



# ASSOCIATION OF STATIC FOOT POSTURE AND DYNAMIC BALANCE IN KNEE OSTEOARTHRITIS

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**Abstract:** The study aimed to investigate the relationship between foot posture and dynamic balance in patients with knee osteoarthritis. A total of 58 subjects were selected based on inclusion and exclusion criteria. Foot posture was assessed using the Foot Posture Index (FPI), while dynamic balance was evaluated using the Functional Reach Test. Descriptive analysis showed that individuals with a pronated foot posture with moderate to high risk of falls, indicating impaired dynamic balance. Furthermore, to show association between foot posture and dynamic balance, Mann-Whitney Test was performed. The finding suggest increased risk of fall in pronated foot compared to neutral foot posture.

**Key words-** Knee Osteoarthritis, Dynamic balance, Static foot posture, Foot posture index

## INTRODUCTION

Osteoarthritis (OA) is the common and non-fatal joint disease in India, affecting around 22% to 39% of the middle-aged to elderly population<sup>1</sup>. It is characterized by the gradual deterioration of joint cartilage, it leads to symptoms like pain, stiffness, and reduced mobility<sup>2</sup>. While OA affects weightbearing joints, like hip and spine but particularly common in the knees. OA is a non-fatal disease which significantly affects the quality of life.

The Ankle-foot complex plays a vital role by providing stability and mobility. alterations in foot posture can disrupt the body's balance mechanism. As foot is biomechanically connected with knee, any alterations in foot posture can alter the alignment of the knee joint. Abnormal foot posture, such as pronated and supinated foot can alter the distribution of forces during weight-bearing activities. This increased stresses can result in increasing the risk of OA development or exacerbating existing OA symptoms. Understanding the relation between foot posture and knee OA is important to plan effective management strategies.

Balance is an integral component of many activities of daily living and has been used as a measure of lower extremity function (cote et al., 2005). It is defined as the process of maintaining the Centre of gravity within the body's base of support.

Dynamic balance is an essential for performing daily activities. Subjects with knee OA often experience impaired balance due to various factors like affected proprioception's and muscle weakness. , Functional reach test is a quick and simple, single-task dynamic test. It is defined as "the maximal distance one can reach forward beyond arm's length, while maintaining a fixed base of support in the standing position" (Duncan et al., 1990)<sup>3</sup>.

The Foot Posture Index (FPI) is a reliable method for evaluating foot posture, It rates weight-bearing posture based on predefined criteria, with scores ranging from -2 to +2. A high positive FPI score (>5) indicates a pronated foot, while significantly negative scores indicate a supinated foot<sup>4,5</sup>. Understanding the relationship between foot posture and dynamic balance in knee OA is essential for optimizing treatment strategies and enhancing the quality of life for affected individuals

**.METHODOLOGY**

This is a prospective cross-sectional observational study with a sample size of 58, determined using Epi Info version 1.02. Inclusion criteria were patients aged 40 to 60 years having unilateral or bilateral knee osteoarthritis (OA), as per the American College of Rheumatology (ACR) Clinical Classification criteria. Exclusion criteria included various factors such as lower limb joint replacement, fractures, and neurological disorders. After approval from the Institutional Ethics Committee data collected was conducted. case record form includes visual Analogue Scale for pain, Foot Posture Index, and Functional Reach Test. For foot posture evaluation, the Foot Posture Index (FPI) was used. Participants stood in a relaxed stance with arms by their side for 2-3 minutes on a platform at examiner's eye level. The FPI assessed components such as talar head palpation, supra and infra lateral malleolar curves, calcaneal frontal plane position, prominence in the talonavicular joint, congruence of the medial longitudinal arch, and abduction/adduction of the forefoot on the rearfoot. The Functional Reach Test assessed dynamic balance by having participants stand next to a wall and reach forward with their dominant arm without taking a step. The distance of the reach was measured using a yardstick fixed on the wall.

