

# Arthrodesis of the Fourth and Fifth Tarsometatarsal Joints in a Sensate Patient with Post-Traumatic Arthritis

## A Case Report and Surgical Technique

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Lateral column arthrodesis of the tarsometatarsal joints is a highly controversial topic in foot and ankle surgery, with minimal prospective research and reproducible findings in the current literature. Arthrodesis of the lateral fourth and fifth tarsometatarsal joints, when performed, is most often done secondary to post-traumatic osteoarthritis or Charcot's neuroarthropathy deformity. This case report focuses on arthrodesis of the lateral column in a patient with post-traumatic osteoarthritis from a previously sustained Lisfranc fracture-dislocation. The patient also experienced a cavus foot deformity that was addressed with a lateral displacement calcaneal osteotomy. Arthrodesis of the fourth and fifth tarsometatarsal joints was found to be successful on this patient, with bony union noted to occur radiographically 12 weeks postoperatively. In addition, the patient experienced significant reduction in her preoperative pain and an ability to return to activities of daily living. Regular visits during an 18-month postoperative period occurred, with the patient continuing to have satisfactory results and a significant reduction in preoperative pain levels. One postoperative complication was encountered 15 months postoperatively: painful hardware, which resulted in the removal of both calcaneal screws and one screw from the fourth tarsometatarsal arthrodesis site. This case report proposes that lateral column arthrodesis may be performed successfully in select patients where other joint-preserving procedures may not be applicable. Herein we outline a suggested surgical technique with hardware that can be used to reproduce these findings and assist surgeons who are unfamiliar with performing this procedure. (J Am Podiatr Med Assoc 113(2), 2023)

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Lisfranc injuries are a relatively uncommon fracture pattern accounting for approximately 0.2% of all fractures.<sup>1</sup> Injuries specifically to the fourth and fifth tarsometatarsal joints are usually associated with Lisfranc fracture-dislocation and resultant post-traumatic osteoarthritis. Ouzounian and Shereff<sup>2</sup> reported approximately 10° of sagittal plane motion in the fourth and fifth tarsometatarsal joints, which has been reported to allow individuals better accommodation on uneven terrain. Given that the fourth and fifth tarsometatarsal joints are an independent unit that afford a great deal of mobility to the midfoot, arthrodesis

of the lateral column has been controversial in the literature.<sup>3</sup>

Various studies showing the importance of preserving motion in the lateral column are available.<sup>4-8</sup> This has led to the general thought that normal gait patterns require the preservation of range of motion in the fourth and fifth tarsometatarsal joints. However, when patients develop arthritic changes to the fourth and fifth tarsometatarsal joints, severe pain and deformity result, with few surgical options offering realistic relief. There has been minimal research on arthrodesis of the lateral column, with varying degrees of successful, reliable, and reproducible results. However, most recently, the largest cohort study pertaining to lateral column arthrodesis by Derner et al<sup>9</sup> specifically evaluated a patient population consisting of neuropathic and painful post-traumatic arthritic patients, with results including significantly decreased pain and low revision rate incidences, offering a promising outlook for the procedure. The purposes of this study were to evaluate a

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successful case of lateral column arthrodesis in a sensate patient who had experienced a previous Lisfranc fracture-dislocation, to outline a surgical technique guide, and to suggest useful hardware for surgeons who want to incorporate this procedure into their practice.

