



## Correlation of Quadriceps Angle With Foot Position In Knee Osteoarthritis

1. **Lendghar Priti G** (B.P.Th), Clinical Physiotherapist, Sancheti Institute College of Physiotherapy, Pune, India
2. **Marwaha Ravinder kaur** (M.P.Th), Associate Professor, Sancheti Institute College of Physiotherapy, Pune, India
3. **Rairikar Savita A** (M.P.Th), Professor and Principal, Sancheti Institute College of Physiotherapy, Pune, India
4. **Sancheti Parag K** (M.Ch. Ortho), Orthopedic Surgeon, Chairman and Dean, Sancheti Institute of Orthopedics and Rehabilitation, Pune, India
5. **Palekar Tushar J** (Ph. D), Professor and Principal, Dr D Y Patil College of Physiotherapy, Pune, India

### Abstract

**Purpose :** Foot posture assessment is usually neglected in knee osteoarthritis patients. Alteration in the foot posture causes a more rapid progression to knee dysfunction. Therefore, the purpose of the study was to find the correlation of quadriceps angle with foot position in patients with knee osteoarthritis.

**Methods:** A cross-sectional study was conducted on 100 subjects diagnosed with osteoarthritis in the age group of 50-70 years which included 70 females and 30 males. The quadriceps angle for both the knees was measured with universal Goniometer and the foot posture was evaluated on foot posture index.

**Results:** Correlation of Q angle of left leg with left foot posture index shows  $r = 0.663$  which is statistically significant ( $p > 0.01$ ). Correlation of Q angle of right leg with right foot posture index shows  $r = 0.65$  which is statistically significant ( $p > 0.01$ ).

**Conclusion:** It was concluded that a positive correlation exists between the Q angle and the foot position in patients with knee osteoarthritis.

**Keywords:** Foot pronation, genu varum, knee osteoarthritis, pes planus.

### Introduction:

Osteoarthritis is a degenerative joint disease. It is a progressive disorder of the joints caused by gradual loss of cartilage and resulting in the development of bony spurs and cysts at the margins of the joints. It results from deterioration or loss of the cartilage that acts as a protective cushion between bones. As the cartilage is worn away, the bone forms spurs, areas of abnormal hardening, and fluid-filled pockets known as subchondral cysts.<sup>15</sup>

As the disorder progresses, pain results from deformation of the bones and fluid accumulation in the joints. The pain is relieved by rest and made worse by movement. In early OA, the pain is minor and may



take the form of mild stiffness in the morning. In the later stages of OA, inflammation develops, the patient may experience pain even when the joint is not being used, and the patient may suffer permanent loss of the normal range of motion in that joint.<sup>15</sup>

The quadriceps angle (Q Angle) is defined as the angle between the quadriceps muscles (primarily the rectus femoris) and the patellar tendon and represents the angle of quadriceps muscle force. Q angle of 10 to 15 degrees measured with the knee either in full extension or slightly flexed is considered "normal".<sup>7</sup> Normally, the Q-angle is 13 degrees for males and 18 degrees for females when the knee is straight.<sup>6</sup> A Q angle of 20 degrees or more is considered abnormal, it increases the lateral pull on the patella against lateral femoral condyle, thus contributing to patella subluxation and other patellofemoral disorders. An increased Q angle is often associated with increased femoral ante version, genu valgum, lateral displacement of tibial tubercle, or increased lateral tibial torsion and pronated foot.<sup>13,3</sup>

A high Q angle increases the chances of developing various knee problems. One of the most common problems associated with an increased Q angle is patella femoral tracking syndrome. A high Q angle interferes with the smooth gliding movement between the patella and the femur. Over time, especially with repetitive activities, this type of micro trauma causes non-specific pain to the anterior knee. As this abnormal tracking continues between the patella and the femur, various knee muscles become imbalanced, and the cartilage on the underside of the patella begins to wear and thin. Eventually the knees become degenerative and develop osteoarthritis.<sup>7</sup>

Normally, genu varum at the knee brings the toes to face medially and hence causing adduction of the foot.i.e.supination. Conversely, the genu valgum at the knee brings the toes to face laterally and hence causing abduction of the foot.i.e.pronation.<sup>7</sup>

Over pronation or flat foot is one of the most common causes of an increased Q angle. Excessive pronation is a result of too much rolling inward of the heel and mid-foot beyond the normal limits during standing, walking or running. Supination is one of the most common causes of a decreased Q angle. Supination is a result of rolling outward of the heel and mid-foot beyond the normal limits during standing.

This study considers a new clinical tool, the Foot Posture Index (FPI). It examines its utility in a physiotherapy outpatient setting with a cohort of patients with osteoarthritis of the knee, and investigates the relationship of quadriceps angle with FPI scores. Foot examination often gets neglected by the physiotherapist, during routine examination of the patients with knee osteoarthritis.