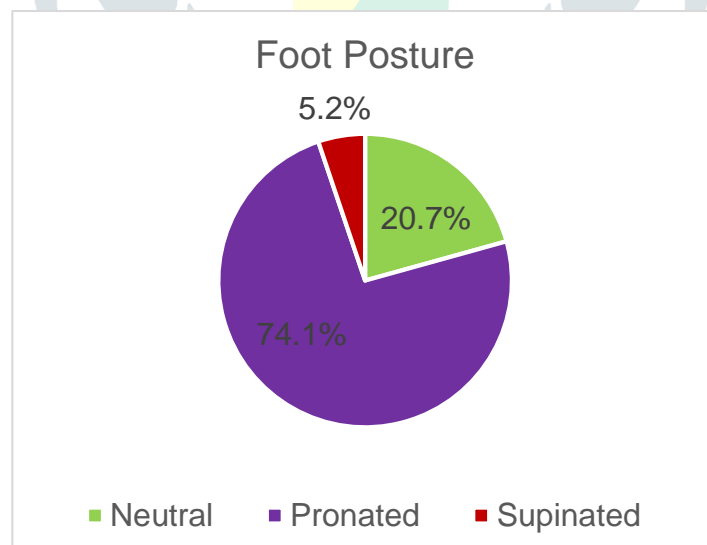
**RESULTS**

The data of the study was analyzed data from 58 osteoarthritic subjects using SPSS 20.

Table 1		Frequencies
Gender	Female	51 (88%)
	Male	7 (12%)
Body Mass Index	Normal	6 (10%)
	Overweight	4 (7%)
	Obese	48 (83%)
Knee osteoarthritis	Unilateral OA	28(48%)
	Bilateral OA	30(52%)

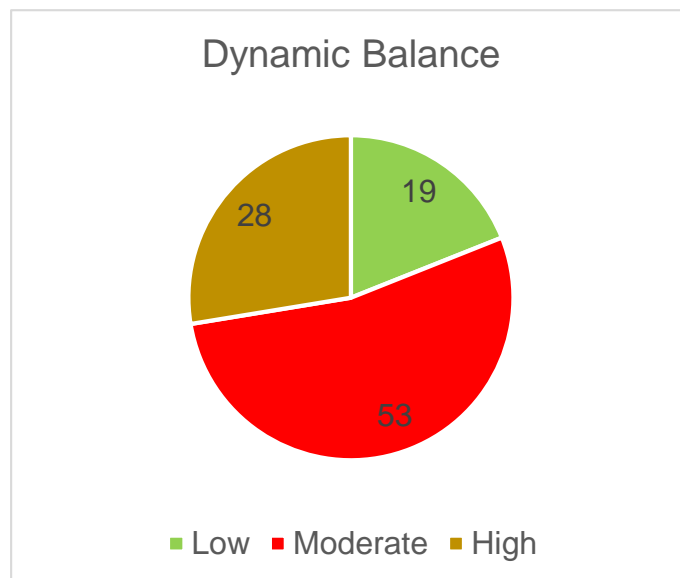
Table 1- Descriptive analysis of population

Graph 1: Type of Foot posture in knee osteoarthritis



Among the sample, 20.7% exhibited a neutral foot posture, while 74.1% showed a pronated foot posture, and 5.2% had a supinated foot posture. Therefore, pronated foot posture was the most prevalent in the sample population.

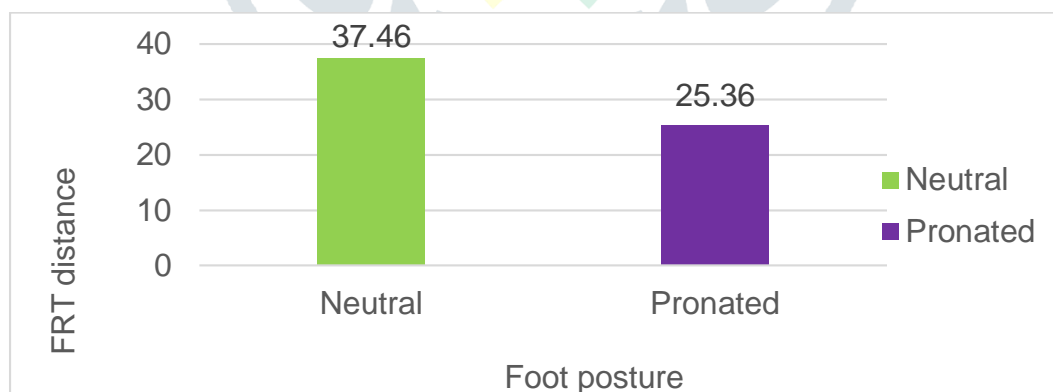
Graph 2: Dynamic balance on basis of Fall risk, derived using functional reach test in knee osteoarthritis



The majority of patients in our sample population were observed to fall within the moderate (53%) to high risk of fall (28%) categories based on their functional reach distances

Graph 3: Association of Foot posture and Dynamic balance

The study compared Functional Reach Test distances between neutral and pronated foot postures, excluding supinated cases due to their small number (n=3). The Mann-Whitney test was used to compare Functional Reach distances between these two groups.



