Effect of Pronated Foot Posture on the Arabic Version of WOMAC Index in Women with Medial Compartment Knee Osteoarthritis

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Abstract

Background: Knee Osteoarthritis (KOA) is one of the most common musculoskeletal conditions affecting old population and is rated as the 4th suspected cause of disability by year 2020. Recent studies have reported difference in foot characteristics between people with medial compartment KOA and asymptomatic controls, indicating a more pronated foot posture in those with OA. Abnormal feet position is associated with altered lower extremity functional and muscle activation patterns.

Aim of the Study: To investigate the effect of pronated foot posture on the Arabic Version of WOMAC index in women with knee osteoarthritis.

Patients and Methods: Sixty six female patients with mean ages (61.66 ± 5.77) years and body mass index (28.71 ± 1.16) Kg/m with primary knee osteoarthritis grade II, III only with a radiographic and diagnostic criterion knee pain participated in this study. Foot posture assessment was done first to categorize them into 3 groups (normal, pronated and supinated) feet using foot posture index. Group (A) normal foot consisted of 24 participants. Group (B) pronated foot consisted of 24 participants. Group (C) supinated foot consisted of 18 participants; knee function assessment was done by using the Arabic version of WOMAC index.

Results: The results demonstrated that that there was significant difference between (Group B (pronated) Vs. Group C (supinated)) with significant increase in ArWOMAC subscale for physical function in favor to Group B (pronated) while no significant difference was found in the other two subscales (pain and stiffness)of the ArWOMAC index (F=1.368, *p=* 0.203).

Conclusion: It can be concluded that there was a significant effect of pronated foot posture on physical function subscale of ArWOMAC index in KOA, while all other foot postures don't affect pain, stiffness or physical function subscales of ArWOMAC index in patients with KOA.

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Key Words: Knee osteoarthritis – Medial compartment knee osteoarthritis – Foot posture – Knee function Questionnaires – ArWOMAC index.

Introduction

OSTEOARTHRITIS of the knee is the most common form of arthritis and leads to more activity limitations (e.g., disability in walking and stair climbing) than any other disease especially in the elderly [1].

Foot posture has been suggested to be related to the development of lower-limb musculoskeletal conditions [2] because of its potential influence on the mechanical alignment and dynamic function of the lower limb [3]. Biomechanical evidence also supports the notion that feet with extremes of foot posture (i.e., planus or cavus) or foot posture (i.e., overpronated or oversupinated) are associated with altered lower extremity functional alignment [4] and muscle activation patterns [5]. Higher prevalence of pronated foot posture and alterations in plantar distribution in knee OA has been revealed in a study [6].

Studies have reported differences in foot characteristics between people with medial compartment knee OA and asymptomatic controls [7,8]. There is limited research on female foot posture, there is an even smaller amount of research on foot posture and its relationship with knee injury; therefore there is a need for additional examination [9]. Additionally, abnormal motion of the foot has also been proposed to lead to greater stress on more proximal structures such as the knee joint due to coupling between the foot and the knee [4].

Aim of the study:

To investigate the effect of foot posture on knee function in knee osteoarthritis' female patients by a valid and reliable tool (ArWOMAC).

Patients and Methods

This study was an observational case-control study was designed to investigate the effect of foot posture (using foot posture index) on knee function (using ArWOMAC index) in women with knee osteoarthritis. It was applied in the General Administration of Medical Affairs Hospital, Menofia University; Egypt. Informed consent was obtained from each patient before enrollment in the study. The study have been approved by Ethical Committee of Faculty of Physical Therapy, Cairo University with number 012/001618 in 30 April 2017.

Inclusion and exclusion criteria:

Sixty six female patients with primary KOA grade II, III only with a radiographic and diagnostic criterion knee pain for most days of prior month, osteophytes at joint margins (radiograph), synovial fluid typical of OA (laboratory), age ≥40, morning stiffness ≤30 minutes, crepitus on active joint motion according to American College of Rheumatology (ACR) [10] were included with mean ages (61.66±5.77); ACR clinical and radiographic criteria. Firstly assessing every patient weight and height by using the scale and tape measurement respectively and measuring BMI only values between 25-30Kg/m^2 was included. Any patient with surgical intervention in the knee and/or hip, any previous fracture in the lower limbs, malignancy, any ligamentous injuries in knee or ankle, spinal cord injury, hormonal imbalance or on hormonal therapy, back problems, using corticosteroids, muscle relaxants or sedatives, knee injection therapy in previous 6 months, physical therapy at last 6 months, using assistive devices, visual or vestibular system problems that could affect the patient's balance were excluded.

