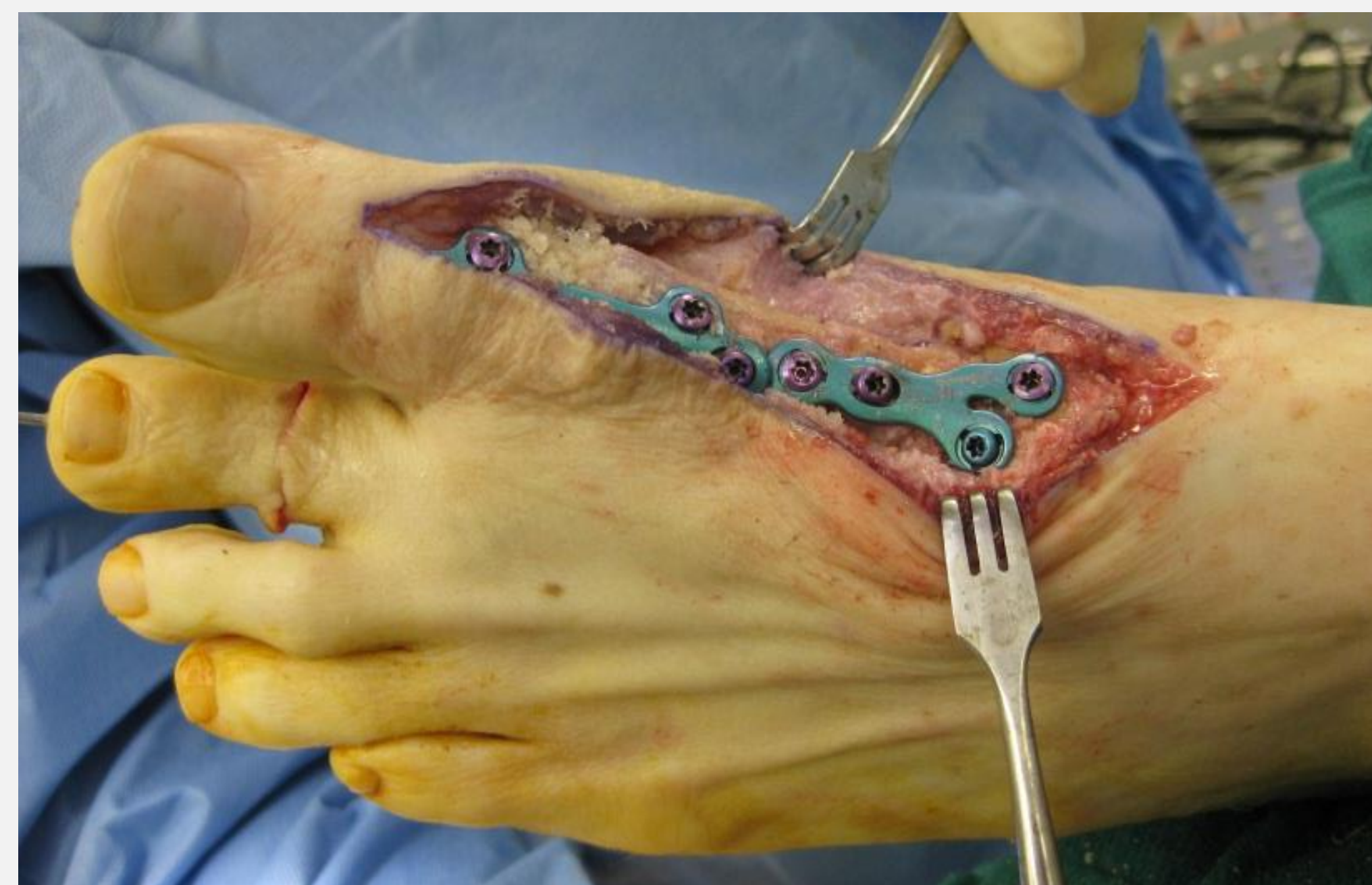
