



Research Article – Physical Therapy

Prevalence of altered foot posture in osteoarthritis of knee

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Abstract

Osteoarthritis (OA) is a non-inflammatory progressive degenerative disorder of weight bearing joint. Changes in foot posture may cause increased mechanical rotational stress on the knee joint and may alter alignment and dynamic function of lower limb. To understand the effect of foot orthosis and footwear modification as a non-operative treatment and to identify patients who are most likely to benefit from it, greater knowledge of foot structure in this population is required to find altered foot posture in medial and lateral compartment OA knee using Navicular Drop Test (NDT) and Arch Index (AI). A cross sectional study done on 100 Osteoarthritis patients diagnosed with ACR clinically diagnostic criteria. Patients were evaluated using NDT and AI. NDT: Using a rigid ruler the height of navicular tuberosity in neutral talus position and relaxed standing position was measured. AI: A foot print was taken on graph paper and divided into 3 equal parts A (anterior), B(middle), C(posterior). The results showed that 64% had medial compartmental OA knee and 36% had lateral compartmental OA knee. Out of total population patient showed equal amount of pronation and supination i.e. 36%, while 28% having no alteration in foot posture. Medial compartment had 19.20% pronated foot due to knee adduction moment arm. 28.12% had supinated foot in order to decrease load on lateral compartment and to delay further degenerative process. The study concluded that medial compartment OA and lateral compartment OA showed more pronated and supinated foot type respectively.

Key words: Osteoarthritis (OA), Navicular Drop Test (NDT), Arch Index (AI), pronation of foot, supination of foot.

Introduction

Osteoarthritis (OA) also known as degenerative arthritis or degenerative joint disease or osteoarthrosis, is a group of mechanical abnormalities involving degradation of joints, including not only articular cartilage but also the synovium, capsule, bone and ligaments leading to subchondral bone attrition and remodeling, meniscal degeneration, ligamentous laxity, fat pad extrusion, and impairments of neuromuscular control [1]. It is a common painful and chronic condition that affects a large proportion of the older population which may decrease physical activity may interfere with the daily-life

activities of patients with knee OA, thereby increasing their disability and economic burden. Osteoarthritis is divided into two types: Primary OA: when the etiology is natural wear and tear with aging or overuse or obesity. Secondary OA: Due to infection, any trauma, mechanical, metabolic disorders, congenital abnormalities [1].

In osteoarthritis, there occurs a loss of ground substances of the cartilage, which results in disturbance of dissipation of the stresses. The collagen fibres are therefore, subjected to excessive stresses and strains leading to their rupture. The cartilage develops fissures, gets eroded and exposes the underlying subchondral bone. Micro-fractures of trabeculae develop in subchondral bone. Resorption of these micro-fracture results in subchondral cyst formation, a characteristic radiographic features of osteoarthritis. There

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develops inflammatory synovitis, new bone and cartilage outgrowths at the margins of the particular cartilage, seen as osteophytes on radiographs. Pain is the main presenting symptom. Initially the pain occurs during or after weight-bearing activity, or at the end of the day. Later on, it becomes continuous, occurring even at rest. The joint becomes swollen due to synovitis [1]. Stiffness gradually sets in; following severe pain and capsular contractures. In later stage of the disease, the joint becomes deformed which may be caused by ligamentous instability, capsular contracture or muscle imbalance. Crepitus is felt on the joint movement. In late stages of the disease, loose bodies develop in the joint, which may cause recurrent joint effusion, pain, swelling and locking of the joint.

It is a non-inflammatory progressive degenerative disorder of weight bearing joint; commonly involving knee joint is, characterized by progressive deterioration of the articular cartilage and formation of osteophytes. Knee OA may in part be due to excessive loading of the articular cartilage during walking as the forces transmitted across the knee joint.

The medial compartment of a normal knee joint bears approximately 70% of body weight whereas the lateral compartment bears the remaining weight. This is a result of the trajectory of the ground reaction force (GRF) vector at the knee joint. The GRF trajectory passes medially and posterior to the knee joint. Any degenerative changes in knee OA leads to shifting of this knee adduction moment to that particular compartment which is directly correlated with joint space narrowing, joint capsule loosening and levels of pain and functional limitation. In order to overcome the sensation of joint instability, the muscles surrounding the respective compartment of the knee adopt a bracing mechanism by which they contract as a whole to stabilize that aspect of the knee joint. This bracing also increases the loads in the compartment [2].

