertigo or dizziness, an apparent visual loss, orthopedic problems in lower extremities, or previous orthopedic surgery, neurological disorder, or peripheral neuropathy. Ethical approval for the study was obtained from the Ethics Committee of the Namik Kemal University.

FMS patients completed visual analog scales (VAS) to evaluate their level of pain and were evaluated with the FMS Impact Questionnaire (FIQ).

The validated version of the FIQ [9] is a specific instrument assessing disease impact on daily living in FMS patients. This instrument measures "physical functioning," "overall impact" (missed work days and job difficulty), and "symptoms" (depression, anxiety, morning tiredness, pain, stiffness, fatigue, and well-being

over the past week). The maximum score for the FIQ is 100, with higher values indicating greater severity. In the severity analysis, a total FIQ score from 0 to <39 was found to represent a mild effect, from ≥39 to <59 a moderate effect, and from ≥59–100 a severe effect [10]. The Turkish version of the FIQ was validated by Sarmer [11].

Baropodometric measurements: Static measurements were done in a silent room and all participants were asked to stand as barefoot on 0.5 m capacity of pressure distribution platform (RScan International, Olen, Belgium) their head to look forward. Active sensor area of the platform was composed of 488 mm x 325 mm and 4096 sensors and data collection frequency was 300 Hz. When the patient came to proper position, snapshot of the measurement was obtained. Measurements were repeated twice and magnitude of pressure distribution was evaluated using foot scan walking software in four quadrants: The right fore foot (RFF), the right hind foot (RGF), the left forefoot (LFF) and the left hind foot (LHF). Relative pressure loads of all four quadrants (%) were recorded.

Statistical analysis

SPSS for Windows version 17.0 software was used for the statistical analyses of our study data. Student's t test was used to compare the numeric data between groups, and chi-square test to compare the categorical variables Correlation analyses were used to examine the associations between the independent variables by Pearson correlation test (r) values. P<0.05 was considered statistically significant.

Results

The data from 38 patients with FMS and 33 healthy controls were analyzed. Demographic characteristics and clinical and laboratory features of the patients are summarized in Table 1.

Statistically significant differences were not found between two groups with regard to static baropodometric measurements (p>0.05) (Table 2).

Table 1: Demographic, clinical and laboratory variables.

Variables	FMS (*n*=38) mean±SD	Control (*n*=33) mean±SD	*p*
Age (years)	41.7±9.4	39.8±5.7	0.12
Gender F/M	38	33	0.17
CRP (mg/L)	6.2±5.1	5.1±3.1	0.18
ESR (mm/h)	23±21.8	22±22.2	0.07
BMD (kg/m^2)	19.4±4.3	20.4±3.6	0.06
VAS (0-100)	43±16.6		
FIQ	68.4±12.6		

FIQ: FMS Impact Questionnaire, BMD: Body mass index, VAS: visual analog scales

Table 2: Intergroup comparison of plantar pressure distribution in static measurements.

Relative pressure-load (%)	FMS (*n*=38) mean±SD	Control (*n* = 33) mean±SD	*p*
Right forefoot	28.824 (2.87)	24.85 (3,856)	0.11
Right rearfoot	26.76 (3.73)	25.25 (2.919)	0.18
Left forefoot	27.25 (2.77)	24.63 (3.44)	0.28
Left rearfoot	25.79 (3.52)	25.44 (2.53)	0.07

Inferior peak pressures in forefoot and hindfoot were associated with higher FIQ and VAS scores (p<0.05) (Table 3).

Table 3: Correlation between the static plantar pressure measurements and clinical measures.

		FIQ	VAS
Right forefoot	r	−.188	−.172
	p	0.004	0.021
Right rearfoot	r	−.154	−.193
	p	0.001	0.006
Left forefoot	r	−.168	−.118
	p	0.031	0.003
Left rearfoot	r	−.195	−.178
	p	0.004	0.003

FIQ: FMS Impact Questionnaire, VAS: visual analog scales

Discussion

Static plantar foot pressure of FMS patients was not different from control group and higher pressures were measured in forefoot and middle foot compared to hind foot.

The relationship between posture and orthopedic and rheumatologic diseases was put forward with scientific studies [12]. Postural system contains static and dynamic balance. Data are sent from peripheral afferent structures (eyes, ears, muscles, tendons) to evaluate in cerebral cortex. The body provided balance through assuming posture and movements [13]. The foot is the supportive and inductive base of walking. It provides support and elasticity for effective weight transfer [7]. Authors recommend to evaluate feet correctly to treat postural problems through strengthening and straining posture muscles [14].

An increase was reported in imbalance and falls risk in studies comparing FMS patients and healthy controls [3]. Falls risk was considered to arise from impaired central and peripheral control mechanisms. Imbalance may be associated with abnormal central and vestibular system function, decreased muscle power, endurance and postural reflex, impaired proprioception, vertigo, dizziness and pain. Rusek and Fulk [5] reported that

postural control is impaired in FMS patients and this may have resulted from the impairment of central perception of vestibular inputs [3]. It was concluded that both central and peripheral components influence balance in FMS patients. In another study, balance was evaluated before and after 24-weeks of sleepiness period and sleepiness-related fatigue influences balance [15]. Low plantar peak pressures in middle and hind foot was found to be associated with high FIQ and VAS scores. Jones et al. found a correlation between balance and FIQ, pain, fatigue in FMS patients.

Use of a device for measurement of plantar pressure is not a frequently used method. A very small number of studies are available performed using baropodometer. Kaercher et al. detected a relationship between plantar pressures and chronic pelvic pain using baropodometer [16]. Rubira et al. investigated the effectiveness of baropodometer in assessment of balance in patients with vestibular impairment [17].

Conclusions and Limitations

Baropodometry analyses evaluate foot dysfunction.
It maps plantar surface pressure which indirectly shows significant posture abnormalities. Therefore, this method has importance for understanding adaptation posture which may be seen secondarily in some diseases which influence posture or which may be influenced by posture.

This study is important as it investigates the distribution of plantar pressure in FMS patients. However, it has some limitations. First, dynamic postural control and thereby plantar pressure changes developing during walking were not evaluated. Second, vestibular system problems were excluded in FMS patients and controls however these patients were not evaluated using audiological tests.

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