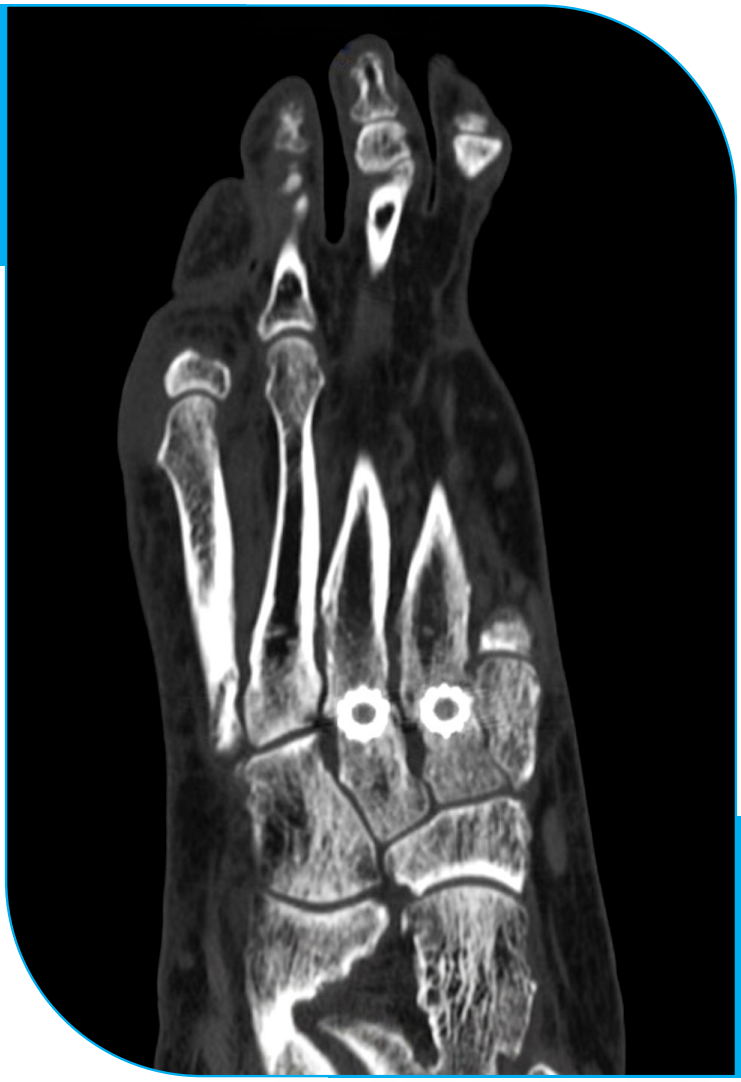
Minimally Invasive Midfoot Arthrodesis

A Clinical Evaluation of the INTREPED® Intraosseous Fusion Device

Author: **Keith Jacobson, DPM, FACFAS**
Date: **2026 - April - 01**



AUXANO® MEDICAL

Step into the Future™

01-60036 REV A

Minimally Invasive Midfoot Arthrodesis

A Clinical Evaluation of the INTREPED® Intraosseous Fusion Device

INTRODUCTION

Midfoot arthritis is a disabling condition characterized by chronic foot pain and impediment of daily activity[1]. While arthrodesis remains the gold standard for patients failing conservative care, traditional fixation methods present significant challenges. Surface-mounted constructs require extensive soft-tissue dissections, while crossing screw constructs can be technically difficult given the angle required to capture osseous structures. Both approaches risk iatrogenic soft-tissue damage, which can result in long-lasting dorsal foot pain and/or sensory disturbances[2]. Additionally, planar resection and curettage techniques of joint preparation can often lead to a detrimental loss of column length and increase the difficulty of apposition. Resection of the central tarsometatarsal joints also destabilizes the complex and alters biomechanical function, and it makes later reconstruction, if necessary, more challenging[3]. Dowel arthrodesis can be a preferable alternative, offering an easy preparation of the joint surfaces through a small incision[4]. This technique avoids shortening of the rays, however, the harvesting of bone dowels lengthens the procedure and is not without risk. Chronic donor site pain, neurological injury, donor site fracture, infection, and other morbidities can arise following bone dowel harvest[5].

The INTREPED® intraosseous fusion device offers a modern solution for dowel arthrodesis. Engineered as a threaded, hollow, 3D-printed titanium dowel, INTREPED® provides a reproducible, minimally invasive, zero-prominence solution for midfoot arthrodesis. The implant's pillared threads are designed to provide rigid primary fixation, while the open architecture of the pillared morphology provides for robust secondary fixation through direct osteointegration[6, 7]. Critical to long-term bone health, the pillared surface has been engineered to deliver mechanical stimulation in the form of continuous transduction provided through the interdigitation of bone and pillar. Intraosseous fusion with INTREPED® may therefore offer the potential to improve the surgical efficiency, reproducibility, and patient comfort for midfoot arthrodesis, while reducing the risk of secondary surgery for symptomatic sequalae associated with prominent dorsal hardware.