A *Pes cavus* or hollow foot or supinated foot is a foot posture in which the longitudinal arches are accentuated and the metatarsal heads are lower in relation to the hindfoot so that there is a dropping of the forefoot on the hindfoot at the transmetatarsal joints. The soft tissues of the sole of the foot are abnormally short, which gives the foot a short

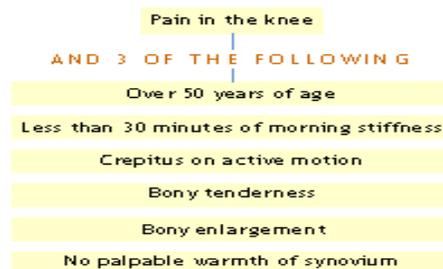
ended appearance. This type of deformity leads to rigid foot with the little ability to absorb the shock and adapt to stress. People with this deformity have difficulty doing repetitive stress activity.

A *Pes planus* or flatfoot or pronated foot is a foot posture in which the calcaneus goes in valgus position, whereas the metatarsal region is in pronation. The talus face medially and downward, and the navicular is displaced dorsally and laterally on the talus. They are accompanied by soft-tissue contracture and bony changes. Foot posture has long been considered to contribute to the development of a range of lower limb musculo skeletal conditions as it may alter the mechanical alignment and dynamic function of the lower limb during most weight bearing activities [3]. Change in foot posture may cause increased mechanical rotational stress on the knee joint and the higher degree of knee OA may also affect foot motion during walking which may lead to a compensatory response to allow typical function of the foot during ambulation and accelerates the degenerative changes at the knee joint.

Methodology

A Cross sectional study was done on 100 males and females who were clinically diagnosed as unilateral OA knee patients according to ACR clinical diagnostic criteria were selected by purposive sampling from Bahusaheb Sardesai Rural Hospital's OPD [9].

Exclusion Criteria: Traumatic foot injury, Oedematous limb, Infective conditions of lower limb, Rheumatoid arthritis, Any other bone disease or tumours, Individuals with BMI > 29.5 [10]. Graph Paper, Rigid Ruler, Ink, Pen, Weighing Machine, Consent Forms were used. Ethical approval was taken from ethical committee. Informed written consent was taken. All subjects with inclusion criteria were selected. The ACR clinical classification criteria for osteoarthritis of knee; using history and examination were as follow:



Patients were examined first by inspecting the knee for any swelling, redness or deformity of knee. On palpation swelling, temperature differences, any bony enlargement, and crepitus of knee were checked. On further examination muscle power and stability of the joint were evaluated. In obese person fat mass can cause outward appearance of a flat foot in individuals also it causes greater mechanical loading of foot leads to flattening of arch hence person with BMI>29.5 were excluded from study. The BMI was calculated of the individuals as weight (kg)/height (meter)² [10] Patient was first evaluated using navicular drop index and then arch index.

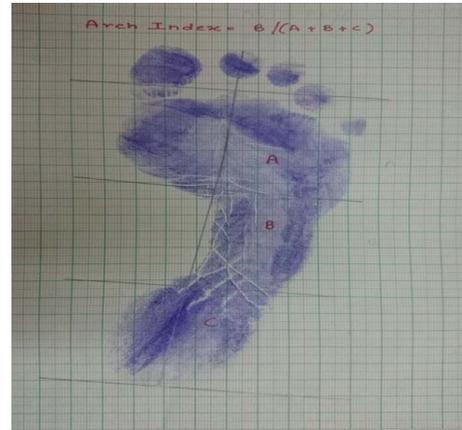
The Navicular drop test: The navicular tuberosity was palpated on medial aspect of foot in non-weight bearing position. Then using a small rigid ruler first the height of navicular tuberosity from floor in neutral talus position was measured. Then same procedure is repeated with patient in relaxed standing position [Fig. 1 A & B] The difference between navicular height was calculated which should be within range of 6-8 mm [4]. If it exceed > /10 mm it is indicative of flattening of medial longitudinal arch during standing and less than 4 mm is suggestive of excess supination of foot [5] [The test is valid and reliable with ICC 0.78] [4,5,6,7]



Navicular Drop Measurements in (A) Relaxed Standing (B) Standing With Equal Weight Bearing.