Secondly foot posture assessment by scoring each of six criteria (Appendix I) according to observation and palpation then total number were summed to categorize patient's foot posture into 3 groups [normal (A) N=24, pronated (B) N=24 and supinated (C) N=18] feet. It was used to assess foot posture supported by researchers as they mentioned that it is considered a novel, valuable and reliable diagnostic clinical tool to quantify positional variations of the foot, it measures foot posture in three planes and two anatomical segments and take into consideration six assessment criteria [11], agreed by a statement that it is an easy tool yielding quantifiable data with good face validity and can be performed with no special equipment [12]. Moreover it is considered a simple and rapid method and has demonstrated good reliability [13].

Then as an inclusion criterion an examination of the flexibility of flatfoot was done by asking each patient to stand on tiptoes and observe flexible and rigid flatfoot; where flexible flat foot was included, while static (rigid) flat foot was excluded.

For knee function assessment; the Arabic version of WOMAC index (Appendix II) was used for every patient in each group for measuring lower limb functional disability supported by a conclusion that the ArWOMAC index is a reliable and valid instrument for evaluating the severity of knee OA, with metric properties in agreement with the original version [14].

Statistical analysis:

Prior to final analysis, data were screened for normality assumption, homogeneity of variance using Shapiro-Wilk test showed that WOMAC for pain, WOMAC for physical function were normally distributed and not violates the parametric assumption.

Additionally, testing for the homogeneity of covariance revealed that there was no significant difference with p-values of >0.05. However, the homogeneity of variance test and test of normality using Shapiro-Wilk test were significant in one variable only (WOMAC for stiffness) with the $p=0.004$. Data transformation (using the logarithm) was conducted. After data transformation, the normality and homogeneity of variance assumptions still violated the parametric tests for WOMAC for stiffness.

Parametric analysis for WOMAC for pain and WOMAC for physical function, while non-parametric analysis for WOMAC for stiffness was conducted. One way MANOVA was used to compare the tested variables of interest (WOMAC for pain and WOMAC for physical function) at different tested groups. While Kruskal-Wallis H-test (nonparametric alternative to the one-way ANOVA and an extension of the Mann-Whitney U-test) was used to compare the WOMAC for stiffness among three groups and "Mann-Whitney tests" was used as post hoc tests if Kruskal-Wallis H-test among three groups is significant. As two statistical analysis tests (one way MANOVA and Kruskal-Wallis H-test) were performed on the examined sample, the alpha level was adjusted to 0.025 (0.05/2) for

each of the two conducted statistical tests. Adjustment was performed to avoid alpha inflation and committing type I error.

Results

Participants were assigned into three studies groups. Group (A) N=24 participants with mean age and BMI values of 61.79±5.97 years and 28.71±1.16Kg/m^2 respectively. Group (B) N=24 participants with mean age and BMI values of 62.58±6.07 years and 28.59±0.97Kg/m^2 respectively. Group (C) N=18 participants with mean age and BMI values of 60.27±5.10 years and 28.19±1.54Kg/m^2 respectively. As indicated by the One Way Analysis of Variance (ANOVA), there were no significant differences (p>0.05) in the mean values of age and BMI among the three tested groups (Table 1).

1- *WOMAC for physical function:*

As presented in (Table 2), the mean ± SD values of WOMAC for function in the "Group A", "Group B", and "Group C" were 21.2±8.79, 25.54±8.93, and 17.05±8.15 respectively. The multivariate test revealed that there was significant difference in the mean values of WOMAC for physical function among three groups (p=0.01). As well as, multiple

pairwise comparison tests (post hoc tests) revealed that there was significant difference between (Group B Vs. Group C) with (p=0.008) and this significant increase in WOMAC for function in favor to Group B. While, there were no significant differences between (Group A Vs. Group B) and (Group A Vs. Group C) with (p=0.266, 0.39) respectively.