## Case Report

A 68-year-old woman with a medical history of hypertension presented with an antalgic gait, noting primarily pain along the right lateral foot. In 2009, the patient sustained a Lisfranc fracture-dislocation secondary to a motor vehicle accident. The patient underwent initial open reduction and internal fixation by an outside physician to stabilize the first, second, and third tarsometatarsal joints. The patient subsequently had an operation to remove the hardware from the initial procedure, followed by arthrodesis of the first, second, and third tarsometatarsal joints. A third procedure was performed to remove painful hardware. The patient never experienced full relief of her symptoms and sought a second opinion in our office. The patient noted difficulty walking and performing activities of daily living. Clinically, the patient had pain on palpation of the fourth and fifth tarsometatarsal joints as well as pain with range of motion across these joints. Plain film radiographic imaging revealed complete consolidation of the medial column arthrodesis sites with significant osteophyte formation and severe arthritic changes of the fourth and fifth tarsometatarsal joints (Fig. 1). In addition, plain film radiographs and clinical evaluation demonstrated a cavus foot position (Fig. 1). Computed tomography confirmed these findings (Fig. 2). Conservatively, three corticosteroid injections were attempted into the fourth and fifth tarsometatarsal joints, providing minimal relief for a brief period. Custom orthotic devices and custom ankle-foot orthoses were trialed but ultimately did not provide sufficient relief of pain or improvement in her gait. Given the advanced arthritis of the lateral tarsometatarsal joints, salvage procedures were not feasible and arthrodesis of the fourth and fifth tarsometatarsal joints was performed. Regarding the cavus foot position, a lateral calcaneal displacement osteotomy was performed (Fig. 3). The patient remained nonweightbearing for 6 weeks in a posterior splint after surgical correction and then transitioned to weightbearing in a fracture boot for an additional 6 weeks. After 12 weeks the patient began to bear weight as tolerated in a sneaker and returned to all daily activities.

At 12 weeks postoperatively, plain film radiographs demonstrated complete arthrodesis site consolidation (Fig. 4). The patient described pain in her heel along the incision for the calcaneal screws and at a palpable screw head on the dorsolateral foot. An elective hardware removal procedure was performed 15 months after the index procedure (Fig. 5). At a total of 18 months postoperatively, she has returned to all activities and regular footwear with significant reduction in preoperative pain levels.

## Surgical Technique

The patient was placed in the supine position with an ipsilateral hip bump and a nonsterile tourniquet on the thigh. General endotracheal anesthesia with a regional foot and ankle block was performed. The limb was exsanguinated and the thigh tourniquet raised to 300 mm Hg.

Intraoperative fluoroscopy was used to ensure correct operative positioning and incision placement. A 5-cm curvilinear incision was performed along the dorsolateral foot extending from the calcaneocuboid joint proximally to the interspace between the fourth and fifth tarsometatarsal joints distally. This was followed by blunt dissection down to the fourth and fifth tarsometatarsal joints. The intermediate dorsal cutaneous nerve was carefully dissected, preserved, and reflected along with the extensor digitorum brevis muscle belly. The fourth and fifth tarsometatarsal joints were noted to be severely arthritic, with a significant amount of sclerosis and osteophyte formation.

A Hintermann retractor was used for joint distraction, and the joint surfaces were prepared in standard fashion using curettage. Once bleeding cancellous bone was noted, fenestration with a Kirschner wire was performed to all joint surfaces. Joints were placed in an adequate position for fusion, with the anatomical alignment of the fourth and fifth tarsometatarsal joints preserved. Bone matrix allograft biologics were applied to the arthrodesis sites, and the joints were compressed using a bone reduction clamp. One 3.5-mm cannulated screw was placed from the base of the fifth metatarsal into the cuboid from distal plantar lateral to proximal dorsal medial. Another 3.5-mm cannulated screw was placed from the base of the fourth metatarsal into the cuboid, perpendicular to the joint. One T-shaped plate was applied across the fourth tarsometatarsal joint arthrodesis site and secured with a combination of 2.4-mm locking and non-locking screws; a contralateral anatomical fifth metatarsal base plate was contoured and secured