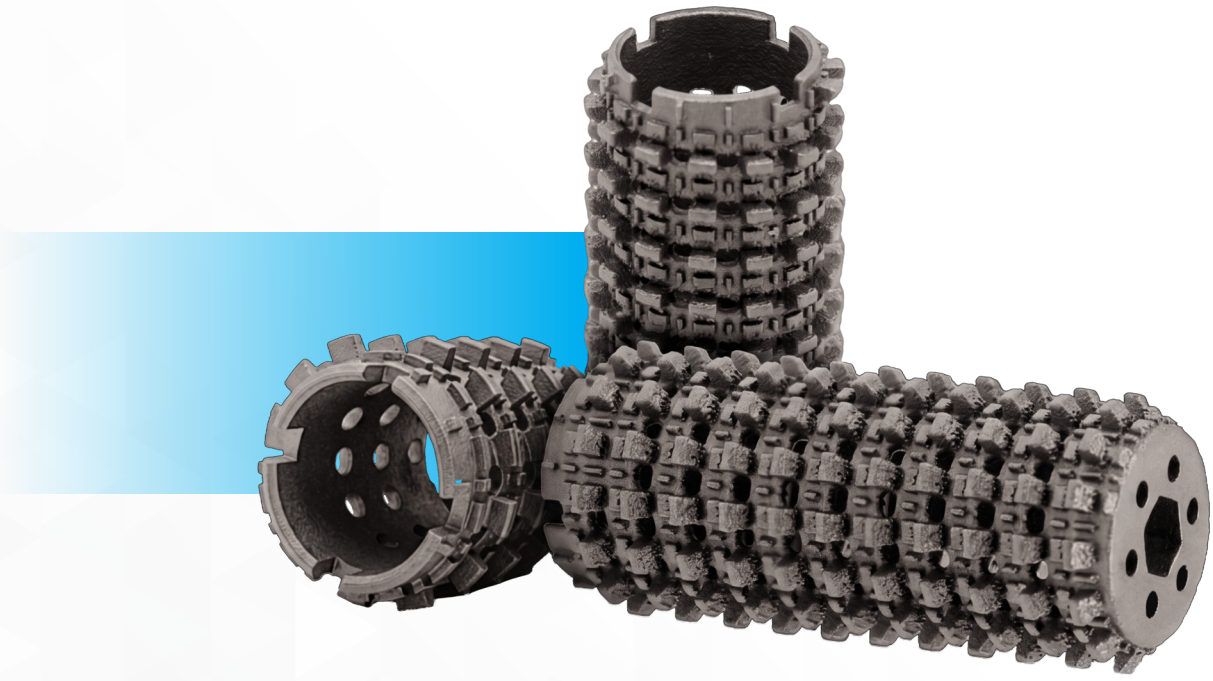


FIGURE 1: INTREPED® Intraosseous Fusion Device by Auxano® Medical (www.AuxanoMedical.net)

INITIAL CASE SERIES

An initial clinical evaluation was conducted on 8 patients (15 joints) undergoing midfoot arthrodesis without significant deformity. Included in this series were 7 arthrodeses of the second tarsometatarsal joint, 6 arthrodeses of the third tarsometatarsal joint, and 2 arthrodeses of naviculocuneiform joints. The primary focus of this evaluation was on implant usability, fixation stability, and fusion success as judged by radiographic/CT evidence.

SURGICAL TECHNIQUE

1. Targeting & Exposure: Target the center of the joint percutaneously using a k-wire, following the natural inclination of the joint. Drive the k-wire to ~50-75% of the joint length. Create a 1 to 1.5-cm primary skin incision extending anteriorly and posteriorly from the k-wire insertion. Dissect down to the dorsal aspect of the ligament capsule and expose the joint through the dorsal ligament, leaving the medial and lateral aspects untouched.
2. Sizing: Determine the implant diameter by placing a sizer over the k-wire and checking the resection profile fluoroscopically. Aim for a resection margin of 1-2 mm. Length is determined off the laser lines on the k-wire, or by measuring with the depth gauge.
3. Joint Preparation & Implant Insertion: Drill over the k-wire using the size-specific drill corresponding to the selected diameter. Be careful not to penetrate the plantar ligament structures if not using the provided drill stop. Tap the prepared hole using the size-specific tap. Thread the implant into the tapped hole until it sits flush with or slightly below the surface of the bone.
4. Grafting & Closure: Pack the hollow cavity of the implant with autograft or a preferred biologic agent. Close in standard layered fashion.

POST-OP PROTOCOL

- 3-weeks non-weight-bearing, followed by 3-weeks weight-bearing-as-tolerated in a walking boot
- Follow-up at 1-week, 2-weeks, 6-weeks, and 12-weeks, with CT at 6-wks and 12-wks
- Transition to a supportive shoe at 6-weeks, dependent upon patient progress.

CLINICAL OUTCOMES & FOLLOW-UP

100% fusion success was observed in this series (8 of 8 patients; 15 of 15 joints). Computed tomography (CT) at 6-weeks post-operative demonstrated predictable implant placement and favorable progression towards fusion. Solid fusion was reliably obtained by 12-weeks.