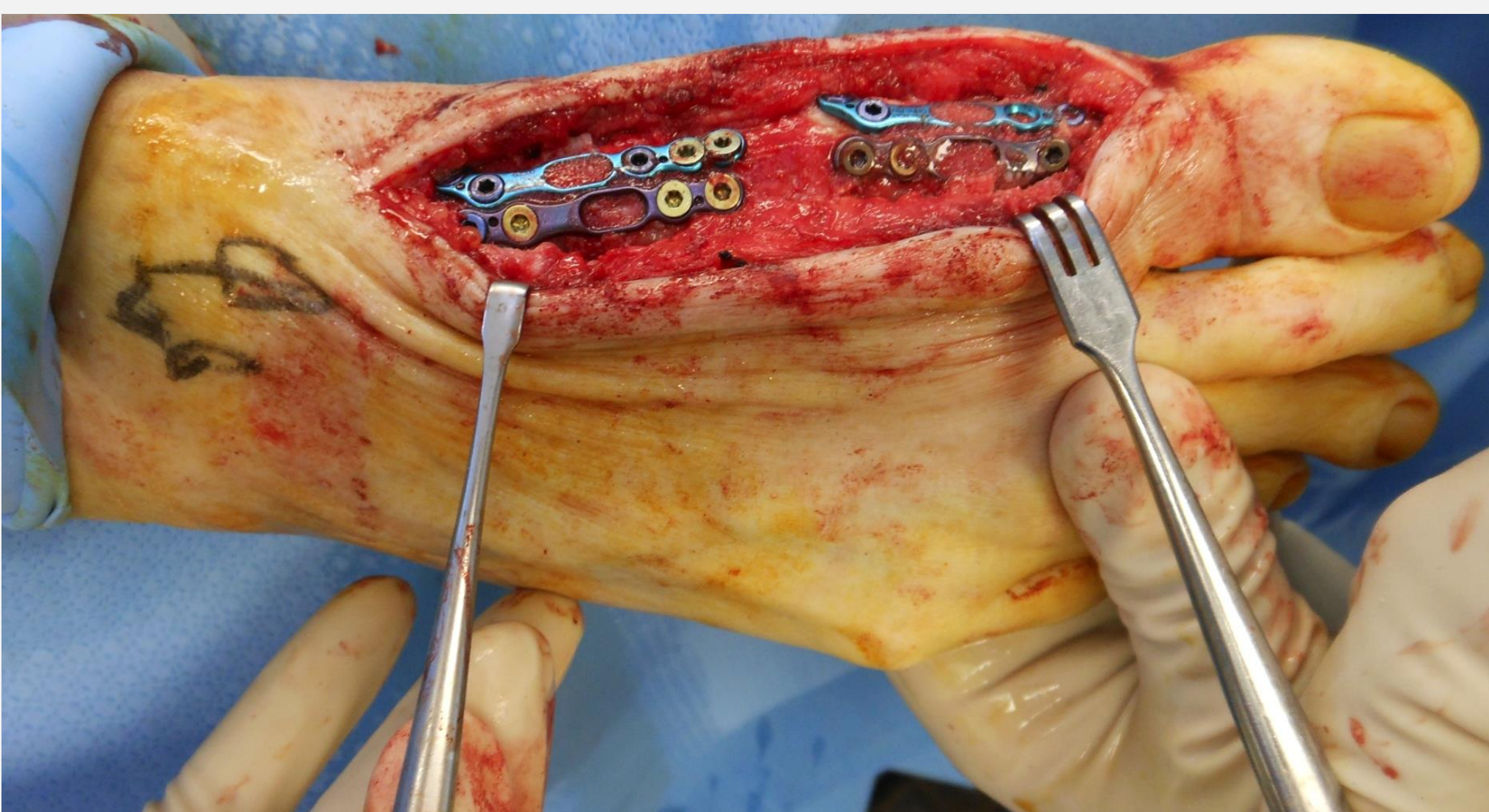