2- *WOMAC for pain:*

As presented in (Table 3), the mean ± SD values of WOMAC for pain in the "Group A", "Group B", and "Group C" were 6.20±3.28, 8.2±3.34, and 6.05±3.81 respectively. The multivariate test revealed that there was no significant difference in the mean values of WOMAC for pain among three groups (p=0.073).

3- *WOMAC for stiffness:*

As presented in (Table 4), the median (IQR) values of WOMAC for stiffness in the "Group A", "Group B", and "Group C" were 2 (3), 1.5 (3.75), and 0.5 (2.25) respectively. The" Kruskal-Wallis H-test" revealed that there was no significant difference in the median values of WOMAC for stiffness among three groups (χ^2=0.32 and p= 0.572).

Table (1): Descriptive statistics and One Way Analysis of Variance (ANOVA) for the mean age and BMI values for the three tested groups.

	Group A (N=24)	Group B (N=24)	Group C (N=18)	F-value	p-value	Level of significant
Age (years)	61.79±5.97	62.58±6.07	60.27±5.10	0.824	0.443	N.S
BMI (kg/m^2)	28.71±1.16	28.59±0.97	28.19±1.54	1.005	0.372	N.S

*: Significant at p-value <0.05.

Table (2): Descriptive statistics and one way MANOVA for WOMAC for physical function among different groups.

Mean ± SD	Group A	Group B	Group C	F-value	p-value
WOMAC for physical function	21.5±8.79	25.54±8.93	17.05±8.15	4.965	0.01

Post hoc tests for the WOMAC for function among different groups			
WOMAC for physical function	Group A	Group B	Group C
Group A		–	–
Group B	0.266		–
Group C	0.39	0.008*	–

*: Significant at p-value <0.025.

Table (3): Descriptive statistics and one way MANOVA for WOMAC for pain among different groups.

Mean ± SD	Group A	Group B	Group C	F-value	p-value
WOMAC for pain	6.20±3.28	8.2±3.34	6.05±3.81	2.736	0.073

Table (4): Descriptive statistics and Kruskal-Wallis H-test of the WOMAC for stiffness among different groups.

Median (IQR)	Group A	Group B	Group C	X^2-value	p-value
WOMAC for stiffness	2 (3)	1.5 (3.75)	0.5 (2.25)	0.32	0.572

*   : Significant at p-value <0.025.
IQR : Interquartile Range.

Discussion

A study's conclusion by Rodriguez et al., 2013 [15] supported the gender selection but in healthy population as they concluded in their study that the most frequent posture was neutral with a certain degree of pronation, with no differences in FPI values between men and women; moreover mentioned in their results that greater proportion of women had neutral and pronated feet and a greater proportion of men had supinated and highly supinated feet, with the differences being no significant. Another study supported the population found in our study but in young players by confirming a tendency towards normal feet as being pronated rather than 'neutral' [21]. Also normative data for the FPI obtained from 619 healthy adults has been presented and compared with grouped data from 1,029 further observations; based on the analyses presented, it was concluded that foot posture was influenced by age and presence of pathology, but is not influenced by sex or BMI [25]. Furthermore Teyhen et al., [26] reported a similar percentage of neutral feet as Rodriguez et al., [15] study but a higher proportion of pronated feet and a lower proportion of supinated feet.

The current study support the correlation between foot posture and lower limb osteoarthritis as concluded by Hillstrom et al., [16]. Also, it comes in line with Levinger et al., [8] in which they compared the FPI between knee OA and controls. They don't found any difference in navicular height between the two groups, however pronated foot type was noted in the knee OA group compared to controls so they concluded that people with medial compartment knee OA exhibit a more pronated foot type compared to controls. Gross et al., reported an association between flat foot morphology and knee pain and medial tibio-femoral cartilage damage, which agrees with our findings [24].

