

# A Prospective Longitudinal Analysis into the Development and Progression of Structural First Metatarsal-Phalangeal Joint Pathology: Pilot data of an Initiated 50-year Investigation



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## Statement of Purpose and Literature Review

Most authoritative textbooks and articles report that both hallux abductovalgus (HAV) and hallux limitus/rigidus (HL) are structural deformities with a relatively young age of onset and slow developmental progression over the course of adult life. It has been documented that most adults report symptoms associated with these deformities between the third and fifth decades of life, with a mean age of surgical correction in the fifth and sixth decades [1-4]. However, any information derived from these and other investigations offer only a limited glimpse into the deformity because they are cross-sectional in nature. These also have an inherent selection bias, in that symptomatic individuals who undergo surgical intervention are primarily investigated as opposed to those with deformity who are less symptomatic or those who do not opt for surgical intervention. In fact, the author is unaware of any prospective longitudinal investigations of symptomatic and asymptomatic individuals which might provide more definitive information on deformity progression and the onset of symptoms.

This information could be of considerable clinical value with respect to patient education on expectations of deformity progression, and could also help guide physician decision making with respect to the timing of surgical intervention. For example, it is common in clinical practice for patients to present with relatively mild deformities which are not substantially symptomatic and ask questions such as "How much worse is this deformity going to get?", "What can I expect in terms of symptoms in the future?", "Should I have surgery now or later when it really becomes painful?". These are questions which physicians can answer based on their clinical experience certainly, but are without a foundation in evidence-based science. Understanding the actual structural pathogenesis of these processes might allow physicians to more accurately discuss potential specific surgical procedures and the timing of surgical intervention with patients.

**The primary objective of this investigation is to analyze the development and progression of structural deformity of the first metatarsal-phalangeal joint through serial biennial radiographs taken over the course of adult life. A secondary objective is to associate objective radiographic findings of deformity severity with the onset and course of subjective symptoms.**

## Methodology

Although admittedly a bit of an ambitious project, its completion might substantially add to the body of knowledge with respect to deformity of the first metatarsal-phalangeal joint. It is likely that a longitudinal study has not previously been completed because most foot and ankle surgeons would not be expected to have access to a large, relatively young, healthy and asymptomatic participant population with the ability to follow them with radiographs on a consistent basis over the course of adult life.

The two keys to successful completion of a project of this type would be 1) recruitment of a relatively large initial subject cohort whose age falls after the development of skeletal maturity but before the expected onset of deformity symptoms, and 2) subject retention over the duration of a prospective, longitudinal design. A cohort of podiatric medical students has two inherent characteristics which make them ideal for their participation in this study. First, most students come directly from their undergraduate education, and therefore are approximately 22 years of age. This puts them in a chronological window between skeletal maturity and the expected onset of the deformity. Second, by nature of their educational investment and training, most will be involved in the field of podiatric medicine/surgery for the duration of their working lifetimes. This implies that they would have at least some natural interest in seeing this investigation through to completion and have the resources available to perform standardized radiographic evaluations of their own feet regardless of their actual physical practice location.

Therefore, subjects will be recruited from consenting graduating students from the Temple University School of Podiatric Medicine (TUSPM). Inclusion criteria consists of fourth-year students of TUSPM, who have successfully completed their didactic and clinical education with passing grades, who are scheduled to graduate from TUSPM, who have matched with a residency program, and are between the ages of 18-30 years of age. Exclusion criteria consists of those with a history of first ray surgery or those less than age 18 or greater than age 30 during initial enrollment.

Subjects will have an initial set of weight-bearing DP and lateral radiographs taken at TUSPM. Following this, subjects will have these standard radiographs taken at their residency program and practice every two years for the next 50 years. These can be electronically transferred to the primary investigator (PI) regardless of practice location. Recorded radiographic measurements will be performed by the PI and will include the first intermetatarsal angle, hallux abductus angle, tibial sesamoid position, first metatarsal-cuneiform joint obliquity, and Coughlin/Shurnas degenerative joint disease classification. Subjects will also complete a survey on enrollment and every two years with respect to symptoms and function of their joints. And on enrollment, a detailed family history will be recorded with respect to the first metatarsal-phalangeal joint.