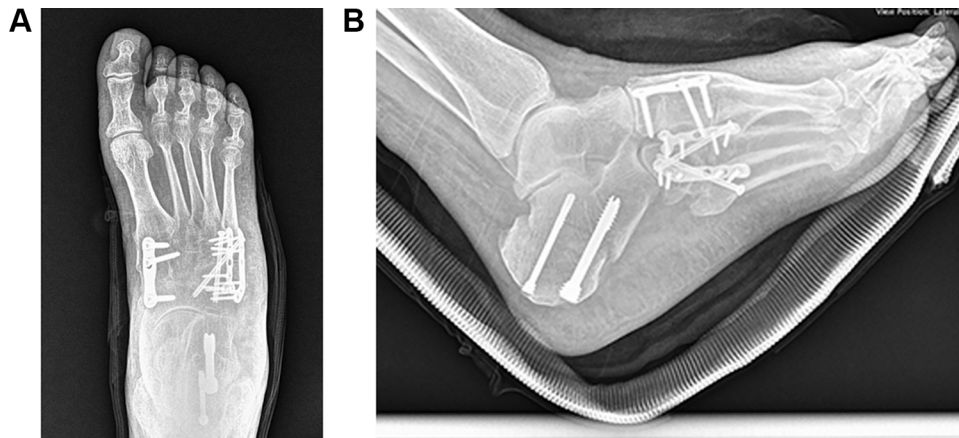
**Figure 1.** Preoperative weightbearing dorsoplantar (A), medial oblique (B), lateral (C), and calcaneal axial (D) foot plain film radiographs demonstrating severe arthritic changes of the fourth and fifth tarsometatarsal joints as well as a cavus foot type with an increase in the calcaneal inclination angle and a varus attitude of the calcaneus. Clinical photograph (E) demonstrating the right heel during resting calcaneal stance position.

with 2.4-mm locking and nonlocking screws across the fifth tarsometatarsal joint arthrodesis site dorsolaterally. Across both joints, three screws were placed proximally and two screws were placed

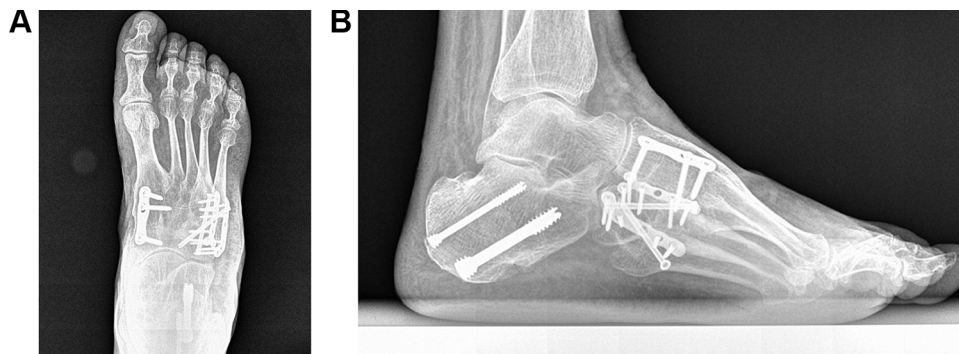
distally in the plate. A lateral calcaneal displacement osteotomy was also performed of the hind-foot, translating the proximal calcaneal fragment 1 cm laterally. This was fixated with cannulated,



**Figure 2.** Preoperative axial (A) and sagittal (B) computed tomography scans demonstrating cystic changes, joint space narrowing, and subchondral sclerosis across the cuboid and the fourth and fifth metatarsal bases.



**Figure 3.** Immediate 7-day postoperative nonweightbearing dorsoplantar (A) and lateral (B) foot plain film radiographs showing intact hardware of the fourth and fifth tarsometatarsal joint arthrodesis and lateral displacement calcaneal osteotomy.



**Figure 4.** Twelve-week postoperative weightbearing dorsoplantar (A) and lateral (B) foot plain film radiographs demonstrating successful union of the fourth and fifth tarsometatarsal joints with intact hardware at the arthrodesis site and lateral calcaneal slide osteotomy.



**Figure 5.** Final postoperative nonweightbearing medial oblique (A) and lateral (B) foot plain film radiographs after removal of the fourth tarsometatarsal joint interfragmentary screw and two calcaneal screws.

partially threaded 7.0- and 4.5-mm screws. After reapproximation of the incision sites, a posterior splint was applied to the lower extremity in standard fashion.