Studies have been done to show relationship between flat foot position with Q angle and knee pain in freestyle wrestlers but there is dearth of literature on correlation between quadriceps angle with foot position in patients with knee osteoarthritis.1,11



### Methods:

A cross-sectional study was conducted on 100 subjects diagnosed as having osteoarthritis since 1yr in the age group of 50-70 years which included 70 females and 30 males. Patients with neurological pathology, peripheral nerve injury, recent surgical, ankle OA, rheumatoid arthritis, post-traumatic knee stiffness or having undergone total knee arthroplasty were excluded from the study. A written consent was obtained from the subjects before assessing them.

Subjects were explained about the method. Approval for the study was obtained from the institutional ethical committee and the educational review board. (ECR/90/Inst/MH/2013)

The Q angle is the angle formed between the line connecting the ASIS to the midpoint of the patella and a line connecting the tibial tuberosity and the midpoint of the patella.<sup>13</sup>

With the help of measuring tape and goniometer, the Q angle was measured as follows:-

- A line was drawn from anterior superior iliac spine (ASIS) to mid-point of patella on the same side and from mid-point of patella to tibial tuberosity.
- The angle formed by crossing of these two lines is the Q angle ,which was measured with the help of plastic goniometer.<sup>15,13</sup>

Obtained data was documented and tabulated.

The foot posture index is a diagnostic clinical tool aimed at quantifying the degree to which a foot can be considered to be in a pronated, supinated or neutral position.<sup>2,4,10</sup>

The patient should stand in their relaxed stance position with double limb support. The patient should be instructed to stand still, with their arms by the side and looking straight ahead. It may be helpful to ask the patient to take several steps, marching on the spot, prior to settling into a comfortable stance position.

Features commensurate with an approximately neutral foot posture are graded

As zero, while pronated postures are given a positive value, and supinated features a negative value.

When the scores are combined, the aggregate value gives an estimate of the overall foot posture. High positive aggregate values indicate a pronated posture, significantly negative aggregate values indicate a supinated overall foot posture, while for a neutral foot the final FPI aggregate score should lie somewhere around zero.

Components of foot posture index include:

1. Talar Head Palpation (Palpation for talo-navicular congruence)
2. Supra and Infra Lateral malleolar curvature (Observation and comparison of curves above and below lateral ankle malleoli)
3. Calcaneal frontal plane Position (Inversion / eversion of the calcaneus)
4. Bulging in the region of the talo- navicular joint (TNJ)
5. Height and congruence of the medial longitudinal arch
6. Abduction/ adduction of the forefoot on the rear foot. (Too many toes sign)



### Data analysis

Pearson correlation co-efficient test was used to co-relate between quadriceps angle and foot posture index. All the analysis was done using SPSS version 12.

### Results

Correlation of Q angle of left leg with left foot posture index shows  $r = 0.663$  and correlation of Q angle of right leg with right foot posture index shows  $r = 0.65$  which is statistically significant ( $p > 0.01$ ).

### Discussion

In this study, 100 subjects were included, 70 were females and 30 were males. It has been proved that the knee osteoarthritis is commonly seen in females and due to broader pelvis they have a tendency for increased Q angle.<sup>6</sup>

This study shows that there was a positive correlation between quadriceps angle and foot position. From table and graph land 2, it was found that positive correlation exists between Q angle and FPI ( $p = 0.00$ ,  $r = 0.398$ ).

The osteoarthritis of knee joint may involve medial or lateral compartment of tibiofemoral joint and patellofemoral joint. In case of involvement of medial compartment, the genu varum deformity is observed, which exhibits an increase in quadriceps angle due to the medial tibial torsion impeding its normal external rotation during gait progression in the stance phase. This excessive internal tibial rotation transmits abnormal forces upward and produces stress over medial knee joint<sup>16</sup> which in turn results in compensatory excessive pronation at subtalar joint, and forefoot valgus causing decrease in the medial longitudinal arch.<sup>6,1</sup> Similarly, involvement of lateral compartment results into genu valgum with a subsequent decrease in quadriceps angle and lateral tibial torsion which is compensated by motions like subtalar supination and forefoot varus.<sup>6</sup> Studies have shown that pes planus i.e. pronation and increase in varus at the subtalar joint is highly associated with anterior knee pain.<sup>11,14</sup>

The combination of a higher Q angle with excessive pronation causes a more rapid progression to knee dysfunction, to patellofemoral arthralgia, to degenerative joint disease.<sup>9</sup> One of the effective way to decrease a high Q angle and lower the biomechanical stresses on the knee joint is to prevent excessive pronation with custom-made, flexible orthotics.<sup>5</sup> One study found that using soft corrective orthotics was more effective in reducing knee pain than a traditional exercise program.<sup>8</sup> Studies have also shown that medial/lateral wedge insoles would be helpful in reducing the load in lateral and medial compartment knee osteoarthritis.<sup>12</sup>

### Conclusion

The study shows that a positive correlation exists between the Q angle and the foot position i.e as the Q angle increases, the score of the foot posture index increases and vice-versa.



