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Relationship between x-ray findings of knee osteoarthritis and foot posture

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Foot posture has been postulated as a risk factor for the development and progression of knee osteoarthritis (OA); however the link between the radiographic findings of the knee and foot posture is not clear. The aim of this study was to investigate the relationship between the radiographic severity of knee OA and foot posture in subjects with medial knee OA. Thirty patients with medial knee OA were undergone to radiographic examination to their knees to classify the severity of OA according to Kellgren-Lawrence grades (K/L I-IV); then, they were undergone to foot examination using the foot posture index (FPI) and arch index (AI). Spearman correlation coefficient was used to investigate the relation between KL grades and both of FPI and AI.KL grades were not correlated to FPI or AI. Subjects with medial knee OA showed no correlation between severity of their disease and foot posture. Future longitudinal study may be helpful to investigate the effect of severity on foot posture.

Keywords: K/L grades, foot posture index, arch index.

INTRODUCTION

Knee osteoarthritis (OA) is a chronic debilitating condition, affecting a substantial number of older people worldwide (Woolf and Pfleger, 2003; and Access economics report, 2007). OA in the medial compartment of the knee is highly prevalent and has been attributed to the increased load transmitted across the medial compartment of the knee joint (Andriacchi, 1994). There are several factors have been associated with the incidence and progression of OA, particularly, the biomechanical factors. Biomechanical factors, including the frontal plane of the knee joint, associated with joint loading have been the focus of recent studies as an important element in the pathogenesis of knee OA (Levinger et al., 2013). Static frontal plane malalignment ,varus and valgus knee, is a potent risk factor of disease progression, given its important association with load distribution between the medial and lateral tibiofemoral compartment, respectively (Sharma et al., 2001; and Brouwer et al., 2007), and with the magnitude of cartilage loss in the more strongly loaded compartment (Cicuttini et al. 2004; Sharma et al., 2010; and Moisio et al., 2011).

However, these studies have focused on the local mechanical malalignment of the knee; people with knee OA exhibit an altered foot posture including foot pronation more frequently than normal subjects (Reilly et al., 2006; Rielly et al., 2009; and Levinger et al., 2010). Furthermore, a recent study showed that approximately 25.3% of people with symptomatic knee OA have concurrent foot pain in one or both feet that adversely affect their function (Paterson et al., 2015).

Therefore, special attention has been given to foot orthoses and footwear modifications as a non-operative treatment of knee OA by

decreasing the knee adduction moment (KAM) (Kerrigan et al., 2002; Erhart et al., 2008; Hinman et al., 2008; Rodrigues et al., 2008; and Erhart-Hledik et al., 2012). However, laterally wedged insoles can alter foot motion, specifically increasing rearfoot pronation leading to decreased KAM (Nester et al. 2003; and Kakihana et al., 2005). Accentuation of rearfoot pronation in already pronated feet could potentially result in detrimental changes to lower limb kinematics, and consequently lead to the development of musculoskeletal problems in other regions such as increasing trunk leaning and rotation range of motions (Resende et al., 2016). These findings indicate that the biomechanical effects of laterally wedged insoles may be influenced by individual variation in foot function, as well as, the degree of severity of the disease. As such, there may be a need to include foot posture screening to appropriately identify those who are most likely to benefit from laterally wedged insoles, in order to guide the selection of modifications such as the addition of arch supports.

There are a paucity in studies which examined the relation between foot posture and radiographic findings of the knee, such as, the degree of severity of OA in people with medial knee OA (Sadbhawna & Sonia, 2014; and Røsland et al. 2015). It is unclear if foot pronation is increasing with the increase in the radiographic severity of knee OA and degenerative changes at its articular surfaces. Thus, this study aimed to investigate the relationship between foot posture and the severity of the disease in people with medial knee OA. We hypothesized firstly that there is a positive relation between the radiographic severity of OA and foot posture.

MATERIALS AND METHODS

This study was approved by the ethics committee of Cairo University. 30 patients with symptomatic medial knee OA were enrolled in this cross-sectional study and they agreed to participate in the study by a written informed consent. Patients were included if their age was between 35-50 years and their symptoms are matched with ACR criteria as following (Altman et al., 1986): Predominance of pain in the medial compartment of the knee; medial knee pain for most days in the past month; pain of at least 30mm on a 0-100mm visual analogue scale (VAS) following physical activities during the previous 2 days; and at least one of the following items: Age greater than 50 years, morning stiffness of less than 30 minute duration, crepitus on active knee joint motion. Patients were excluded if they had uncontrolled systemic disease and or a pre-existing neurological, rheumatoid arthritis or other orthopaedic condition that affected their walking. In bilateral cases, data were collected from the most symptomatic limb.

