The Prevalence and Correlation of Foot Deformity in Primary Osteoarthritis of the Knee

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Background: *Foot deformities have long been recognized as highly prevalent in older people. Knee osteoarthritis (OA) is a common painful and chronic condition that affects a large proportion of older people. The presence of foot deformities increase disability levels in knee osteoarthritis.*
The purpose of our study is to investigate the prevalence and correlation of foot deformity in primary knee OA.
Methods: *The study design was a cross-sectional survey study of the primary OA knee patients during 4 years period presented in the IPD and OPD patient in Siriraj Orthopedic Department. 113 patients were enrolled in the study. The measure for the association was between the femur-tibia angle (FTA), the hallux valgus angle (HVA), the intermetatarsal angle (IMA), and the calcaneal pitch angle.*
Results: *The prevalence of foot deformities in primary OA knee patients was 70.5% (n=80). The prevalence of the hallux valgus, pes planus and hind foot varus in primary OA knee patients were 51.9%, 41.8%, and 32.9%. The radiographic measurements have no statistically significant association between the alignment of osteoarthritis of the knee (the femur-tibia angle) and foot deformities. No significant association was seen between the femur-tibia angle (FTA), the hallux valgus angle (HVA), the intermetatarsal angle (IMA), and the calcaneal pitch.*
Conclusions: *The prevalence of foot deformities is significantly higher in OA knee. Hallux valgus, pes planus and hind foot varus were the most common foot deformity associated with OA knee. However there is no correlation of radiologic parameters between knee and foot deformity.*

Keywords: *Foot deformity, OA knee*

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Introduction

Knee osteoarthritis (OA) is a common and painful chronic condition that affects a large proportion of older people. Severe knee OA is a long term pathological process that could change the alignment of the entire lower limb and accelerate degeneration of the ankle joint(1). Like the knee OA, foot pain and deformity can reduce the quality of life and is a major cause of disabilities(2). Experiencing frequent foot or ankle pain is common in middle-aged and old people and is likely to co-occur with other joint pain(3). Foot pain and deformities are commonly seen in knee OA and the presence of foot deformities increases the severity of disabilities(4). People with medial compartment knee OA exhibit a more pronated foot type compared to controls. Whether deformities are a risk factor or consequence of knee OA has not been determined(5). Study by Chandler et al. showed that knee and hindfoot alignment can be mechanically related and hindfoot alignment usually changes after change in knee alignment(6). Limited number of studies has been examined for the prevalence of foot deformities in primary knee OA patients. Previous data and studies regarding the correlation between malalignment of the lower extremity is still controversial. The objectives of this study was to determine the prevalence and correlation of foot deformities in primary knee OA patients and to determine the radiographical association between deformities of knee osteoarthritis, hallux valgus, pes planus and hind foot varus.

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Materials and Methods

A cross-sectional study was conducted at the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand during the period of 4 years. All the patients who were admitted for surgical treatment for primary knee OA were included. The indication for surgery was the failure of non-operative treatments while patients with pathologic tibia & fibular diseases, pathologic hip diseases, pathologic spine diseases, and non-weight bearing status were excluded. The sample size was

113 patients and calculated by the correlation coefficient. Written informed consent was taken by the principal investigator or co- investigator. Information relating to foot pain was collected in an interview and during clinical assessment. Respondents were asked about the character, duration, and location of their pain and asked to indicate the location of pain on a foot diagram. A standardized medical examination was performed by a trained orthopedics resident to collect information about the presence of pain, specific problems related to the feet, gait, and several indicators of physical health status. After an interview, the respondents were taken to provide a picture of their feet using a mirror box stand which provides many different views, including the plantar surface. (Fig. 1, 2) The picture was given to the principal investigator to confirm the diagnosis of foot deformities. Pes planus by convention refers to loss of the normal medial longitudinal arch(7,8). A calcaneal pitch angle of less than 19° was defined as pes planus(9). A hallux valgus angle (HVA) of greater than 20° was defined as hallux valgus(10). A scanogram film, standing AP, and lateral view of the foot, and standing mortise view of ankle were recorded.

Fig. 1 Standard front picture taken from a mirror box stand. A picture shows foot and ankle profiles in all directions. All pictures were evaluated by the investigator to defined knee and ankle deformity.

Fig. 2 Standard hindfoot picture taken from a mirror box stand. A picture shows foot and ankle profiles in all directions. All pictures were evaluated by the investigator to defined knee and ankle deformity.

The parameters measured in the X-Ray for diagnosis of foot deformities included the femur-tibia angle (FTA), hallux valgus angle (HVA), intermetatarsal angle (IMA) and calcaneal pitch angle. The *f*emur- tibia angle (FTA) is a line traversing the center of the hip joint and the center of the knee and forms an angle of 6 to 9 degrees with the axis of the shaft of the femur. The mechanical axis generally passes near the center of the normal knee joint. Significant deviations from this mechanical axis may be present in the genus varum or genu valgum deformity. Scanogram was used to measure the femur-tibia angle (FTA). Hallux valgus angle (HVA*)* is the angle between the long axes of the proximal phalanx and the first metatarsal (normal < 15°). The intermetatarsal angle (IMA) is the angle between the first and second metatarsals (normal < 9°). The calcaneal pitch angle is formed by intersection of line parallel to floor with line connecting to most inferior points on calcaneus. The data was weighted by age, sex, body mass index, foot deformities and parameter measurements from the X-ray film which included the FTA, HVA, IMA, and calcaneal pitch angle. All analyses were performed by using SPSS Version 18.0 and included a mean, 95% confidence interval for mean, standard deviation, and chi-square test.

