Research Article

Relationship between Foot Posture Index and Musculoskeletal Disorders

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Abstract

Background: In this study our utmost priority is to determine the relationship between foot posture index (FPI) and musculoskeletal disorders (MSDs) and also it's correlation with age, gender and weight. Methods: Healthy hospital employees aged over 30, who came to ward sport medicine for routine health examinations were enrolled in this study. Based on eye examination of foot, participants were given a score between -2 and +2 for each criterion. FPI score was calculated by summation of scores patient get from each of the six criteria. Results: FPI increased with aging, while there was no association of FPI with weight and gender. In addition, MSDs were more prevalent in patients with higher FPI. Conclusion: Considering the high prevalence of MSDs particularly LBP, it is so critical to find the cause of LBP. We recommend routine examination of feet in patient complaining of LBP.

Keywords: Musculoskeletal disorders; Low back pain; Foot Posture Index (FPI)

Introduction

Low back pain (LBP) is very a common disorder and about 18% of general population sustained LBP. [1] LBP burdened a large economic on healthcare system, with a reported cost of $90.7 billion in the USA in 1998. [2] In most patients with LBP, no specific pathology or anatomical disorders can be detected. [3]

Postural variations such as decreased lumbar lordosis [4,5] and imbalanced length of leg [6] are some risk factors of LBP that play a role by altering the stresses placed on soft tissue structures around the spine. In addition, individuals with pes planus [7] and cavus foot posture [8] are more likely to complain of LBP. Moreover it has been also reported that both feet pronation and supination have a significant impact on MSCD [9] and in this study this correlation is going to be evaluated by FPI. Some medical assistance, such as a proper foot orthosis and other Rehabilitation measures like physiotherapy and manipulation are suggested to improve patients' quality of life.

LBP is a frequent practical complaint that many physicians faced with every day. Nonetheless, few studies analyzed the role of the plantar arch on musculoskeletal disorders (MSDs) like LBP. Since the feet are important elements for postural system, it is essential to analyze effect of abnormal foot postures on MSDs. Hence, in this study, we aimed to assess the relationship between foot posture index (FPI) and MSDs like low back pain and it's connection with age, gender and weight.

Methods

As a cross-sectional study participants were healthy hospital employees aged over 30, recruited from ward sport medicine at Taleghani hospital, a teaching hospital of Shahid Beheshti University of Medical Sciences, Tehran, Iran in February and March 2016. Participants came to our hospital for routine health examination. Ethical committee of Shahid Beheshti University of Medical Sciences approved the study protocol. Written informed consent was obtained from all participants. Individuals with a history of knee or lumbar spine surgery, inflammatory diseases, arthritis, periarticular fractures, presence of neurological deficit or congenital musculoskeletal anomalies were excluded. Patient with bilateral anomalies were not considered separately from unilateral cases.

For ease of this communication, we used FPI (foot posture index), a clinical tool to determine the degree of pronation (dorsiflexion, eversion and abduction) or supination (plantar flexion, inversion and adduction) of one foot. The six clinical criteria employed in the FPI-6 are: (1) Talar head palpation, (2) Supra and infra lateral malleolar curvature, (3) Calcaneal frontal plane position, (4) Prominence in the region of the talonavicular joint, (5) Congruence of the medial longitudinal arch, (6) Abduction/adduction of the forefoot on the rear foot [Table 1]. All patients were in stance and relaxed positions with limbs support as well, during observations and examinations. The patient was ordered to stand still, with their arms by the side and looking straight ahead for roughly two minutes. Patient was requested to take several steps, marching on the spot, earlier than settling into a comfortable stance position. During the evaluation, we ensured that the patient does not rotate to try to see what is happening for him or herself, as this will meaningfully affect the foot posture. The examiner was able to move around the patient during the assessment and to have continuous access to the posterior aspect

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of the leg and foot in whole examination. Table 1 shows how to calculate scores that are expressed between -2 and +2 for each FPI criteria. Final FPI score was computed by summation of scores patient get from each of the six criteria.

Statistical Analysis

The continuous and categorical variables are described as mean (SD) and number (percent), respectively. Chi square test was used to test association between categorical variables. Analysis of variance (ANOVA) was applied to compare means of continuous variables based on LFPI score and RFPI score. P-value ≤ 0.05 was considered as statistical significance level. All statistical analysis was performed using SPSS version 16.0.

