The Latest Breakthrough in TTC Fusion Technology

Treatment of Hindfoot Non-Union with DynaNail TTC Fusion System
A CASE REPORT
Dr. L. Daniel Latt, MD, PhD
The DynaNail® TTC Fusion System is intended for use in tibiotalocalcaneal (TTC) fusion to treat various conditions including:

- Rheumatoid Arthritis
- Osteoarthritis
- Severe Deformities
- Degenerative Conditions
- Post-Traumatic Injury
- Failed Total Ankle Arthroplasty
- Non-Union from Ankle or Subtalar Arthrodesis

DynaNail contains an internal Nickel Titanium (NiTiNOL) **Compressive Element** that adapts to changes in loading across the joint. The Element is stretched intra-operatively (up to 6 mm) and fixed with screws in the calcaneus and tibia. After surgery, the Compressive Element can recover its stretched length in response to bone resorption or settling. This unloading allows DynaNail to sustain compression across the joint.

The figure to the left shows the axial compressive force applied by DynaNail in comparison to static intramedullary (IM) nails and an external fixation frame. Whereas static IM nails lose compression after 1 mm resorption, **DynaNail maintains compression for up to 6 mm of resorption**, similar to an external frame.1,2

The unloading of the element can be tracked by X-ray or CT scan using several methods:

1. In its fully stretched position, the Sliding Element extends plantarly from the outer body of the Nail. As resorption/settling occurs, the Sliding Element will retract back into the Nail Body.

2. The position of the calcaneal screws in their associated slots can be visualized under fluoroscopy and used to determine the extent the Compressive Element has unloaded. When the Compressive Element is in its fully stretched position, the calcaneal screws are located at the distal end of the slots (1) and a lucent region appears above the L-M screw (see X-ray above). As the Compressive Element unloads, the screws progressively shift upwards. The element has completely unloaded when the screws are at the proximal end of the slot and the lucent region disappears (2).
Introduction

Achieving fusion using bone graft materials has proven challenging in high-risk patients with degenerative bone conditions or who are immuno-compromised. A study by Jeng et al. reported a 50% non-union rate in patients who underwent TTC fusions using a femoral head allograft and in particular, no fusions in diabetic patients.3

This report presents two cases with diabetic patients who both underwent revision TTC fusion with DynaNail to treat failed hindfoot arthrodesis.

Performing Surgeon
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Case Report #1

Background Information

The patient, an 80 year old man, former smoker with diabetes mellitus and a previous ankle fusion underwent a subtalar arthrodesis with two headless compression screws. One year after the procedure, he still had pain in the lateral hindfoot. X-rays and CT demonstrated a clear non-union of the subtalar arthrodesis.

Procedure

A revision subtalar arthrodesis was performed. The headless compression screws were removed, the lateral approach to the subtalar joint was recreated, and the subtalar joint was curetted, drilled, and shingled. The arthrodesis site was filled with cancellous allograft chips mixed with iliac crest bone marrow aspirate. A 13.5 mm tunnel was drilled through the calcaneus into the tibia and a 12 x 220 mm DynaNail was inserted according to the recommended surgical technique. The Compressive Element was stretched 6 mm before fixating with screws. A 65 mm headless P-A screw and 45 mm headed cortical L-M screw were used in the calcaneus. The proximal and distal tibial cortical screws used were both 25 mm. An intra-operative X-ray shown to the left reveals the Compressive Element is stretched 4.5 mm after screw insertion.

Results

3 Weeks Post-Surgery:
No pain or swelling was observed and the wound was well healed. As observed on the X-rays to the right, the position of the P-A screw in the calcaneus indicates that the Compressive Element had unloaded a total of 2.5 mm in response to bone resorption and settling while still maintaining compression. The patient remained immobilized in a boot at this time.

9 Weeks Post-Surgery:
No pain or swelling was observed. The Compressive Element had unloaded a total of 2.9 mm while still maintaining compression. The patient was transitioned to 50% weight-bearing in a boot at 7 weeks.