## Purpose

Performing an arthrodesis in the foot and ankle has many benefits, and can be a positive solution to a variety of joint pathology. The purpose of our study is to do a retrospective review of patients who received the double fusion, and report on the occurrence and variety of complications that occurred from the combined procedures.

## Methods/ Hypothesis

A retrospective chart review was performed on 28 patients, 17 male and 11 female. The average age of our patients was 53 years. The follow up on patients ranged from 26 to 130 months. The methods used to determine factors in complications were whether the patient smoked, their body mass index (BMI) percentage, medical co-morbidities, graft versus non-graft, previous fusion surgery, if the patient had existing hallux extensis or interphalangeal joint (IPJ) arthritis, time to radiographic union and time to return to shoes and full weight bearing. The patient was asked throughout the postoperative period if they were smoking and if they had smoked through the postoperative period. The patient's BMI and medical co-morbidities were gathered from past medical history on the patients' initial presentation to the clinic. Operative reports were reviewed to determine whether a graft was used or not. The patient's past surgical history was reviewed from the patient's initial presentation to the clinic. Preoperative and postoperative x-ray findings were assessed by three board certified surgeons for IPJ arthritis, hallux extensis, mal-union, mal-position, nonunion, and determining complete union. The complications assessed for the double fusion procedure were amputation, osteomyelitis, nonunion, mal-position, mal-union, failed hardware, superficial and deep infection, hematoma/seroma, dehiscence, metatarsalgia and IPJ arthritis. We divided the complications into major and minor categories. Major complications were defined as amputation, osteomyelitis, and nonunion. Minor complications were defined as mal-position, mal-union, failed hardware, superficial/deep infection, hematoma/seroma, dehiscence, metatarsalgia, and hallux IPJ arthritis. All complications were gathered from chart review and x-ray reports. A two-tail paired T-test was used to determine p-values and statistically significant factors.



## Procedure

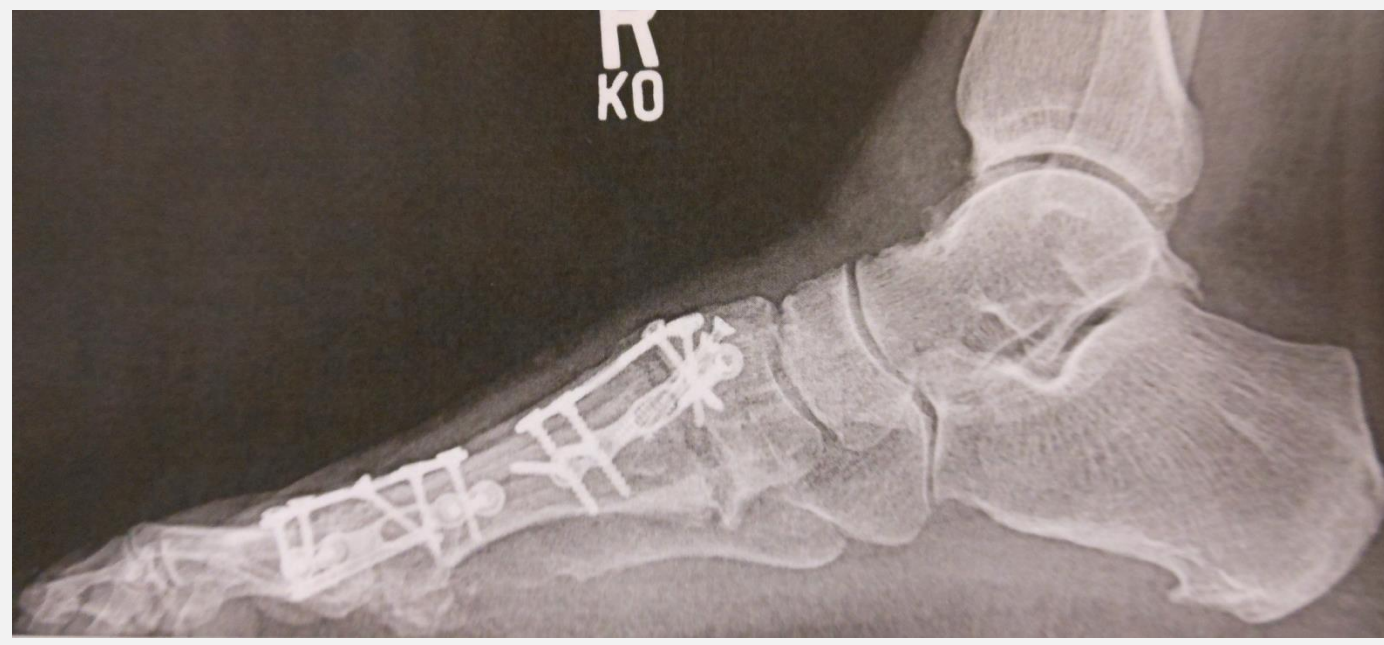
A fusion of the 1<sup>st</sup> metatarsal-cuneiform joint was performed in conjunction with a 1<sup>st</sup> metatarsophalangeal joint fusion in patients with a variety of pathology in these respective joints. The selection and amount of hardware used for fixation was dependent on bone quality, weight of the patient, and compliance of the patient.