Results

A total of 309 individuals (233 men and 76 women) were enrolled in this study. The mean age and weight of participants were 41.6 and 80.4, respectively and among them, 31.4% sustained MSDs. LFPI in All patients were given a LFPI score from -2 to +3 and a RFPI score from -1 to +3. LFPI in 99.4% of patients and RFPI score in 99.7% of patients were between 0 and +3.

Patients' mean age increased as both LFPI and RFPI increased. According to Left and right FPI scores means age of patients was significantly different between groups (P-value 0.03 and 0.04, respectively). However, there was no significant difference when we compared patients' sex and weight according to both LFPI and RFPI scores. MSDs were more prevalent in individuals with higher LFPI and RFPI scores. For LFPI, 64.6% of participants with MSDs had a score of +2 or +3, while 32.2% of participants without MSDs had a score of +2 or +3. For RFPI, 60.8% of participants with MSDs had a score of +2 or +3, while 32.7% of participants without MSDs had a score of +2 or +3. Results of chi-square test revealed statistically significant difference between MSDs and both LFPI and RFPI scores (P-value <0.001 for both). Detailed information of patients' characteristics and results of analysis is provided in Table 2 and Table 3.

Discussion

In the present study, we found that FPI increased with aging, while there was no association of FPI with weight and gender. In addition, MSDs were more prevalent in patients with higher FPI.

We realize that FPI is higher in older patients. Already existed foot anomalies and abnormal foot postures might get worse by aging. Therefore, it is quite predictable that FPI in elders have greater deviation from normal population. This deviation may be irreversible and treatment will be so hard in old patients in comparison to youth or children.

Connection between FPI and sex has been found in some studies.[10,11] The information about relationship between gender and FPI is limited, but small study population can affect our results.

With respect to MSDs, our results were consistent with results of most previous investigations.[12,13] In one of studies, Rothbart and Estabrook showed that individuals with excessive pronation have higher risk of LBP.[14] However, there are literatures that reported the opposite results and demonstrated negative relationship,[11] Roncarati and McMullen in on a survey of 674 subjects tried to determine risk factors of low back pain in general population. They concluded that there is a negative relationship between pes cavus (high arch) and low back pain, indicating that low back pain subjects tend to have normal longitudinal arches of the feet and that the pes cavus individual has less incidence of low back pain.[8]

In children with foot deformities, MSDs such as spinal and vertebral pains can be avoided by some medical measures like proper foot orthosis and other rehabilitation measures like physiotherapy and manipulation. In children with calcaneovalgus, Mild cases can be treated with stretching exercises performed at each diaper change. Stretching consists of gentle plantar flexion of the foot with mild inversion for a count of 10, repeated three times. In moderate cases or when stretching fails to correct the deformity, splinting or firm, high-top, lace-up shoes that prevent dorsiflexion can be used. For severe deformities, with significant limitation of ankle plantar flexion, serial mobilization casting is performed until corrected, followed by nightly maintenance use of a bivalved cast or

Table 1: Criteria for calculation of FPI score.

FPI criteria	Score				
	-2	-1	0	+1	+2
Talar head palpation	Talar head palpable on lateral side/but not on medial side	Talar head palpable on lateral/slightly palpable on medial side	Talar head equally palpable on lateral and medial side	Talar head slightly palpable on lateral side/ palpable on medial side	Talar head not palpable on lateral side/but palpable on medial side
Supra and infra lateral malleoli curvature (viewed from behind)	Curve below the malleolus either straight or convex	Curve below the malleolus concave, but flatter/more than the curve above the malleolus	Both infra and supra malleolar curves roughly equal	Curve below the malleolus more concave than curve above malleolus	Curve below the malleolus markedly more concave than curve above malleolus
Calcaneal frontal plane position (viewed from behind)	More than an estimated 5o inverted (varus)	Between vertical and an estimated 5o inverted (varus)	Vertical	Between vertical and an estimated 5o everted (valgus)	More than an estimated 5o everted (valgus)
Prominence in region of TNJ (viewed at an angle from inside	Area of TNJ markedly concave	Area of TNJ slightly, but definitely concave	Area of TNJ flat	Area of TNJ bulging slightly	Area of TNJ bulging markedly
Congruence of medial longitudinal arch (viewed from inside)	Arch high and acutely angled towards the posterior end of the medial arch	Arch moderately high and slightly acute posteriorly	Arch height normal and concentrically curved	Arch lowered with some flattening in the central position	Arch very low with severe flattening in the central portion - arch making ground contact
Abduction/adduction of forefoot on rearfoot (view from behind)	No lateral toes visible. Medial toes clearly visible	Medial toes clearly more visible than lateral	Medial and lateral toes equally visible	Lateral toes clearly more visible than medial	No medial toes visible. Lateral toes clearly visible

FPI foot posture index; TNJ talovavicular joint

Table 2: Distribution and comparison of variables based on LFPI score.