12 Weeks Post-Surgery:
Slight swelling was noted and attributed to an increase in activity. A CT scan revealed 70% fusion of the posterior facet of the subtalar joint and complete fusion of the ankle joint. The Compressive Element had unloaded a total of 3.0 mm while still maintaining compression. The patient was cleared to begin walking in rocker-soled shoes.
Procedure

The nail and broken screws were removed. The ankle joint was prepared in standard fashion through an anterior approach. Iliac crest bone marrow aspirate mixed with crushed cancellous allograft was used to fill the defect at the tibiotalar joint. A fibular osteotomy was created to allow compression across the ankle joint. A 12 x 220 mm DynaNail was placed. The Compressive Element was stretched 6 mm and 6 mm of manual compression was applied across the joints. A 65 mm headless P-A screw and 45 mm headed cortical L-M screw were used in the calcaneus. The proximal and distal tibial cortical screws used were 25 mm and 30 mm, respectively. An intra-operative X-ray shown to the left reveals the Compressive Element is stretched 5 mm after screw insertion with 1 mm of settling occurring during the procedure.

20 Weeks Post-Surgery:

The patient had returned to walking comfortably in rocker-soled shoes; he was not experiencing any pain and had no swelling. The Compressive Element had unloaded a total of 3.1 mm while still maintaining compression. He was cleared to return to playing doubles tennis.

Case Report #2

Background Information

A 66 year old man with diabetes mellitus and Charcot neuroarthropathy of the hindfoot presented with ankle and subtalar arthritis with a severe varus deformity. He underwent a TTC arthrodesis with a standard IM nail through a posterior approach and was equipped with an external bone simulator. Successful fusion was achieved across the subtalar joint, but non-union of the ankle joint resulted in hardware failure. The patient experienced no pain but continued to have swelling at the ankle joint. After one year, there was no visible bony union of the ankle joint and a revision TTC fusion was scheduled.

Procedure

The nail and broken screws were removed. The ankle joint was prepared in standard fashion through an anterior approach. Iliac crest bone marrow aspirate mixed with crushed cancellous allograft was used to fill the defect at the tibiotalar joint. A fibular osteotomy was created to allow compression across the ankle joint. A 12 x 220 mm DynaNail was placed. The Compressive Element was stretched 6 mm and 6 mm of manual compression was applied across the joints. A 65 mm headless P-A screw and 45 mm headed cortical L-M screw were used in the calcaneus. The proximal and distal tibial cortical screws used were 25 mm and 30 mm, respectively. An intra-operative X-ray shown to the left reveals the Compressive Element is stretched 5 mm after screw insertion with 1 mm of settling occurring during the procedure.
Results

3 Weeks Post-Surgery:
The patient remained non-weight-bearing. There were no pain or wound problems noted. The midline position of the sliding element in the calcaneal slot indicated that the Compressive Element had unloaded 4 mm in response to bone resorption and settling while still maintaining compression. The cast was removed and replaced with a Cam boot.

6 Weeks Post-Surgery:
The wounds were well healed and the patient was experiencing no pain. The radiograph revealed that the Compressive Element had unloaded 5 mm in response to resorption and/or settling while still maintaining compression. A CT scan was ordered at this point.

8 Weeks Post-Surgery:
The patient was advanced to 50% weight-bearing in a boot. A CT scan showed 80% fusion across the ankle joint and 60% fusion of the posterior facet of the subtalar joint.
7 Months Post-Surgery:
The patient was doing well. He had no pain and minimal swelling. He was walking in rocker-soled shoes without an assistive device and had returned to all of his routine activity.

13 Weeks Post-Surgery:
The patient was completely weight-bearing using the assistance of a cane. There was no report of pain or swelling.

17 Weeks Post-Surgery:
The patient was full weight-bearing in boot. The joint was well-aligned and there was mild swelling related to increased activity. At this point, the patient was advanced to walking in a rocker-soled shoe.
Dr. L. Daniel Latt, MD, PhD is an Assistant Professor in the Department of Orthopaedic Surgery at the University of Arizona Medical Center in Tuscon, AZ. Dr. Latt received his Doctor of Medicine degree from the University of Pittsburgh, where he also holds a Ph.D. in Bioengineering. He then completed his Orthopaedic Surgery Residency at McGill University followed by a Foot & Ankle Fellowship at the Duke University Medical Center in Durham, NC and a Sports Medicine Fellowship at Kaiser Permanente San Diego in El Cajon, CA. Dr. Latt is a Candidate Member of the American Academy of Orthopaedic Surgery and a Fellow Member of the American Orthopaedic Foot and Ankle Society.

This report is presented to demonstrate the clinical outcomes shown by Dr. L. Daniel Latt. MedShape, as the manufacturer of this device, does not practice medicine and is not responsible for selection of the appropriate surgical technique to be utilized for an individual patient. Always refer to the package insert, product label, and/or product instructions prior to using a MedShape product.

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