Results

One hundred and thirteen patients were enrolled in the study. The baseline characteristics were well balanced except for gender as females outnumbered men in this study possibly due to the fact that the prevalence of knee OA in females is much higher than males in the normal population. Demographic data was similar in both genders (Table 1). The prevalence of foot deformities in primary OA knee patients was 70.5% (n=80). The prevalence of hallux valgus, pes planus and hind foot varus in primary knee OA patients was 51.9% (n=59), 41.8% (n=47), and 32. 9% (n=37), respectively (Table 2). The radiological measurements in the osteoarthritis of a knee patient who was admitted for surgery had a femur- tibia angle (FTA) n of 183 (5.96 Std. Deviation) (Table 1). The radiographic association between alignment of osteoarthritis of the knee (FTA) and foot deformities showed no statistical significance (p= 0. 58). No significant association was seen between FTA, HVA, IMA, and calcaneal pitch angle.

Table 1 Demographics of the patients.

Characteristic No. (%)			**Female** **94 (83.2%)**	**Male** **19 (16.8%)**
Age				
	Mean		67.44	67.44
	95% Confidence Interval for Mean	Lower Bound	65.50	66.27
		Upper Bound	69.38	73.62
	Std. Deviation		9.422	7.392
BMI				
	Mean		27.63	28.05
	95% Confidence Interval for Mean	Lower Bound	26.45	25.72
		Upper Bound	28.81	30.38
	Std. Deviation		4.277	2.786
Femur-Tibia Angle (Right/Left)				
	Mean		183.40/184.54	183.29/183.44
	95% Confidence Interval for Mean	Lower Bound	139/170	174/171
		Upper Bound	199/207	190/193
	Std. Deviation		8.39/6.22	4.83/7.21

Table 2 The prevalence of foot deformities in primary knee OA patients.

Foot deformities (%)	80 (70.5%)
Hallux valgus (%)	59 (51.9%)
Pes planus (%)	47 (41.8%)
Hindfoot varus (%)	37 (32.9%)

Discussion

Foot deformities have long been recognized as highly prevalent in older people. Foot pain and deformity mainly hallux valgus and pes planus is commonly seen in OA of the knee and this causes abnormal overload to the medial compartment of the knee joint and medial rotation of the tibia[2,4]. The possible compensatory motion or posture is the subtalar joint pronation, which causes valgus force and results in in pes planus and hallux valgus[11]. Hallux valgus is a complex deformity of the first ray and it is frequently accompanied by deformity and symptoms in the lesser toes. A valgus angle of the first metatarsophalangeal joint that was more than 15-20 degrees was considered to be the upper limits of normal. If the hallux valgus angle exceeds 30- 35 degrees, pronation of great toe usually occurs[10]. Pes planus by convention refers to the loss of normal medial longitudinal arch[8]. Radiographic measurement especially calcaneal pith angle and meary angle can be useful in detecting pes planus[9]. Study by Iijima et al concluded that the presence of bilateral flat feet but not unilateral flat feet was significantly associated with the worst knee pain[12]. Foot posture has long been considered to influence the mechanical alignment and dynamic function of the lower limb[5]. Genu varum malalignment of the knee may lead to compensatory foot pronation to enable the foot to be plantigrade when weight bearing. People with medial compartment knee OA have a more pronated foot compared to the control group[5]. Guler et al evaluated foot deformities in 115 women with OA knee and showed significant correlation between the presence of foot deformities and increased disability levels in women with knee OA[4]. Foot function was related to the hallux valgus and overlapping toes, especially in the obese[13]. Hogan and Staheli evaluated 99 physically active men and women who had foot and ankle examinations and answered a questionnaire and found that there was no relationship between the configuration of the arches and pain scores related to the ankle and hind foot[14]. OA knee and hindfoot alignment has linked mechanism. Although previous literatures are most favorable of hind foot valgus deformity following OA knee, in our study we found 32.9% hind foot varus deformity and it may be due to intact tibialis posterior tendon or patient may compensate to walk on lateral side. In ideal situation, we have to confined knee deformity precisely but in our study we wont do it and this is one of the drawback of this study.

Our study demonstrates that there is a high prevalence of foot deformities, mainly hallux valgus, pes planus and hind foot varus in patients with knee OA however, foot pain and duration of foot deformities is hard to recall. Most patients complained more about knee pain than foot pain. This might be because the foot has many joints which could adapt to abnormal mechanical loads than the knee, so even if the patient has a foot deformity, most of them are unable to recognize it.

There were several limitations of this study. One was its small sample size. Additionally, the patients were unable to recall how long they have experienced the foot pain and deformities which must be considered when interpreting the results of our study. A further study needs to be carried out to improve clinical care of such patients.

Conclusions

The prevalence of foot deformities is significantly higher in OA knee. Hallux valgus, pes planus and hind foot varus were the most common foot deformity associated with OA knee. However there was no correlation of radiologic parameters between knee and foot deformity. A further study evaluating foot pain with deformities with a larger population may improve clinical care.

Conflict of Interest

There was no conflict of interest associated with this manuscript.

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