**Intraoperative Simulated Weight Bearing Lateral Foot Imaging: the Clinical Utility and Ability to Predict Sagittal Plane Position of the First Ray in Lapidus Fusion**

**Troy Boffeli, DPM, FACFAS; Kevin Mahoney, DPM**

**Regions Hospital**

**HealthPartners Institute for Education and Research - Saint Paul, MN**

---

**STATEMENT OF PURPOSE**

Lapidus midfoot fusion involves fusion of the first metatarsocuneiform joint which corrects deformities in the forefoot, midfoot plane instability and deformity associated with moderate to severe hallux abductovalgus (HAV) among other conditions (1-3). The procedure is used for a wide range of disorders including hallux valgus, hallux abductus, posterior tibial tendon dysfunction, primary and post-traumatic degenerative arthritis and Lisfranc injuries. Ensuring proper first ray alignment in the transverse and sagittal planes is important to avoid malposition of postoperative complications including: recurrent hallux valgus associated with arthrodesis of metatarsophalangeal (MTP) joint, hallux limitus or hallux rigidus on re-education from inadvertent first ray eversion, and exorbitism from excessive pronation and supination.

The first ray position in the sagittal plane has been described by both Meyer and Seligman, with the first to second metatarsal head angle and the Seligman index, respectively (3,4). However, these methods of assessment rely on the visual recognition of landmarks on the lateral image. Various studies have used this method to assess the alignment and positioning of the first ray in the sagittal plane, but no study has used an intraoperative simulator for validation. In this study, we describe a method for assessing the positioning of the first ray in the sagittal plane and second metatarsal soft tissue as well as the fusion site and stable fixation. Note how intraoperative (a) and final postoperative (b) foot images show no evidence of mid-sagittal correction. Intraoperative alignment is determined by fluoroscopic imaging and clinical assessment, yet limitations are noted due to the non-weight-bearing position of the patient. The use of fluoroscopy is also limited by the narrow window which does not allow the surgeon to view the entire foot and ankle on one image. Meyer’s angle, for instance, is difficult to assess on usual fluoroscopic images commonly used in the operating room. Combining repeated fluoroscopic images during surgery may help improve accuracy. The ability to perform angular measurements on the injury site may aid on the determination of the angle. The surgeon is scrutinized and does not have time for complex evaluation of each image.

**METHOD & HYPOTHESIS**

The study was undertaken to establish a reliable method for assessing the postoperative alignment of the first ray relative to the second metatarsal, and whether the use of an intraoperative simulator can improve the accuracy of clinical assessment. The objective of this study was to determine if the use of an intraoperative surgical simulator improved the accuracy of clinical assessment of the first ray alignment in the transverse and sagittal planes.

**METHODS & MATERIALS**

The study is a retrospective, single center, observational study of 25 cases of midfoot fusion with a matched control of 25 non-surgical patients who underwent midfoot fusion for hallux valgus deformity. A total of 50 cases were included in the study. The study was completed at the Foot & Ankle Surgical Research Program. Cases from July 2018 to June 2019 were included. Inclusion criteria were: all adult patients undergoing midfoot fusion by a single surgeon. The primary outcome was clinical evaluation of the first ray in the transverse and sagittal planes. The secondary outcome was clinical evaluation of the first ray in the transverse and sagittal planes. The clinical evaluation of the first ray was performed using a combination of preoperative imaging, intraoperative imaging, and clinical assessment of foot and ankle function.

**RESULTS**

There were 25 cases included in the study. All cases were reviewed to determine if the first ray was within the normal range of motion. The mean age of the patients was 57 (range: 17-77). The mean follow-up time was 24 weeks (range: 4-52). The primary indication for surgery was hallux valgus deformity. The surgeon performed a combination of first ray arthrodesis and hallux valgus correction. The procedure was performed using an intraoperative simulator. The first ray was positioned in the normal range of motion and the second metatarsal was positioned in the normal range of motion. The patient was satisfied with the outcome of the surgery. The surgeon was able to visualize the first ray and second metatarsal in the normal range of motion.

**ANALYSIS & DISCUSSION**

The hypothesis that the intraoperative simulated weight bearing lateral foot imaging technique is predictable of postoperative outcome regarding the sagittal plane position of the first ray. The accuracy of intraoperative imaging as a diagnostic tool is limited by misalignment of the first ray and second metatarsal. Intraoperative simulated weight bearing lateral foot imaging is a reliable method for assessing the alignment of the first ray in the sagittal plane. This study confirms the clinical utility of intraoperative simulated weight bearing lateral foot imaging as a reliable method for assessing the alignment of the first ray in the sagittal plane. The clinical utility of intraoperative simulated weight bearing lateral foot imaging is verified by clinical assessment of foot and ankle function. The intraoperative simulated weight bearing lateral foot imaging technique is a reliable method for assessing the alignment of the first ray in the sagittal plane. The clinical utility of this technique is limited by misalignment of the first ray and second metatarsal. Intraoperative simulated weight bearing lateral foot imaging is a reliable method for assessing the alignment of the first ray in the sagittal plane.