Surgical efficiency and speed were significantly improved secondary to a simplified approach, decreased exposure and avoidance of traditional joint preparation. The average surgical time per joint was 15 minutes (range: 7–22 minutes), measured from skin incision to closure. This time decreased from ~20 minutes per joint in the first case to under 10 minutes towards the end of the series.

There was no incidence of device-related migration, breakage, or loss of fixation. Patient satisfaction was high, with no reports of symptomatic hardware. There were no hardware removals.

A 54-year-old female presented with a chief complaint of pain in the right foot, with no significant past medical history. Patient subsequently underwent over two years of conservative treatment, including rest, ice, anti-inflammatories, local PT modalities and intraarticular steroid injections. Patient related no relief of symptoms with conservative treatment. Physical exam showed pain adjacent to the second and third tarsometatarsal joints, with pain and crepitus on range of motion. Radiographic evaluation showed significant narrowing of the 2nd and 3rd tarsometatarsal (TMT) joint spaces of the right foot on weight-bearing AP view with dorsal osteophytes.

Treatment options were discussed with the patient. The patient's activity level, surgical exposure, and recovery timeline were considered, and the decision was made to proceed with arthrodesis of the 2nd and 3rd TMT joints.

On the day of surgery, autograft was harvested from the patient's calcaneus through a percutaneous approach using a small trephine prior to arthrodesis. Arthrodesis was accomplished by inserting two 9 x 15 mm INTREPED® implants central to the 2nd and 3rd TMT joints, following the surgical technique described above. The sizing of both implants was determined intraoperatively, using radiographic sizers to assess the joint resection in the AP view and measuring k-wire depth on the lateral view. Both implants were packed with a mix of calcaneal autograft and an HCA-based moldable putty prior to closure.