## Literature Review

The first tarsometatarsal joint (TMTJ) fusion procedure is a well-known solution to many conditions such as hypermobility syndrome, hallux limitus, hallux valgus, medial column stabilization with pes planus and arthrosis of the first TMTJ (1). The consequences of these conditions often affect not only the TMTJ but the 1st metatarsophalangeal joint (MTPJ) as well. Many etiologies of 1st MTPJ destruction are the result of 1st TMTJ pathology, such as hypermobility, pes planus foot type, hallux valgus and hallux rigidus (2, 3). The purpose of 1st MTPJ and 1st TMTJ arthrodesis is elimination of pain with functional ambulation. These procedures are rarely performed in conjunction with one another, and to our knowledge, there is no substantial literature reporting results of the double fusion. (4)

## Results

Of the 28 patients reviewed, four were smokers and had smoked throughout their surgical and postoperative treatment, the average BMI was 24.5%, three patients had Down syndrome, five had rheumatoid arthritis, two had diabetes and two had traumatic arthritis. Twelve patients received a bone graft, six patients had previous surgery, eight patients had prior hallux extensis and IPJ arthritis, the average time to radiographic union was 9.5 weeks, and average time to full weight bearing and return to shoes was 11.1 weeks. Of the complications reviewed six had malposition, four non-unions, eight mal-unions, four failed hardware, no superficial or deep infections, no hematomas or seromas, one dehiscence, four with metatarsalgia and eight with IPJ arthritis. Overall, 42.9% of patients had no complications. Eight of the twelve patients who received grafts had no complications, whereas only four of the sixteen patients who did not receive a graft were without complications. 50% of the smokers had no complications. All Down syndrome patients had at least one complication. Half of the diabetic patients had no complications. The one cerebral palsy patient had at least one complication. 60% of rheumatoid and 50% of trauma patients had no complications. 64.3% of patients had no osseous complications. Of the soft tissue complications assessed, only one patient had a dehiscence. 10% of patients resulted in acquiring hallux IPJ arthritis. Only 14.3% of patients had a major complication, that being a nonunion. Patients who had a graft placed did significantly better than patients who didn't (p= 8.8x 10<sup>-6</sup>). Patients who received a graft had a significant decrease in mal-union (p= 1.4x 10<sup>-7</sup>), mal-position (p= 4.3x 10<sup>-6</sup>), IPJ arthritis (p= 9.2x 10<sup>-7</sup>), failed hardware (p= 1.8x 10<sup>-5</sup>), and non-union (p= 2.0x 10<sup>-7</sup>).



