

# How Much Do Lesser Metatarsal Lengths Matter?

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## Introduction

Many foot and ankle surgeons believe that metatarsal length plays a large role in development of lesser pathology making it a factor for procedural selection. This belief has become commonplace and there is no sound biomechanical evidence to support this theory and in fact biomechanical studies using peak plantar pressure have shown there to be no correlation with metatarsal length and maximal peak plantar pressure. First ray insufficiency is likely the cause for the majority of cases (1). Addressing deformity of the medial column may relieve symptoms and address the primary etiology. We have conducted a retrospective review of metatarsal parabola measurements pre and post-operatively to investigate this idea further.

## Purpose:

The purpose of this study is to emphasize the importance of first ray stability and revisit the variability of lesser metatarsal length measurements. If we are using lesser metatarsal osteotomies to correct lesser metatarsalgia with a primary etiology of first ray insufficiency caused by a deviation in the biomechanics of the entire musculoskeletal system related to the center of gravity, we need further investigation to confirm this will even provide satisfactory outcomes in the long term by comparing outcomes. When the insufficient first ray support system is not corrected, surgical intervention to the lesser metatarsals may also lead to subsequent pathology of the digits and need for revisional correction in the future.

## Methods:

A database search through from 2008-2017 revealed 161 metatarsal cuneiform fusion procedures. Procedures from 2016 to early 2017 were used for the study data for a total of 29 modified lapidus procedures which were reviewed retrospectively to evaluate for metatarsal protrusion length preoperatively and postoperatively. All patient charts from our cohort were performed by the one surgeon. Nilsson's method of metatarsal protrusion measurement was used to evaluate preoperative and postoperative plain film radiographs with negative values indicating first metatarsal length shorter than second and positive values representing the vice versa (6). Many of these first ray stabilization procedures were accompanied by rearfoot alignment if necessary as well as correction of equinus when indicated.

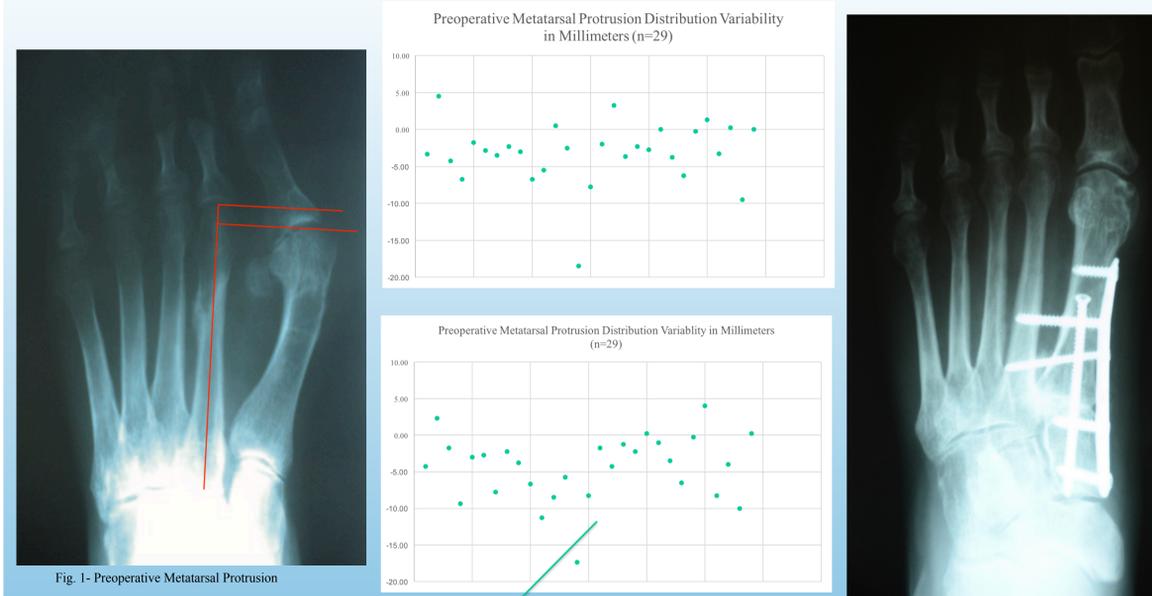


Fig. 1- Preoperative Metatarsal Protrusion



Fig. 3 - Demonstration of increased weight bearing pressure to the second metatarsal head in patient with HAV deformity, also note decrease in weight bearing load to the first metatarsal head indicating first ray insufficiency.



Fig. 4- Increased IM angle in HAV patient with first ray insufficiency and sub second metatarsal callus formation



Fig. 5- Lateral radiograph of patient with HAV deformity. Note the elevation of the first ray indicative of first ray insufficiency.

## Discussion

We found that the metatarsal protrusion distance postoperatively in patients addressed with medial column stabilization was outside the limits of what is viewed to be pathological according to some studies. Our preoperative plain film metatarsal protrusion distance average was found to be - 4.28 mm compared to -2.86 mm in the postoperative group. Based on some of the literature, this is considered to be outside range for non - pathological forefoot. Those with significantly high metatarsal protrusion values (approaching 9-10 mm), metatarsalgia of the lesser rays was not observed after stabilization of the first ray, correction of equinus and alignment of the rearfoot. Perhaps the underlying etiology of metatarsalgia in the majority of cases may be from increased IM angle, elevation of the first ray and contracture of the posterior muscle group in an attempt to compensate for lack of uniform sagittal plane forefoot propulsion through the gait cycle.

## Conclusion

Given the results that we have observed in our study related to reproducibility of the metatarsal parabola paradigm, we suspect that this system of evaluation may not be optimal for use in procedural selection. It has been supported in the recent literature as well that there is no biomechanical evidence for evaluation of parabola in relation to surgical planning. In addition to the question of etiology, there is also significant variance noted in previous literature regarding methods of measurement for measuring metatarsal length (2,3,4,5). If relative metatarsal length measurements are this variable, shouldn't we be focusing on an etiology that has been observed to have a much greater influence on forefoot and even global foot mechanics: the first ray? We anticipate continued discussion about this topic as well as additional evaluation from our patient database and use of advanced imaging (MRI, CT 3D reconstruction) to provide three dimensional perspective of the forefoot parabola paradigm.

## Sources

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