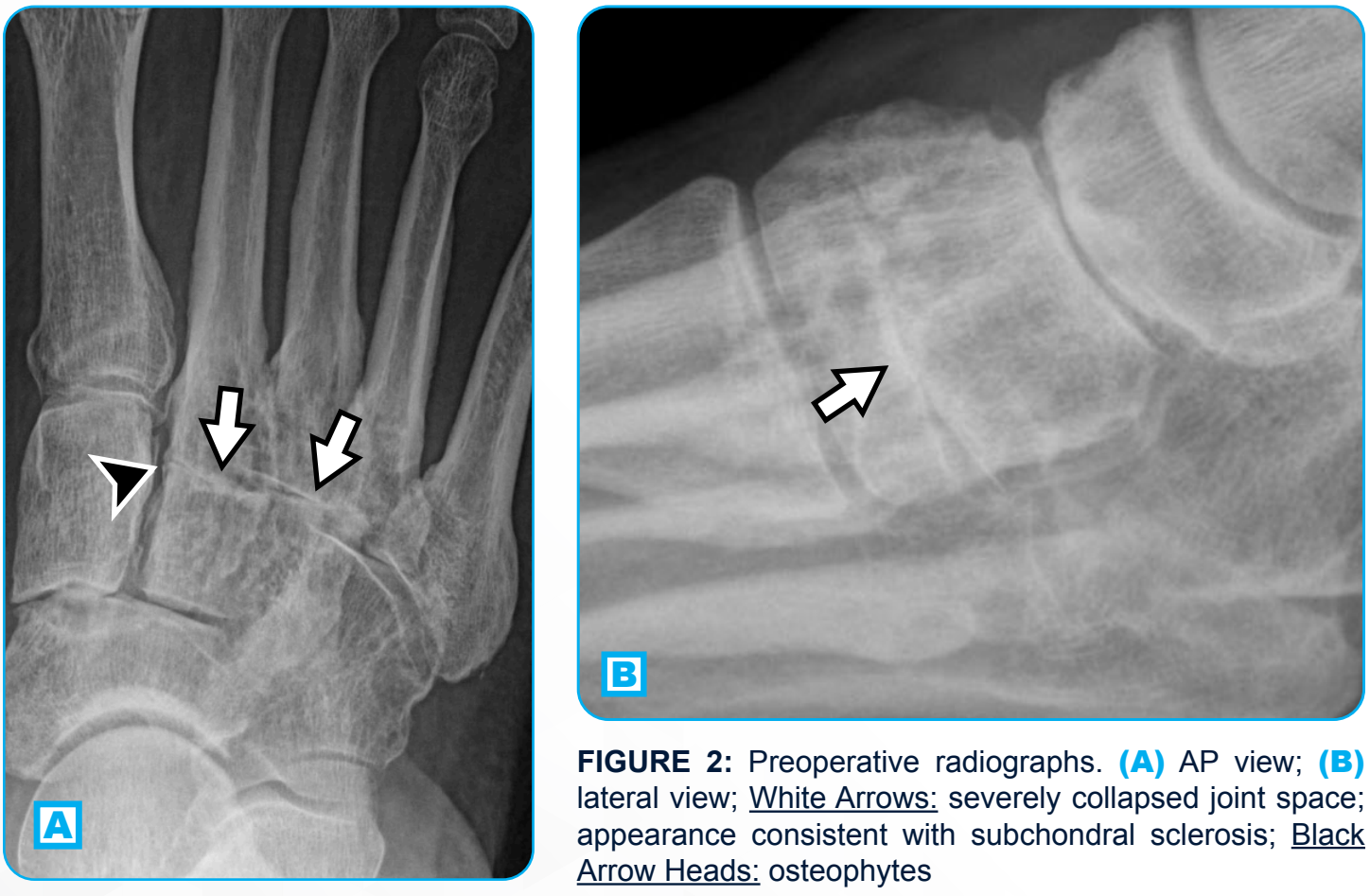


FIGURE 2: Preoperative radiographs. **(A)** AP view; **(B)** lateral view; White Arrows: severely collapsed joint space; appearance consistent with subchondral sclerosis; Black Arrow Heads: osteophytes

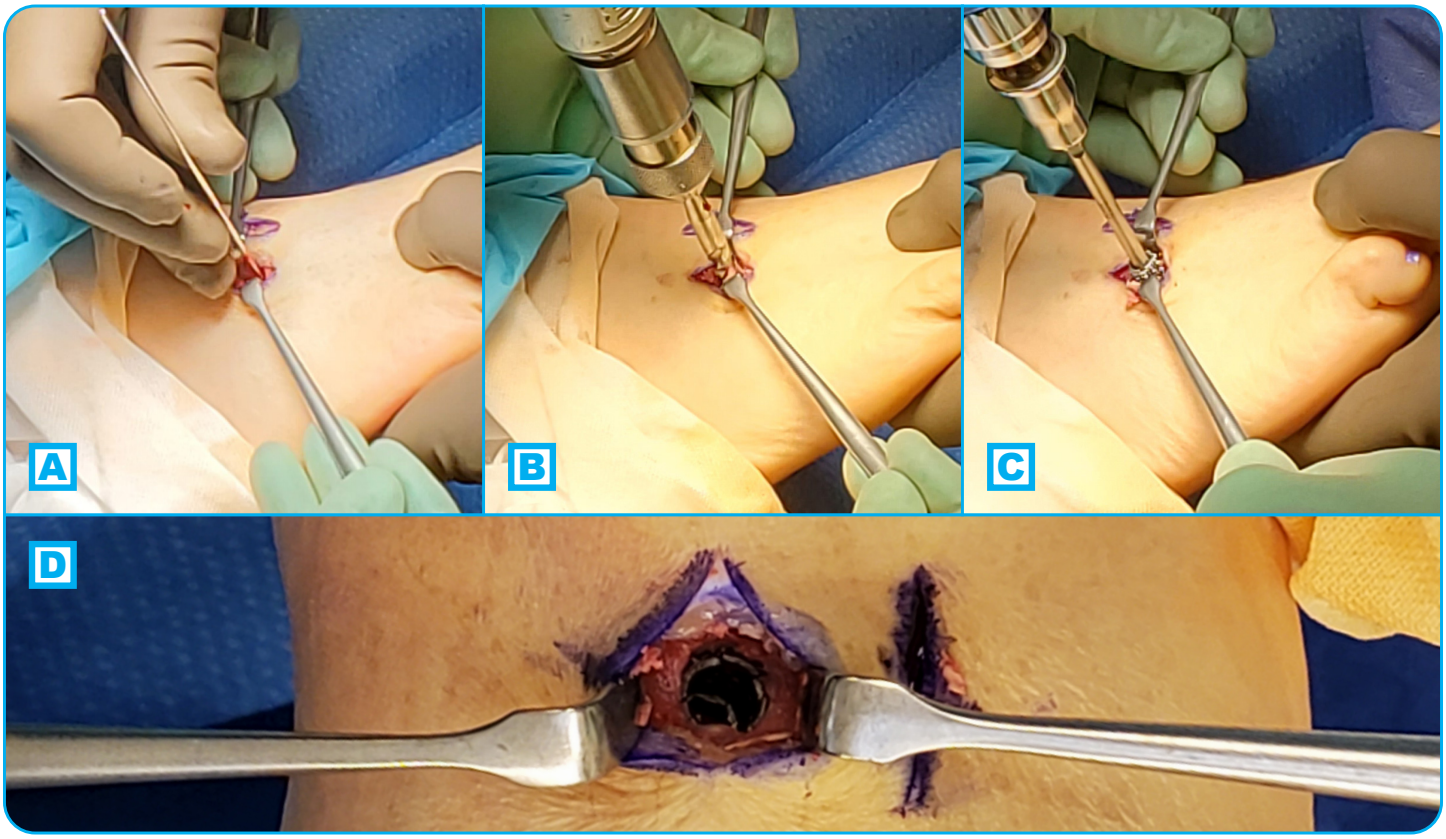


FIGURE 3: Targeting, joint preparation via drilling and tapping, and placement of an INTREPED® implant during TMT arthrodesis. **(A)** Targeting the joint center; **(B)** Decorticating and preparing the fusion site; **(C)** Inserting the implant into the tapped hole; **(D)** Final position of the countersunk INTREPED® implant.