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**Table 1: Correlation between Quadriceps angle and foot posture index of left leg.**

		Q angle left	FPI left
Q angle left	Pearson Correlation	1	.398(**)
	Sig. (2-tailed)	.	.000
	N	99	99
FPI left	Pearson Correlation	.398(**)	1
	Sig. (2-tailed)	.000	.
	N	99	99

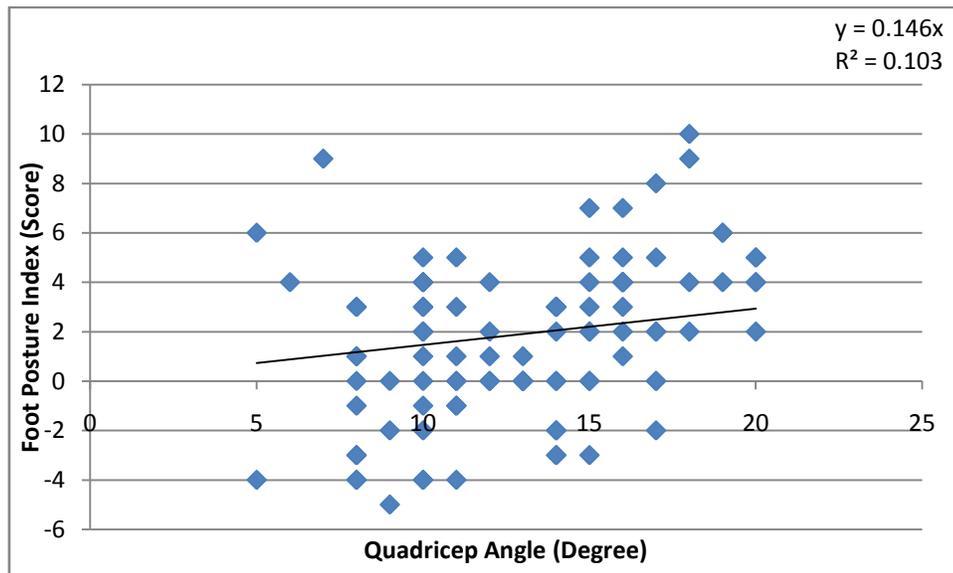
\*\* Correlation is significant at the 0.01 level (2-tailed).

**Table 2: Correlation between Quadriceps angle and foot posture index of right leg.**

		Q angle right	FPI right
Q angle right	Pearson Correlation	1	.583(**)
	Sig. (2-tailed)	.	.000
	N	99	99
FPI right	Pearson Correlation	.583(**)	1
	Sig. (2-tailed)	.000	.
	N	99	99

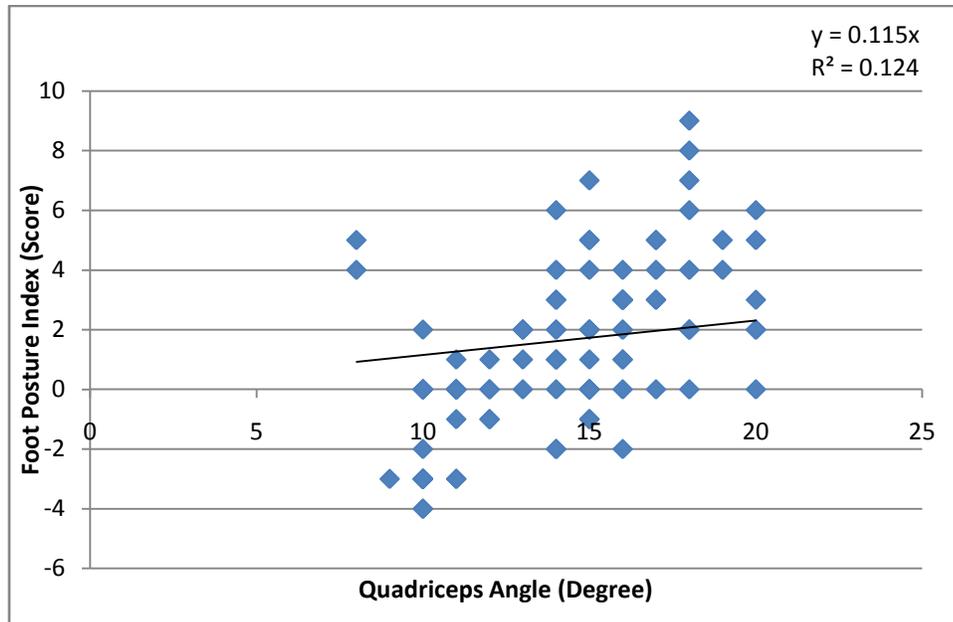
\*\* Correlation is significant at the 0.01 level (2-tailed).

**GRAPH 1 : Correlation of quadriceps angle with foot posture index of left leg**





**GRAPH 2: Correlation of quadriceps angle with foot posture index of right leg**



Corresponding Author E-mail address: [priti.lendghar@gmail.com](mailto:pritti.lendghar@gmail.com)