## Discussion

Normal gait patterns are believed to require preservation of the fourth and fifth tarsometatarsal joints. Findings from the cadaveric biomechanical study by Ouzounian and Shereff<sup>2</sup> show that tarsometatarsal motion is greatest in the lateral two rays. In efforts to maintain this motion, numerous procedures have been attempted over the years consisting of joint debridements and osteophyte removal procedures, joint interposition of soft-tissue structures, and synthetic ceramic spherical joint spacers in an attempt to avoid fusion.<sup>5-8</sup> Some of these studies showed promising initial findings but failed to have long-term satisfactory follow-up.

Recent literature has shown promising results for arthrodesis of the fourth and fifth tarsometatarsal joints.<sup>9,10</sup> As noted by Derner et al,<sup>9</sup> many patients with joint salvage procedures are likely to have an increase in pain with improved motion after years of arthritis. In this case study, the patient was fully sensate and the arthritis was from a previous Lisfranc injury, not Charcot's neuroarthropathy. Our belief was that motion had been restricted in the lateral column for many years and that performing a joint salvage procedure would have likely led to increased pain and need for future revisions. The patient had severely limited range of motion of the lateral column, and the hope was that arthrodesis would allow a reduction in pain, thereby improving her gait and activities of daily living.

Given the rarity of this procedure there are no anatomical plates that can be placed over the unique shape of the fifth tarsometatarsal joint.

Therefore, we used a left-sided fifth metatarsal base fracture plate for a right-sided fifth tarsometatarsal joint fusion. We found that inverting this plate from its intended use provided a plate that nicely followed the curvature of the fifth tarsometatarsal joint. We used a standard T-plate construct for the fourth tarsometatarsal joint. We also used an interfragmentary screw for both joints because we felt that this provided a superior construct. In addition, this patient had a cavus foot type with fusions of the first, second, and third tarsometatarsal joints; therefore, a lateral calcaneal slide osteotomy was performed. This procedure was selected to decrease loading of the lateral column, preventing future hardware failure and stress risers (Fig. 3). In addition, the patient noted pain isolated to the lateral column; therefore, we believed that a midfoot cavus surgical reconstruction was not indicated.

At 15 months postoperatively, the patient noted pain at the calcaneal osteotomy screw insertion site and at the calcaneocuboid joint. Both of these issues were thought to be related to painful hardware, and so the interfragmentary screw from the fourth tarsometatarsal joint and the calcaneal osteotomy screws were removed (Fig. 5). The patient reported a reduction in pain after hardware removal. Eighteen months after surgery, no hardware failures or nonunions have developed from the fusion sites, and there was successful correction of cavus deformity (Figs. 4 and 6). The patient is walking with a significant reduction in her preoperative pain levels and full return to activities of daily living.

This is a single case; therefore, it offers the limitation of being difficult to extrapolate concrete significant data. Although we offer one successful hardware technique, there are likely further options available to surgeons that would offer comparable results.



**Figure 6.** Six-month postoperative clinical photograph showing the right heel corrected into a rectus position during resting calcaneal stance position.

## Conclusions

We presented a case study of a sensate patient with a history of Lisfranc fracture-dislocation originally treated by open reduction and internal fixation of the first, second, and third tarsometatarsal joints followed by a revisional arthrodesis of the first, second, and third tarsometatarsal joints who subsequently developed severe arthritis and pain of the lateral column joints. We performed an arthrodesis of the fourth and fifth tarsometatarsal joints and a lateral calcaneal slide osteotomy to address a cavus foot deformity. The patient had satisfactory results, and at 18 months the only postoperative complication she had experienced was painful hardware that resolved on removal of select hardware. She has

not had any other significant postoperative complications or recurrence of pain.

We present this case study to add our surgical technique to the literature and recent publications by Derner et al<sup>9</sup> on fourth and fifth tarsometatarsal joint arthrodesis. We agree that this fusion procedure should be applied to a patient who would not otherwise qualify for a salvage procedure.

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**Conflict of Interest:** None reported.

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