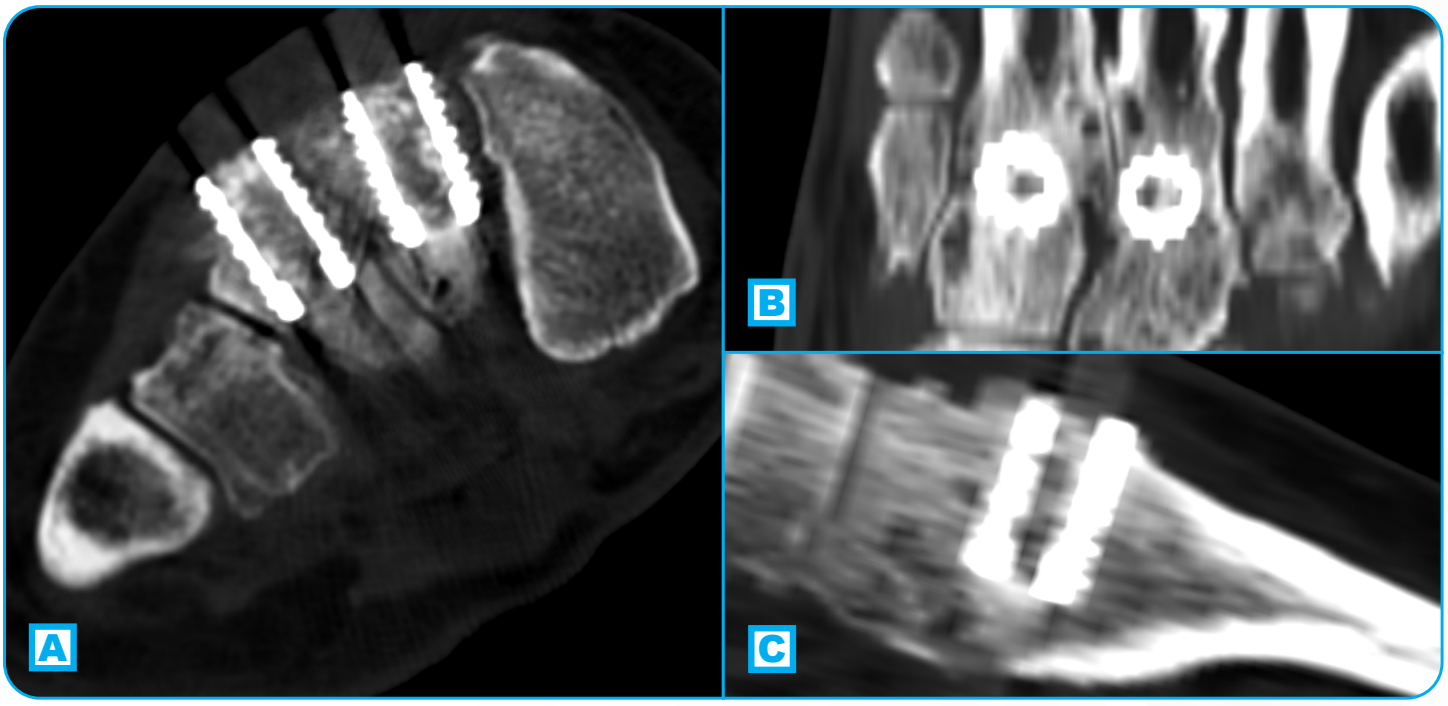


FIGURE 4: 12-weeks post-operative CT showing anatomic alignment with solid fusion of the second and third tarsometatarsal joints. **(A)** Coronal, **(B)** Axial, **(C)** Sagittal

The same patient returned approximately 1 year after successful TMT surgery on the right foot, with chief complaint of the same pain in the left foot. The patient reported failed conservative treatment on the left foot as previously provided on the right. On exam, she showed pain on palpation adjacent to the dorsal navicular cuneiform joints, with pain and crepitus on range of motion. Radiographic evaluation showed significant narrowing of the medial and intermediate navicular cuneiform articulations on weight-bearing AP view.

Treatment options were discussed with the patient. Based on the patient's activity level and positive experience with the right foot, the decision was made to proceed with naviculocuneiform (NC) arthrodesis of the intermediate and medial cuneiforms of the left foot.

Arthrodesis of the naviculocuneiform articulations was completed following a similar approach to the TMT, with restoration of the medial longitudinal arch provided through anatomic reduction during drilling and hole preparation, achieved through plantarflexion of the medial column. Two INTREPED® implants were placed central to the navicular articulations of the medial and intermediate cuneiforms, consisting of a 9 x 20 mm implant within the medial articulation and a 9 x 10 mm implant within the intermediate articulation. Both implants were packed with a mixture of calcaneal autograft and HCA-based moldable putty prior to closure.