The arch index: A foot print of involved knee is taken on graph paper with application of ink. The line is drawn from centre of heel to tip of second toe and was measured. Next perpendicular line was drawn tangentially to most anterior point of the main body of the foot print. Their line of intersection was marked. The foot is divided in 3 equal parts from that point to perpendicular to foot axis. The area is determined in sq. mm. The anterior, middle and posterior part marked as A, B, C

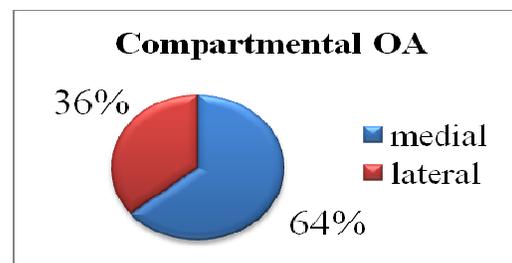
respectively. The arch index was calculated as middle foot area divided by entire foot area i.e. B/(A+B+C) [Fig. 2] Arch index> 0.26 is low arched, 0.210 & 0.26 normal, <0.21 is high arched foot [8] and the data was collected.



Statistical Analysis: Non Parametric Test was done for statistical analysis.

Results

Out of 100 subjects 75 were female and 25 were male. Mean age of total populations was 61.63 and standard deviation was 9.654. Out of all subjects 36 were diagnosed with lateral compartmental OA knee and 64 were diagnosed with medial compartmental OA knee. The mean BMI was 28.95 and standard deviation was 35.72.

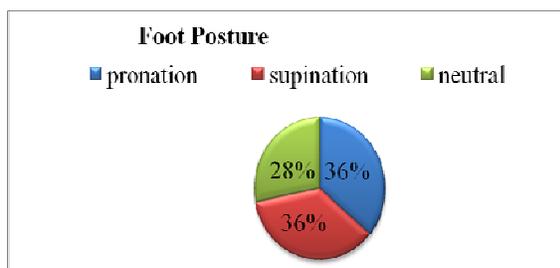


Graph 1. Medial lateral compartmental OA

The above graph shows that, out of total population, 64% have medial compartmental OA KNEE and 36% have lateral compartmental OA KNEE. 46 females and 18 males were diagnosed as medial compartmental OA knee where as 29 females and 7 males were diagnosed as lateral OA knee.

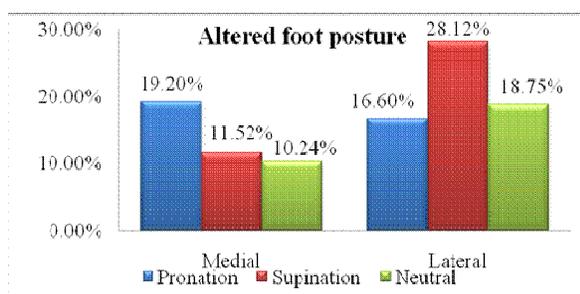
	Female	Male
Medial compartment OA k	46(71.87%)	18(28.12%)
Lateral Compartment OA l	29(80.5%)	7(19.44%)

Graph 2. Foot Posture: Alteration with OA Knee



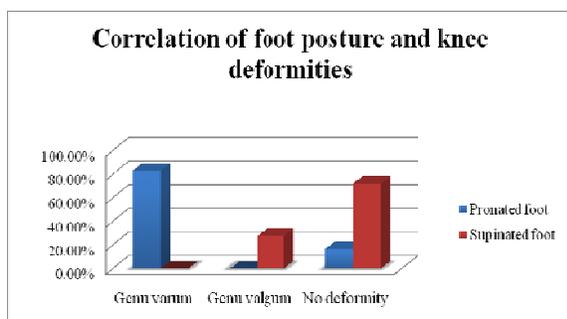
The above graph shows that, out of total population, 36% have pronation of foot, 36% have supination of foot & 28% have no alteration.

Graph 3. Altered foot posture with OA knee



The above graph shows that, the above graph shows that in medial compartment more of pronated foot i.e.19.20% is seen & in lateral compartment more of supinated foot i.e.28.12% is seen.