Assessment of foot posture:

Foot posture was assessed using the foot posture index (FPI), and the arch index (AI). FPI is a valid and reliable tool that scores six features from -2 (more supinated) to +2 (more pronated) (Redmond, Crosbie, & Ouvrier, 2006). These features include talar head palpation, lateral malleolar curvature, calcaneus inversion/eversion, talonavicular bulge, arch congruence and ab/adduction of the forefoot. Total scores range from -12 (highly supinated) to +12 (highly pronated). AI was measured with the participant standing on a calibrated paper by inked feet in relaxed bipedal stance. A static footprint was obtained excluding the toes (truncated foot length) and was divided to three equal sections. The AI was then calculated as the ratio of the middle section to the entire footprint area (figure 1) calculated by Adobe Photoshop software (CCx64). AI demonstrated excellent reliability (ICC=0.93) (Levinger et al., 2010).

Assessment of radiographic severity of knee OA:

The knee was evaluated by short antero-posterior (A/P) plain X-ray in fully extended weight bearing position to categorize the severity of OA according to the Kellgren-Lawrence (K/L) classification grades (I-IV) (KELLGREN & LAWRENCE, 1957). Patients were be classified (I, II, III, and IV) by an experienced radiologist who was blind to the measures of foot posture. K/L grades were classified as the following: Grade I doubtful narrowing of the joint space and possible osteophytes; grade II definite osteophytes and absent or questionable narrowing of the joint space; grade III moderate osteophytes and joint space narrowing, some sclerosis and possible deformity; and grade IV large osteophytes, marked narrowing of the joint space, severe sclerosis and definite deformity. Statistical analysis was conducted using SPSS for windows, version 23 (SPSS, Inc., Chicago, IL) to test the strength and direction of relationship between the variables of (KL grades, FPI, and AI) using Spearman's correlation coefficient (ρ) at alpha level of 0.05.

RESULTS

Mean values ± standard deviations of age, weight, height and body mass index (BMI) were(46.7±4.2; 78.6±7; 1.5±0.06; and 32.6±2.3), respectively. Spearman's correlation coefficient revealed no correlation between KL grade and each of FPI and AI (figure 1 & 2) and (The table).

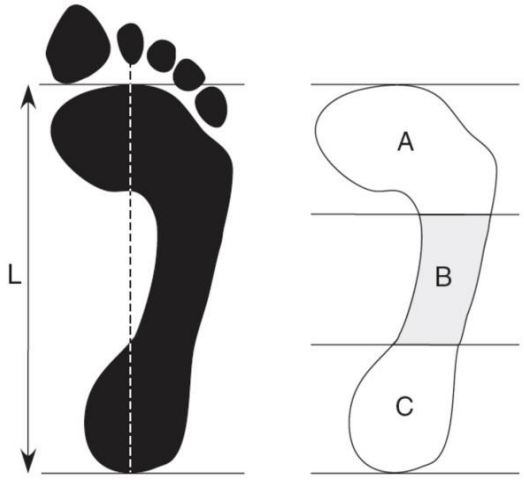

Figure 1. Arch index (AI) = B/A+B+C

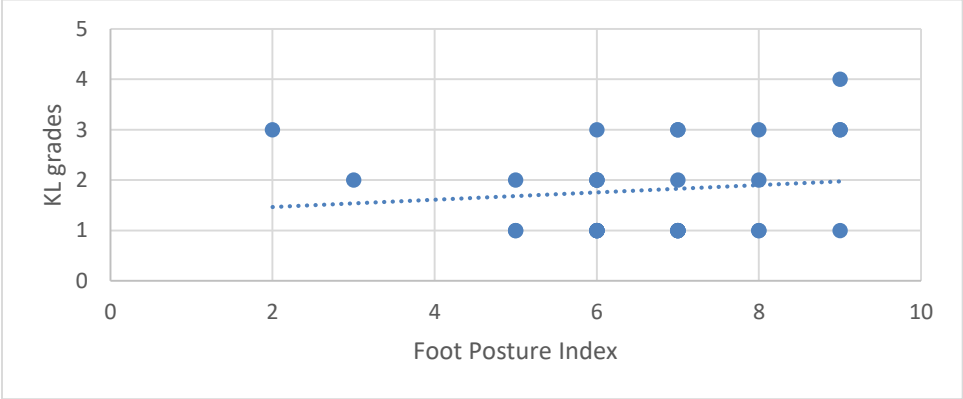

Figure 2. Scatter plot for the bivariate correlation between foot posture index (FPI) and KL grades.