Variables		Total	LFPI score						P-value
			-2	-1	0	+1	+2	+3	
No. (%)		309	1 (0.3)	1 (0.3)	105 (34)	72 (23.3)	91 (29.4)	39 (12.6)	
Age (year) ± SD		41.6 ± 8.5	-	-	39.9 ± 7.5	42.7 ± 9.0	41.6 ± 8.8	44.3 ± 8.6	0.03
Gender (%)	Male	233 (24.6)	-	-	76 (32.9)	49 (21.2)	76 (32.9)	30 (13)	0.12
	Female	76 (75.4)	-	-	29 (38.2)	23 (30.3)	15 (19.7)	9 (11.8)	
Weight (kg) ± SD		80.4 ± 17.5	-	-	81.1 ± 17	76.1 ± 14.1	82.4 ± 21.8	82.9 ± 11.3	0.09
MSDs (%)	Yes	97 (31.4)	-	-	5 (5.2)	29 (30.2)	41 (42.7)	21 (21.9)	<0.001
	No	212 (68.6)	-	-	100 (47.4)	43 (20.4)	50 (23.7)	18 (8.5)	

LFPI: Left Foot Posture Index; SD: Standard Deviation; Kg: Kilogram; MSDs: Musculoskeletal Disorder

Table 3: Distribution and comparison of variables based on RFPI score.

Variables		Total	RFPI score					P-value
			-1	0	+1	+2	+3	
No. (%)		309	1 (0.3)	107 (34.6)	73 (23.6)	89 (28.8)	39 (12.6)	
Age (year) ± SD		41.6 ± 8.5	-	39.8 ± 7.5	42.4 ± 8.9	42.3 ± 9.0	43.6 ± 8.7	0.04
Gender (%)	Male	233 (75.4)	-	78 (33.5)	51 (21.9)	74 (31.8)	30 (12.9)	0.21
	Female	76 (24.6)	-	29 (38.7)	22 (29.3)	15 (20)	9 (12.9)	
Weight (kg) ± SD		80.4 ± 17.5	-	81.5 ± 17.3	76.1 ± 14.1	82.7 ± 21.8	83.4 ± 11.1	0.07
MSDs (%)	Yes	97 (31.4)	-	7 (7.2)	31 (32)	40 (41.2)	19 (19.6)	
	No	212 (68.6)	-	100 (47.4)	42 (19.9)	49 (23.2)	20 (9.5)	<0.001

RFPI: Right Foot Posture Index; SD: Standard Deviation; Kg: Kilogram; MSDs: Musculoskeletal Disorders

splinting of the posterior aspect of the leg for a two- to 10-week course.[15] Treatment for pronation in children depends on the child's age and level of pronation. Examples of treatments include braces to wear at night, custom-made orthotic inserts and exercises to reduce pronation. In many cases, orthotic inserts are the chief method used to train the foot to keep it from pronating.

Conclusion and Limitations

On the other hands, in adults with MSDs who are referring to therapeutic clinics both feet should be examined. In the event of problem, they may need medical assistance, such as a proper foot orthosis and other measures to treat and improve patients' quality of life. For treatment of excessive supination or pronation clinicians advise patient's shoes that designed for pronators or supinators. As well as, physical therapy that strengthen the muscles of the legs and feet can help patients.

This study had some limitations. First, we had a small sample size. Second, this is a cross sectional study that cannot predict causality. Finally, we could not evaluate all risk factors of MSDs. Considering the high prevalence of MSDs such as LBP, it is so critical to find the cause of LBP. We found that patients with higher FPI are more likely to have MSDs and LBP. Therefore, we recommend routine examination of feet in patient complaining of LBP.

Conflict of Interest

The authors disclose that they have no conflicts of interest..

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