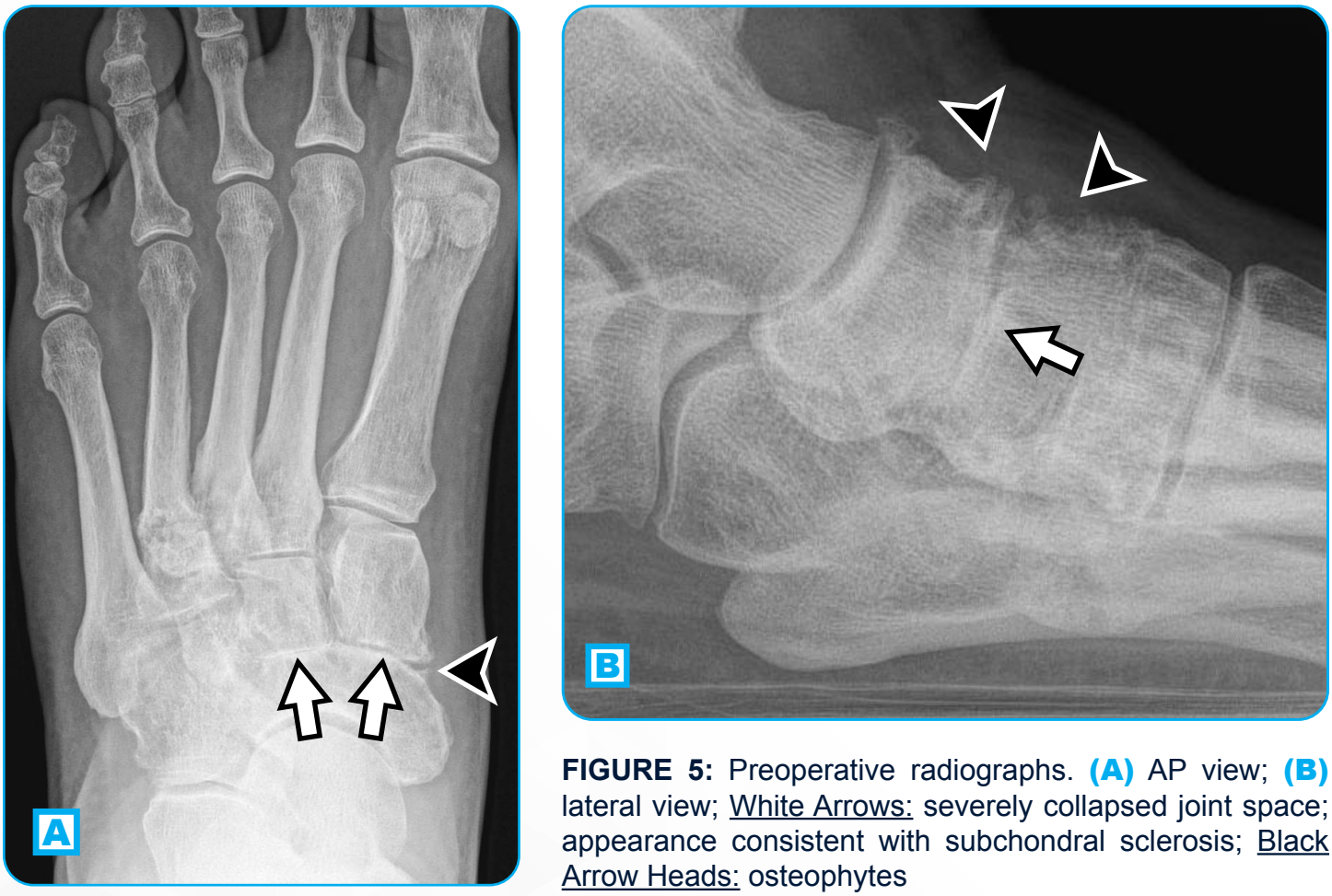


FIGURE 5: Preoperative radiographs. **(A)** AP view; **(B)** lateral view; White Arrows: severely collapsed joint space; appearance consistent with subchondral sclerosis; Black Arrow Heads: osteophytes