## Analysis/ Discussion

The double fusion technique resulted in only 14.3% of patients having a major complication, that being a nonunion. 96% of patients were free of any soft tissue complication. No amputations or cases of osteomyelitis were found. These are two procedures that require meticulous and careful dissection to preserve the blood supply and accurate placement for optimal position to have a successful outcome of a functional painless foot (5). We understand that positioning in this procedure is difficult. Historically, placing the TMTJ in a slightly plantarflexed, laterally reduced and neutral position and MTPJ in a slightly dorsiflexed, abducted and neutral position has been difficult with the various foot types surgeons see (6). We have found, just as surgeons that routinely perform these fusions, that there is not one optimal position that fits all feet. Rear foot alignment and forefoot positioning, including rigidity and laxity of the foot need to be taken into consideration when final placement is chosen to accommodate a double fusion. The surrounding joint arthritis must also be considered. After positioning the TMTJ fusion, the surgeon must make a decision for the correct alignment of the 1st MTPJ fusion. When a joint is fused in the foot, we often find the formation of arthritis in proximal or distal joints, as the body adjusts to finding the adequate range of motion it needs. Osteoarthritis can be found in the 1st MTPJ after a TMTJ fusion. In patients with rheumatoid arthritis, it makes sense to fuse the 1st MTPJ and the 1st TMTJ with the existing arthritis present. The authors were pleased to find that only 10% of the patients developed hallux IPJ arthritis, after two fusion procedures along the medial column. Although our Down syndrome and rheumatoid patients had complications, all of these patients could not comfortably fit into a shoe and ambulate without significant discomfort before surgical intervention. After the procedure, all of these patients could ambulate comfortably and regained good lower extremity function. What made a significant difference was comparing those patients who received a graft to those who didn't, and the osseous complications that occurred. We found a significant decrease in mal-position, mal-union, nonunion, failed hardware, and IPJ arthritis when a graft was used for the fusion. All patients but one were pleased with their overall surgical results, and would have the double fusion again. We note that there exist limitations to this study. The fixation of the arthrodesis varied from patient to patient. Whether the graft was used in one or both joints. What type of graft was used, autograft or allograft. Our number of patients was relatively small. Literature on these two fusions performed at the same time was also minimal, which made it difficult to compare findings with current research.

We conclude that a double fusion technique of the 1st MTPJ and 1st TMTJ can be an effective solution to multiple painful pathologies, and should be performed with a graft for optimal results. We also appreciate that this is not a primary procedure of choice for most pathology, and that this procedure should be reserved for severe pathology and revision surgery.

## References

1. Blitz NM. The versatility of the lapidus arthrodesis. Clin Podiatr Med Surg 2009; 26:427-441.
2. Rajczy RM, McDonald PR, Shapiro HS, Boc SF. First metatarsophalangeal joint arthrodesis. Clin Podiatr Med Surg 2012; 29:41-49.
3. Root M, Orien W, Weed J. Normal and abnormal function of the foot. Los Angeles (CA): Clinical Biomechanics 1977.
4. Treadwell JR. First metatarsophalangeal joint arthrodesis: What is the best fixation option? A critical review of the literature. Clin Podiatr Med Surg 2013;30:327-349
5. Anderson JJ, Jeppesen N, Hansen MH, Brady C, Gough A, Fowler Z. First Metatarsophalangeal Joint Arthrodesis: Comparison of Mesenchymal Stem Cell Allograft versus Autogenous Bone Graft Fusion Rates. Surg Sci, 2013;5(4):263-267.
6. Anderson JJ, Hansen MH, Rowe GP, Swayzee Z. Complication Rates in Diabetics with First Metatarsophalangeal Joint Arthrodesis. Diabetic Foot Ankle, 2014;27(5).