Patients with pronated foot posture exhibited a lower mean functional reach distance compared to those with neutral foot posture. This difference was statistically significant ( $p=0.02$ ). The lower functional reach distance in the pronated foot posture group indicates a higher risk of falls. This suggests an association between dynamic balance and foot posture in patients with knee osteoarthritis

## DISCUSSION

The study was undertaken to find out whether foot posture has an association with Dynamic balance in Knee Osteoarthritic individuals. The study included 58 subjects with knee osteoarthritis. Depending upon FPI score, Out of 58 subjects, 43 (74.1%) had a pronated foot posture, 12 (20.7%) were with neutral foot and 3 (5.2%) were with supinated foot posture. Hence, pronated foot observed most frequently in our population. Dynamic balance was assessed using Functional Reach Test, on the basis of the reach distances during the test, the patients were categorized on the basis of fall risk, as follows: 11

with low risk of fall, 31 with moderate risk of fall and 16 with high risk of fall. Data was further analyzed on the basis of bilateral and unilateral Osteoarthritis. There was a statistically significant difference in the functional reach distances amongst neutral and pronated foot postures. Indicative of an association between foot posture and dynamic balance in patients with knee osteoarthritis

#### Pronated foot in OA

In normal, the weight bearing line passes medial to knee joint, which creates a knee adduction moment during gait. In Individuals with a Varus alignment of the knee joint which is commonly seen in medial compartment OA, there is increased knee adduction moment as line passes more medial to knee creating an increased Varus moment which further increases medial knee compressive forces<sup>6</sup>. The foot's contact with the ground influences the ground reaction force. compensatory foot Pronation might reduce the adduction moment by shifting weight bearing line laterally thus reducing medial compressive forces. potentially easing load on the inner knee<sup>7</sup>.

Another reason would be Weakness in hip muscles like the gluteus maximus and medius is common in knee osteoarthritis. During walking, there's a natural movement where the hip moves in adduction, rotates internally, and flexes. When the gluteus maximus is weak, it can't counteract this movement, leading to more inward movement of the hip. which can lead to lifting of the lateral foot Since the foot stays on the ground,, the tibia goes in abduction resulting in a dynamic knee valgus and foot pronation.<sup>8</sup>

#### Dynamic balance in knee Osteoarthritis

Several potential mechanisms may be responsible for the balance deficit observed within the Osteoarthritis group.

Deficits in lower limb proprioception, muscle strength and pain are associated with knee Osteoarthritis and thus may cause impaired balance. Joint effusions are known to cause an arthrogenic reduction in activation. In these patients, articular damage may stimulate articular mechanoreceptors evoking abnormal sensory information, which decreases excitability of  $\alpha$  -motoneurons which is responsible for voluntary activation, also reduces  $\gamma$  -motoneurone excitability, this would decrease muscle spindle sensitivity and consequently decrease proprioceptive acuity.<sup>9,10</sup>

Pain associated with the osteoarthritic knee may play a role in balance impairments. The presence of pain may reflexively inhibit the muscles around the knee, mainly quadriceps, which could perpetuate the lack of motor responses in postural control. Furthermore, pain may result in reduced loading of the affected joint, potentially jeopardizing an individual's ability to maintain their centre of mass within the base of support.

#### Effect of foot posture on dynamic balance in knee osteoarthritis

The foot serves a critical function in maintaining balance by serving mobility and stability. During weight-bearing activities, there is a transition of foot from pronation and supination depending upon the need. The normal foot effectively transit between pronation and supination to optimize adaptability versus stability as needed, foot malalignments that negatively affect foot mobility may diminish the ability of the lower leg to function optimally during weight-bearing stance. Individuals with flat feet often exhibit increased activation of intrinsic foot muscles to compensate for ligament laxity and foot hypermobility. This increased muscle activity may lead to overuse injuries and cause fatigue<sup>11</sup>, which can alter sensory feedback from the foot<sup>9</sup>, potentially impacting proprioception and joint position sense.

## CONCLUSION

In conclusion, our study highlights significant findings regarding knee osteoarthritis and its impact on foot posture and dynamic balance. Firstly, we found that the majority of individuals with knee osteoarthritis has a pronated foot posture. Knee osteoarthritis individuals showed moderate to high risk of falls on dynamic balance assessment. Importantly, we found a significant association between foot posture and dynamic balance, with patients having a pronated foot posture showing significantly lower functional reach distances compared to those with a neutral foot posture.

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