

## Percutaneous Metatarsophalangeal Fusion – Joint Preparation and Structures at Risk

Zuhair J. Mohammed<sup>1</sup>, Matthew McCrosson<sup>1</sup>, Robert W. Rutz<sup>1</sup>, Matthew Yeager<sup>1</sup>, Mathew Hargreaves<sup>1</sup>, Mila Scheinberg<sup>1</sup>, Shrey Nihalani<sup>1</sup>, Swapnil Singh<sup>1</sup>, Ashish Shah<sup>1</sup>

<sup>1</sup>University of Alabama at Birmingham, Birmingham, AL  
zuhair.j.mohammed@gmail.com

**Disclosures:** Zuhair J. Mohammed (N), Matthew McCrosson (N), Robert W. Rutz (N), Matthew Yeager (N), Mathew Hargreaves (N), Mila Scheinberg (N), Shrey Nihalani (N), Swapnil Singh (N), Ashish Shah (N)

**INTRODUCTION:** The treatment of first metatarsophalangeal (1-MTPJ) joint pathologies, such as hallux rigidis and hallux valgus, often involves arthrodesis. Traditional open surgical approaches have been associated with significant soft tissue trauma and post-operative complications. Recent advancements in foot and ankle surgery have introduced minimally invasive techniques, including percutaneous approaches using the Shannon burr, which promise reduced trauma to surrounding structures and improved post-operative outcomes. However, limited literature exists on the efficacy of the Shannon burr in joint preparation.

**METHODS:** This study utilized 11 fresh frozen cadaver foot and ankle specimens to evaluate 1-MTPJ joint surface preparation with the Shannon burr. Joint preparation was performed using a percutaneous approach, and joint surfaces were subsequently examined through dissection. Image analysis using ImageJ software was conducted to measure the joint surface area prepared on both the distal metatarsal and proximal phalanx articular surfaces. Following joint preparation, dissection was carried out to locate and evaluate critical soft tissue structures in the vicinity of the 1-MTPJ, including the extensor hallucis longus (EHL) tendon, medial dorsal cutaneous nerve (MDCN), and lateral dorsal digital artery (LDA). Measurements from the surgical site to these critical structures were recorded.

**RESULTS SECTION:** The average percentage of joint preparation for the distal first metatarsal was 71.8% (+/- 24.0%), and for the proximal first phalanx was 78.2% (+/- 19.8%). There was no statistically significant difference in joint preparation percentage between both surfaces ( $p = 0.507$ ). The raw joint surface area prepared on the metatarsal and phalangeal surfaces was 215.24 mm<sup>2</sup> and 187.98 mm<sup>2</sup>, respectively. Contact with the LDA and EHL occurred three times each out of the 11 procedures (27%) through the dorsal-lateral approach without macroscopic laceration. The MDCN was contacted three times (27%) via the medial approach without macroscopic laceration and transected once (9%).

**DISCUSSION:** This study shows that percutaneous 1-MTPJ arthrodesis using the Shannon burr offers comparable joint surface preparation to other minimally invasive techniques, however, inferior joint preparation compared to open techniques. The choice between minimally invasive and open approaches should be based on the patient's individual characteristics and post-operative goals. This study also emphasizes the importance of understanding local anatomy and maintaining surgical precision during percutaneous 1-MTPJ fusion using a Shannon burr. Future studies with larger in vivo sample sizes are warranted to further refine the percutaneous approach and enhance patient outcomes.

**SIGNIFICANCE/CLINICAL RELEVANCE:** This study examines both joint preparation and soft-tissue damage in percutaneous MTP fusion using a Shannon burr, providing insight into the efficacy of such a device. This shows similar outcomes to other arthroscopic and minimally invasive techniques.

### IMAGES AND TABLES:

Figure 1. Prepared joint surfaces of the (a) distal first metatarsus and (b) proximal first phalanx

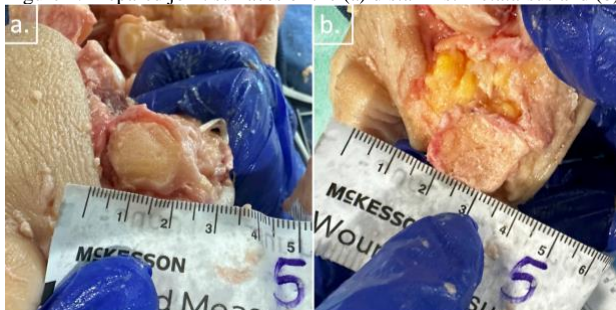


Figure 2. Box and whisker plot of surface area prepared.