Graph 4. Correlation of foot posture and knee deformity



Out of 36 pronated foot 30 subjects had genu varum (83.3%) & 6 subjects showed no deformity in knee (16.6%). Out of 36 supinated foot, 10 subjects had genu valgum (27.7%) and remaining 26 subjects had no knee deformity (72.2%).

Subjects who had no changes in foot posture were not suffering from any knee deformity suggestive of early OA.

Foot	Genu varum	Genu valgum	No deformity
Pronated foot	83.30%	0%	16.60%
Supinated foot	0%	27.70%	72.20%

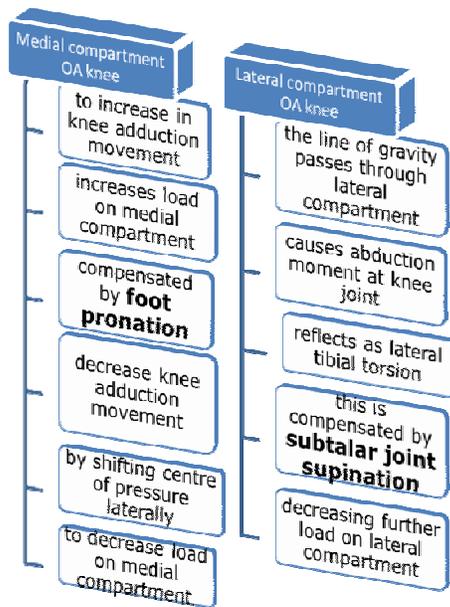
Discussion

The purpose of the study was to find prevalence of altered foot posture in OA knee patient. In this study 75 were females and 25 were males included. This study assessed the foot characteristics of people with knee OA was investigated using Navicular Drop Test and Arch Index. The result showed that out of total population 36% has pronation of foot, 36% have supination of foot & 28% have no alteration in foot posture whereas 64% have medial compartmental OA KNEE and 36% have lateral compartmental OA KNEE. Out of 36 pronated foot 30 subjects showed genu varum knee deformity while 10 subjects had genu valgum among 36 subjects with supinate foot.

The results showed that the medial compartment OA had more of pronated foot type i.e.19.20% and lateral compartment OA had more of supinated foot type i.e. 28.12% which may be due to following biomechanical changes that occurs during abnormal loading of knee joint during weight bearing activities. In the medial compartmental OA there is increase in the adduction moment arm which further increases load on medial compartment due to wear and tear of cartilage [14,19]. To compensate this foot adapts subtalar joint pronated position [20]. This decreases the knee adduction moment arm by shifting the pressure towards lateral compartment. Thus decrease the further load on medial compartment [14,17].

In lateral compartment OA the line of gravity passes through lateral compartment due to degenerative changes which cause slight abduction moment at knee joint which reflects as lateral tibial torsion. This is compensated by subtalar joint supination which decreases further load on lateral compartment. This axial malalignment increases the risk for progression of knee osteoarthritis and predicts a decline in physical function. However there were some individuals who showed pronated foot in lateral compartment OA i.e.16.60% and supinated in medial compartment OA i.e. 11.52% which cannot be commented as there was no pre-study foot posture data was available. Those showing

neutral foot posture i.e.in medial compartment OA KNEE 10.24% and in lateral compartment OA KNEE 18.75% may have early degenerative changes in knee which did not reflect any changes on foot posture. Hence in clinical assessment of OA knee foot structure should also be evaluated which may advance our understanding of potential role of foot orthosis and foot wear modification on lower limb alignment and function and thus decrease degenerative processes in knee. Following image shows the biomechanical changes occur in medial and lateral compartmental KNEE OA [3,15,16].



Conclusion

The study concluded that there was altered foot posture in people with OA knee. People with medial compartment OA showed more pronated foot type and lateral compartment OA showed more supinated foot type.

Clinical Significance

As the altered foot posture further increase mechanical stress on lower extremity joints [12]. It is therefore recommended that the assessment of patients with knee OA in clinical practice should include simple foot measures, and that the potential influence of foot structure and function on the efficacy of foot orthosis in the management of OA knee be further investigated.

Limitations

Pre-study foot posture data was not available. All acute as well as chronic cases were included.

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