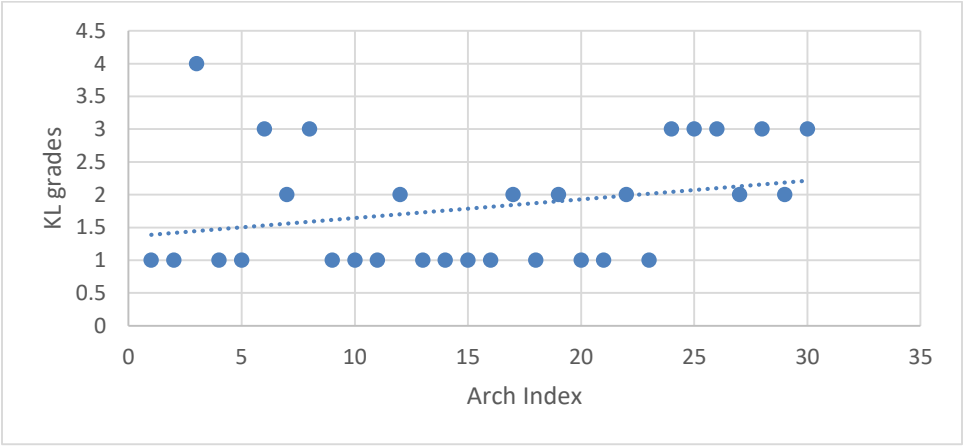

Figure 3. Scatter plot for the bivariate correlation between arch index (AI) and KL grades.

Table. Correlation between KL grades and both of foot posture index (FPI) and arch index (AI).

		FPI	AI
KL grades	**Correlation Coefficient (Spearman's) (ρ)**	0.168	0.124
	p-value	0.375	0.514

DISCUSSION:

Further comprehensive assessment of foot posture and its effect on the degenerative degree of OA could be important and accordingly, early corrective interventions to prevent the disease progression. However, there are few studies investigated the correlation between radiographic severity of knee OA and foot posture (Sadbhawna & Sonia, 2014; and Røsland et al., 2015).

In the present study, it was hypothesized that KL grade and both foot posture measures (FPI and AI) will be correlated. However, our finding did not support that, consisting with the results of Lidtke et al., (2010). They tested the hypothesis that symptomatic medial knee OA is associated with altered loading of the foot (either medial or lateral borders) during gait, as assessed by foot center of pressure measurements. They found no correlation between plantar pressure distribution and KL grade in subjects with medial knee OA.

Additionally, in our study, we observed, that only 26.6% of subjects were lying in grades III and IV while, 73.3% were of mild degrees, close to the results of Lidtke et al., (2010) which were 32% of grade III while, 68% of grade I & II. Recently, it is supposed that foot pronation does not increase in mild grades of medial knee OA (KL grades I,II) (Røsland et al., 2015; Sadbhawna & Sonia, 2014), but increases in severe degrees of the disease (KL grades III, IV) (Hara et al., 2015) to compensate the increasing knee varus by further pronation. However, future longitudinal study will be helpful to clarify the effect of knee OA severity on foot posture and its kinematics.

The main limitation of this study was the heterogeneity in the severity of knee OA in such a small sample size. In future studies, a large sample size will be required to compare foot posture between groups classified according to the disease severity.

CONCLUSION

Severity of medial knee OA was not associated with alteration of foot posture. Further longitudinal study may be required to investigate effect of radiographic severity of knee OA on foot posture.

CONFLICT OF INTEREST

There was no conflict of interest

REFERENCES

Access, economics report, 2007. Painful realities: The economic impact of arthritis in Australia (July).

Altman R, Asch E, Bloch D, Bole G, Borenstein D, Brandt K, Wolfe F, 1986. Development of criteria for the classification and reporting of osteoarthritis: Classification of osteoarthritis of the knee. *Arthritis & Rheumatism*, *29*: 1039–1049.

Andriacchi TP, 1994. Dynamics of knee malalignment. *The Orthopedic Clinics of North America*. 25: 395–403.

Brouwer GM, Tol AW, Van- Bergink AP, Belo JN, Bernsen RM, Reijman M, Bierma-Zeinstra SM, 2007. Association between valgus and varus alignment and the development and progression of radiographic osteoarthritis of the knee. *Arthritis & Rheumatism*. *56*: 1204–1211.

Cicuttini F, Wluka A, Hankin J,Wang Y, 2004. Longitudinal study of the relationship between knee angle and tibiofemoral cartilage volume in subjects with knee osteoarthritis. *Rheumatology*. *43*: 321–324.

Erhart-Hledik JC, Elspas B, Giori NJ, Andriacchi TP, 2012. Effect of variable-stiffness walking shoes on knee adduction moment, pain, and function in subjects with medial compartment knee osteoarthritis after 1 year. *Journal of Orthopaedic Research. 30*: 514–21.

Erhart JC, Mundermann A, Elspas B, Giori NJ, Andriacchi TP, 2008. A variable-stiffness shoe lowers the knee adduction moment in subjects with symptoms of medial compartment knee osteoarthritis. *Journal of Biomechanics*. 41:2720-2725.

