

Comparative Radiographic Analysis of Normal Hallux Valgus and Hallux Limitus Feet: An Institutional Based Study

Rajesh Kumar¹, Siddiqui Faiza Bano^{2*}

¹Assistant Professor, Department of Orthopaedics,
IQ City Medical College Hospital, Durgapur, Burdwan, West Bengal, India.

^{2*}Associate Professor, Department of Anatomy,
Gouri Devi Institute of Medical Sciences & Hospital, Durgapur, West Bengal, India.

ABSTRACT

Background: This study was conducted for comparative analysis of radiographic measurements in normal hallux valgus, and hallux limitus feet.

Materials and Methods: This study aimed to compare radiographic measurements between individuals with normal hallux valgus and those with hallux limitus. A total of 100 participants were included, comprising 35 individuals with hallux valgus, 35 with hallux limitus, and 30 healthy controls. Radiographs were taken on three separate occasions, capturing six dorsoplantar and six lateral weightbearing views to measure various angles and linear dimensions. The radiographs were meticulously cleared of any pencil annotations and were randomly remeasured after each session. All data were systematically recorded and analyzed using SPSS software.

Results: The study found that hallux valgus had greater hallux abductus and metatarsus primus adductus angles, while hallux limitus had higher hallux interphalangeal angles. Hallux valgus also showed increased first metatarsal protrusion distance and metatarsal breadth, but no significant differences were found in lateral radiographic measurements among the groups.

Conclusion: A greater angle at the hallux interphalangeal joint may serve as an indicator for the onset of hallux limitus, whereas an elongated first metatarsal is associated with the emergence of hallux valgus.

Keywords: Hallux Valgus, Hallux Limitus; Interphalangeal joint; Metatarsal; X-ray.


*Correspondence to:

Dr. Siddiqui Faiza Bano,
Associate Professor,
Department of Anatomy,
Gouri Devi Institute of Medical Sciences & Hospital,
Durgapur, West Bengal, India.

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INTRODUCTION

Many authors have referred in the podiatric and medical literature to an excessively long or excessively short first metatarsal as an aetiology of hallux valgus. Excessive length of the first metatarsal with respect to the second has been associated to hallux valgus¹⁻⁴ more often than has a short first metatarsal relative to the second.⁵ We also find authors who do not associate an alteration in the protrusion of the first metatarsal with hallux valgus.^{5,6}

When a first metatarsal bone is said to be excessively long in absolute length, it does not mean that it is longer than the second, rather than the first metatarsal is longer than normal, while still shorter than the second. The association of an excessive absolute length of the first metatarsal and the deformity of hallux valgus has been reported previously.⁷

However, there are also authors who state that in feet with this deformity, the first metatarsal is no longer than the second, rather

it has a greater relative protrusion.⁸ Hence; the present study was conducted for comparative analysis of radiographic measurements in normal hallux valgus, and hallux limitus feet.

MATERIALS AND METHODS

The present study was conducted for radiographic measurements of normal hallux valgus, and hallux limitus feet. The study involved a total of 100 participants, which included 35 individuals diagnosed with hallux valgus, 35 with hallux limitus, and 30 healthy control subjects. Comprehensive demographic and clinical data were gathered from all participants. A structured data collection form was employed to record detailed radiographic findings. Each participant underwent a standardized X-ray while positioned comfortably in a standing posture. Both groups, those affected by hallux valgus and hallux limitus, presented with

significant symptoms and signs of deformity in the first metatarsophalangeal joint, warranting corrective surgical procedures. Radiographs were obtained on three distinct occasions, capturing six dorsoplantar and six lateral weightbearing

views to assess various angles and linear measurements. The radiographs were carefully cleared of any pencil markings and were randomly remeasured following each session. All data were systematically recorded and analysed using SPSS software.

Table 1: Gender-wise distribution of subjects

Gender	Number of subjects	Percentage
Males	60	60%
Females	40	40%
Total	100	100%

Table 2: Comparison of radiographic variables

Radiographic variables	Hallux Valgus	Hallux Limitus	Controls	p-value
Hallux Abductus angle	26.7	13.8	10.3	0.012*
Hallux Interphalangeal angle	5.2	10.3	9.8	0.003*
Metatarsus adductor angle	18.9	17.9	17.5	0.15
Metatarsus Primus adductus angle	13.4	11.5	9.6	0.004*
Metatarsal width	93.1	85.2	89.4	0.04*
Metatarsal break angle	142.7	141.4	140.3	0.014*

*: Significant

RESULTS

A total of 100 individuals participated in the study, comprising 60 males and 40 females. The results revealed that the cohort with hallux valgus exhibited significantly greater hallux abductus and metatarsus primus adductus angles when contrasted with both the control group and the hallux limitus group. In contrast, the hallux limitus group displayed significantly higher hallux interphalangeal angles compared to the hallux valgus group. Furthermore, the hallux valgus group demonstrated a statistically significant increase in first metatarsal protrusion distance and metatarsal breadth when compared to both the control and hallux limitus groups. Nevertheless, lateral radiographic measurements did not indicate any significant differences among the groups.

DISCUSSION

Healthcare professionals involved in the treatment of foot and ankle disorders are confronted with a high prevalence of hallux valgus deformity. The prevalence of this deformity increases from 3.5% in a healthy population of adolescents to 35.7% in adults aged over 65 years.⁹⁻¹³ The most frequent complaint of patients with hallux valgus is pain as a result of pressure between the bunion and the shoe or between the first and second toe. Pain can also be caused by overloading the plantar aspect of one or more metatarsophalangeal joints.^{14,15} Hallux valgus and bunion are separate entities, in contrast to the lay use of the term bunion to equate hallux valgus. Elevated pressure on the skin as a result of inter-digital contact and shoe wear could also lead to ulceration. This is a serious complication in patients with insensate feet, for example due to diabetic neuropathy. These patients need specialised attention and adequate intervention.¹⁶ Some authors use the term 'clinical hallux valgus' when the deformation has developed to a certain severity that causes complaints.¹⁷ Hence, the present study was conducted for comparative analysis of radiographic measurements in normal hallux valgus, and hallux limitus feet at a tertiary care centre.

In a study conducted by Bryant A et al¹⁹, authors investigated the differences in weightbearing, foot radiographs among normal subjects, those with hallux valgus, and those with hallux limitus. An intrarater reliability study of various x-ray measurements was conducted, utilizing seven dorsoplantar and six lateral measurements. The results showed that metatarsus primus adductus, increased metatarsal width, and a positive first metatarsal protrusion distance were associated with hallux valgus, whereas increased hallux interphalangeal angle was associated with hallux limitus. Knox AF et al established whether any such differences exist. Dorsoplantar and lateral weightbearing radiographs of both feet in 30 patients with unilateral hallux limitus were assessed for grade of disease, lateral intermetatarsal angle, metatarsal protrusion distance, plantar gapping at the first metatarsocuneiform joint, metatarsal head shape, and hallux abductus interphalangeus angle. Mean radiographic measurements for affected and unaffected feet demonstrated that metatarsus primus elevatus, a short first metatarsal, first-ray hypermobility, a flat metatarsal head shape, and hallux interphalangeus were prevalent in both feet. There was no statistically significant difference between feet for any of the radiographic parameters measured. No significant differences exist in the presence of the structural risk factors examined between affected and unaffected feet in patients with unilateral hallux limitus.²⁰

CONCLUSION

In increased angle at the hallux interphalangeal joint may indicate the initial stages of hallux limitus, while an elongated first metatarsal is linked to the development of hallux valgus.

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