Although perhaps relatively young, the PI is not planning on living for another 50 years, so in a couple decades will pass off this project to a new, younger PI. IRB approval for this project was challengingly, but eventually, obtained.

## Results

This project was initiated in the Spring of 2018 with a total of 21 participants (42 joints) enrolled. Each TUSPM graduating class for the next 10 years (until the Spring of 2028) will be invited to participate in an effort to enroll several hundred total subjects. This means that a complete data set will not be obtained until the year 2078, but the PI plans to analyze and present data approximately every 10 years over this period of time.

Descriptive data of the initial enrollment group are as follows:

### Descriptive Demographic Data (n=21 participants; 42 joints)

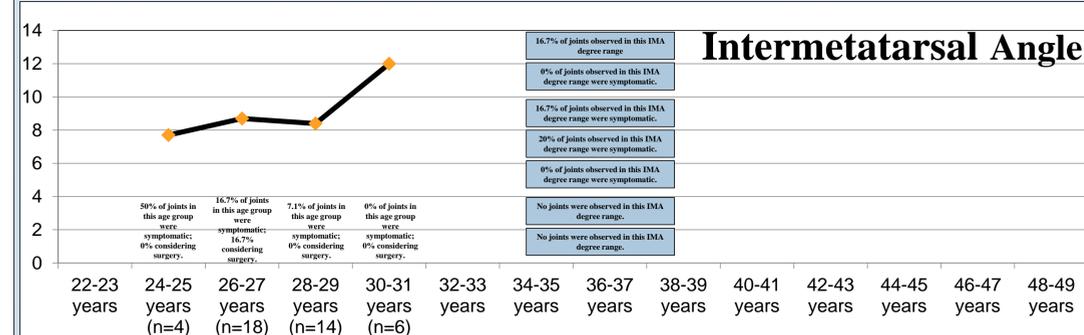
-Age: 27.3 ± 1.53 years (25-30)  
-Gender: 11/21 (52.4%) male

-Any current 1<sup>st</sup> MPJ symptoms?: 5/42 (11.9%)  
-Average VAS of any 1<sup>st</sup> MPJ symptoms? 0.21 ± 0.81 (0-4)  
-Are you considering surgery? 3/42 (7.1%)

-Any family history of 1<sup>st</sup> MPJ pathology?  
-Mother: 3/21 (14.3%) -Father: 2/21 (9.5%)  
-Siblings: 2/21 (9.5%)  
-Grandparents: 8/21 (38.1%)  
-Aunts/Uncles: 3/21 (14.3%)

-Intermetatarsal angle: 8.6 ± 1.6 degrees (5-12)  
-Hallux abductus angle: 10.6 ± 5.5 degrees (0.6-20.1)  
-Tibial sesamoid position: 2.0 ± 0.9 (1-4)  
-Coughlin/Shurnas grade: 0.5 ± 0.6 (0-2)

This graph represents an example of the types of data that are being collected for each radiographic measurement:



## Discussion

**The objectives of this study are to objectively analyze the development and progression of structural deformity of the first metatarsal-phalangeal joint, and to associate objective radiographic findings of deformity severity with the onset and course of patient symptoms. This will be done through a prospective longitudinal design occurring over the next several decades. The intention of this poster is to present preliminary data on the pilot cohort and declare the initiation of the study to our profession.**

## References

- [1] The Framingham Foot Studies including PubMed ID#s: 24040231, 26645379, 23861176, 24138804, 24965070.
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- [3] Thordarson D, Ebramzadeh E, Moorthy M, Lee J, Rudicel S. Correlation of hallux valgus surgical outcome with AOFAS forefoot score and radiological parameters. Foot Ankle Int. 2005 Feb; 26(2): 122-7.
- [4] Saro C, Jensen I, Lindgren U, Fellander-Tsai L. Quality of life outcome after hallux valgus surgery. Qual Life Res. 2007 Jun; 16(5): 731-8.