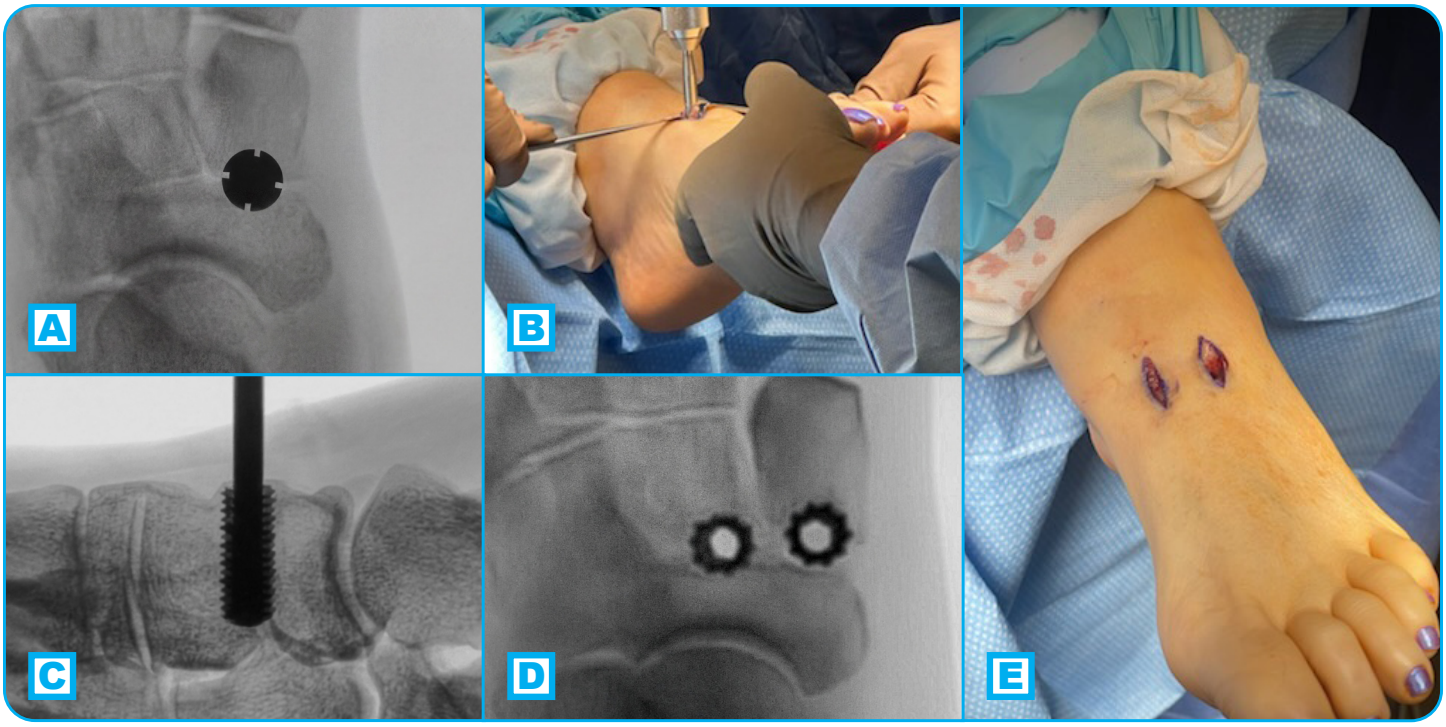


FIGURE 6: Surgical exposure, joint preparation via drilling and tapping, and implant placement during naviculocuneiform arthrodesis. **(A)** Fluoroscopic assessment of the resection profile; **(B)** Joint preparation prior to tapping; **(C)** Insertion under fluoroscopy; **(D)** Final anteroposterior position; **(E)** Immediate post-operative result highlighting the minimal exposure required for NC fusion with two INTREPED® implants.