Hara Y, Ikoma K, Arai Y, Ohashi S, Maki M, Kubo T, 2015. Alteration of hindfoot alignment after total knee arthroplasty using a novel hindfoot alignment view. *Journal of Arthroplasty*. *30*: 126–129.

Hinman RS, Bowles KA, Payne C, Bennell KL, 2008. Effect of length on laterally-wedged insoles in knee osteoarthritis. *Arthritis & Rheumatism 59*: 144–147.

Kakihana W, Akai M, Nakazawa K, Takashima T, Naito K, Torii S, 2005. Effects of laterally wedged insoles on knee and subtalar joint moments. *Archives of Physical Medicine and Rehabilitation*. *86*: 1465–1471.

Kellgren JH, Lawrence JS, 1957. Radiological assessment of osteoarthrosis. *Annals of the Rheumatic Diseases*. *16*: 494–502.

Kerrigan DC, Lelas JL, Goggins J, Merriman GJ, Kaplan RJ, Felson DT, 2002. Effectiveness of a lateral-wedge insole on knee varus torque in patients with knee osteoarthritis. *Archives of Physical Medicine and Rehabilitation*. *83*: 889–893.

Moisio K, Chang A, Eckstein F, Chmiel J, Wirth W, Almagor A, Prasad P, Cahue S, Kothari A, MD5, Sharma L, 2011. Varus-Valgus Alignment: Reduced Risk for Subsequent Cartilage Loss in the Less Loaded Compartment, *182*: 6697–6708.

Sharma L, Song J, Dunlop D, Felson D, Lewis C, Segal N, Torner J, Cooke T, Hietpas J, Lynch J, 2010. Varus and Valgus Alignment and Incident and Progressive Knee Osteoarthritis. Ann Rheum Dis. *69*: 1940–1945.

Levinger P, Menz HB, Fotoohabadi MR, Feller JA, Bartlett JR, Bergman NR, 2010. Foot posture in people with medial compartment knee osteoarthritis. *Journal of Foot and Ankle Research*, *3*, 29.

Levinger P, Menz HB, Morrow AD, Bartlett JR, Feller JA, Bergman NR, 2013. Relationship between foot function and medial knee joint loading in people with medial compartment knee osteoarthritis. *Journal of Foot and Ankle Research*. *6*, 33.

Lidtke RH, Muehleman C, Kwasny M, Block JA, 2010. Foot center of pressure and medial knee osteoarthritis. *Journal of the American Podiatric Medical Association*, *100*: 178–184.

Nester CJ, Van Der Linden ML, Bowker P, 2003. Effect of foot orthoses on the kinematics and kinetics of normal walking gait. *Gait and Posture*. *17*: 180–187.

Paterson KL, Hinman RS, Hunter DJ, Wrigley TV, Bennell KL, 2015. Impact of concurrent foot pain on health and functional status in people with knee osteoarthritis: Data from the osteoarthritis initiative. *Arthritis Care and Research*, *67*: 989–995.

Redmond AC, Crosbie J, Ouvrier RA, 2006. Development and validation of a novel rating system for scoring standing foot posture: The Foot Posture Index. *Clinical Biomechanics*. *21*: 89–98.

Resende RA, Kirkwood RN, Deluzio KJ, Hassan EA, Fonseca ST, 2016. Ipsilateral and contralateral foot pronation affect lower limb and trunk biomechanics of individuals with knee osteoarthritis during gait. *Clinical Biomechanics*. *34*: 30–37.

Rodrigues PT, Ferreira AF, Pereira RM, Bonfá E, Borba EF, Fuller R, 2008. Effectiveness of medial-wedge insole treatment for valgus knee osteoarthritis. *Arthritis & Rheumatism*. *59*: 603–608.

Røsland T, Gregersen L , Eskehave T, Kersting U, Arendt-Nielsen L, 2015. Pain sensitization and degenerative changes are associated with aberrant plantar loading in patients with painful knee osteoarthritis. *Scandinavian Journal of Rheumatology*. *44*: 61–69.

Sadbhawna D, and Sonia S, 2014. Influence of Different Grades of Knee Osteoarthritis on Foot Posture. *Indian Journal of Physiotherapy and Occupational Therapy. 8*,14.

Sharma L, Song J, Felson DT, Cahue S, Shamiyeh E, Dunlop DD, 2001. The role of knee alignment in disease progression and functional decline in knee osteoarthritis. *The Journal of the American Medical Association*. *286*: 188–195.

Woolf AD, and Pfleger B, 2003. Burden of major musculoskeletal conditions. *Bulletin of the World Health Organization*. *81*: 646–656.