A study by Abourazzak et al., [17] revealed that pronated foot posture and flat foot are significantly associated with medial compartment knee osteoarthritis in Moroccan people. Moreover abnormal foot posture was found in another study of people with severe knee medial compartment OA; authors reported a significantly higher median score in those with knee OA, indicative of a more pronated foot posture [7].

Also Reilly et al., assessed the foot type of three groups medial compartment knee osteoarthritis, hip osteoarthritis, and healthy age matched controls; this study showed significant difference between groups concerning ankle dorsiflexion and arches, they concluded that people with medial compartment knee OA had a normal ankle dorsiflexion and more pronated foot type as indicated by the FPI [22], a study of U.S. Marine recruits found that flat or pronated feet were found to be associated with shin splints or knee pain [23]. Our findings in the study also support a statement that variations in foot posture are thought to influence the function of lower limb [12].

The findings of the current study showed a significant effect of pronated foot on ArWOMAC physical function subscale which come in line with Menz et al., [18] question whether foot posture is associated with falls in older people and Scott et al., [19] assumption that it can be a tool for assessing age-related differences in foot structure. Furthermore AlAbdulwahab and Kachanathu 2016 [20] concluded that higher degrees of FPI might have an effect on standing dynamic balance in healthy subjects.

On the other hand a study found that patients with knee osteoarthritis have no correlation between foot and knee Posture characteristics [27].

The results of the current study offered the need for considering exercises, wedge insole or silicone gel arch for flatfoot treatment in knee osteoarthritis patients and normalizing foot posture should be considered a necessity for maintaining optimal mechanics and injury prevention.

Conclusion:

According to the results, it can be concluded that there is a significant effect of pronated foot posture on ArWOMAC physical function subscale while no significant effect was found in the other two subscales (pain and stiffness) of the ArWOMAC index. Also there was no significant effect of other foot postures on knee function in women with KOA.

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Appendix I

Foot Posture Index Datasheet

FACTOR	PLANE	SCORE 1 Date Comment		SCORE 2 Date Comment		SCORE 3 Date Comment	
		Left (-2 to +2)	Right (-2 to +2)	Left (-2 to +2)	Right (-2 to +2)	Left (-2 to +2)	Right (-2 to +2)
Talar hand palpation	Transverse						
Ourves above and below lateral malleoli	Frontal/ trans						
Inversion/eversion of the calcaneus	Frontal						
Bulge in the region of the TNJ	Transverse						
Congruenoe of the medial longitudinal arch	Sagittal						
Abd/adduction of forefoot on rearfoot (too-many-toes)	Transverse						
TOTAL							

Reference values

Normal= 0 to +5
Pronated = +6 to +9, Highly pronated 10+
Supinated = —1 to —4, Highly supinated —5 to —12

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Appendix II

WOMAC index

J 1Lʟij

0: Not any.

1: A little.

2: Moderate.

3: Important.

4: Very important - extreme.

۰- لا شىء،

۱- قليلة.

۲- متوسطة،

۳- كبيرة.

٤- كبيرة جدا.

P Subscale:

How much pain do you have:

1: Walking on flat surface.

2: Going up or down stairs.

3: At night while in bed.

4: Sitting or lying.

5: Standing upright.

آ) الأوجاع:

ما هى شدة الأوجاع التى تحس بها؟

۱- عندما تمشى على أرض مستوية.

۲- عندما تصعد أو تنزل الدرج.

۳- فى الليل وآنت فى فراشك.

٤- عند الجلوس أو الإستلقاء،

٥- عند الوقوف.

S Subscale:

How severe is your stiffness:

1: After first wakening in the morning.

2: After sitting lying or resting later in the day.

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PF subscale:

What degree of difficulty do you have:

1: Descending stairs.

2: Ascending stairs.

3: Rising from sitting.

4: Standing.

5: Bending to floor.

6: Walking on flat.

7: Getting in/out of car.

8: Going shopping.

9: Putting on socks/stockings.

10: Rising from bed.

11: Taking off socks/stockings.

12: Lying in bed.

13: Getting in/off bath.

14: Sitting.

15: Getting on/off toilet.

16: Heavy domestic duties.

17: Light domestic duties.

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Annex 1. English and Arab versions of WOMAC index.