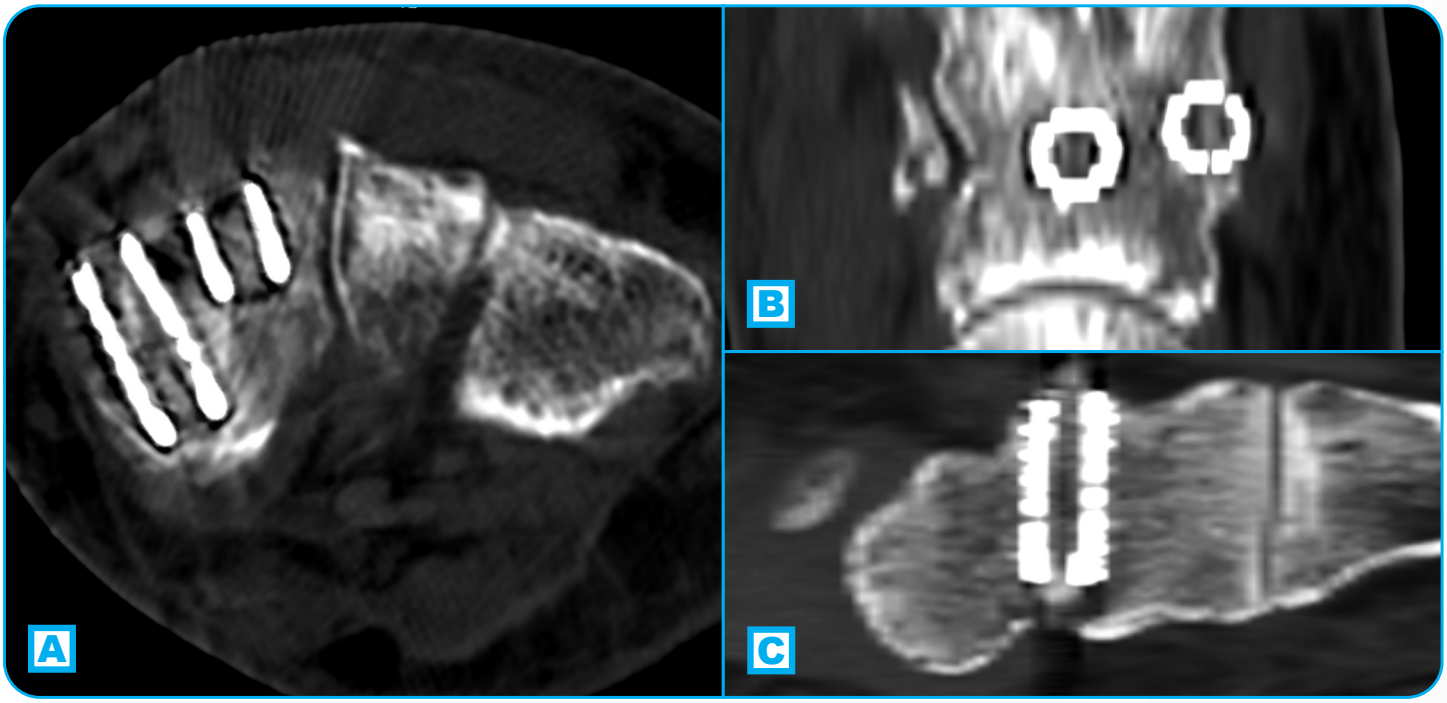


FIGURE 7: 6-weeks post-operative CT following naviculocuneiform arthrodesis, demonstrating anatomic alignment and partial osseous bridging across the joint space. **(A)** Coronal, **(B)** Axial, **(C)** Sagittal

TECHNIQUE PEARLS

- **Diameter selection:** Aim for a ~1-2 mm joint resection margin.
- **Length selection:** Ideal coverage is ~50-75% of the joint depth. Avoid the temptation to go longer than needed, due to the plantar narrowing of the midfoot articulations.
- **The implant does not need to span the entire joint surface**, medial to lateral as well as inferior to superior.
- **Localize the surgical exposure prior to targeting.** Using a K-wire as a pointer, identify the center of the joint fluoroscopically and mark the skin at this location. Use this local target for percutaneous k-wire delivery.
- **Do not dissect the collateral ligaments.** These intact ligaments work with the implant to provide compression across the fusion site through ligamentotaxis.
- **Do not penetrate the plantar ligament structures.** During targeting, avoid driving the k-wire beyond the intended implant depth. When drilling, use the drill stop to avoid overpenetration.
- **If trying to correct sagittal plane deformity**, you must hold the correct position while drilling and tapping.

LIMITATIONS

Observations reflect early experience with approximately one year follow-up and should not be interpreted as evidence of superiority. Prospective studies are encouraged to further evaluate union rates and long-term functional outcomes.

CONFLICT OF INTEREST

The author is a paid consultant for Auxano® Medical.

MEDICO-LEGAL STATEMENT

This document is intended for educational purposes only and does not replace independent clinical judgment. Implant selection and surgical technique should always align with the manufacturer's Instructions for Use. Individual outcomes may vary.

REFERENCES

1. Verhoeven N, Vandeputte G. Midfoot arthritis: Diagnosis and treatment. Foot and Ankle Surgery. December 2012;18(4):255-262.

2. Ismailoglu AV, Sehirli US, Ayingen D, Bayramoglu A, Savasan C, Kocaoglu B. The Topographic Map of the Midfoot: Implication for Improving Safety of Dorsal Approach of Midfoot Surgeries. Journal of the American Academy of Orthopaedic Surgeons: Global Research and Reviews. January 2025;9(1):e24.00339.

3. Downey MW, Fleming JJ, Elgamil B. In Situ Tarsal Metatarsal Dowel Arthrodesis with Trephine Reamers and Cancellous Bone Plugs: A Technique Guide and Case Report. Journal of Arthritis. 2016;5(3):198.

4. Johnson JE, Johnson KA. Dowel Arthrodesis for Degenerative Arthritis of the Tarsometatarsal (Lisfranc) Joints. Foot & Ankle. 1986;6(5):243-253.

5. Boone DW. Complications of iliac crest graft and bone. Foot and Ankle Clinics. March 2003;8(1):1-14.

6. Causey GC, Picha GJ, Price J, Pelletier MH, Want T, Walsh WR. The effect of a novel pillar surface morphology and material composition demonstrates uniform osseointegration. November 2021;123:104775.

7. Causey GC, Picha GJ, Price J, Pelletier M, Want T, Walsh WR. In-Vivo response to a novel pillared surface morphology for osseointegration in an ovine model. Journal of the Mechanical Behavior of Biomedical Materials. July 2021;119:104462.

For more information visit us at www.AuxanoMedical.net

440 262 2000 | CS@AUXANOMEDICAL.NET

AUXANO® MEDICAL

AUXANO® MEDICAL

Step into the Future™

Auxano® Medical
8006 Katherine Boulevard
Brecksville, OH 44141
www.AuxanoMedical.net
Made In USA