Meta OGIX®

REVOLUTION EXTERNAL PLATING SYSTEM

TTC ASSIST SURGICAL TECHNIQUE GUIDE NICK KUSNEZOV MD





✓ Elderly fragility fractures.

- Ankle fractures in uncontrolled diabetics (complicated by peripheral neuropathy or Charcot arthropathy.
- Unsalvageable comminuted distal tibial pilon or talar body fractures.

Terminally ill patients with short life expectancy.

✓ Salvage for failed ORIF or TAA.





PATIENT POSITIONING & OR SETUP

 The patient is positioned supine on a standard OR table with radiolucent foot support.

 \checkmark Bone foam is placed under the operative extremity.

A thigh tourniquet may be used as well but is optional.

✓ The large C-arm is positioned on the side opposite the extremity

 \checkmark The extremity is prepped up to the thigh.



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EXTERNAL FIXATOR APPLICATION TIBIAL FIXATION

✓ Select two 5.0mm tibial half-pins.

- ✓ The first pin is applied 1-2 fingerbreadths distal to the tibial tubercle, with a small stab incision, then predrilled, and placed anterior-to-posterior bicortically.
 - These pins are intentionally placed more proximally to permit placement of 150 or 200mm hindfoot fusion nails. Longer nails may be obstructed by these pins, which would then have to be removed prior to reaming.

✓ The Z-bar or multi-hole clamp is then loosely placed over this pin. The second pin is then placed distally in a similar fashion.

✓ AP/lateral fluoroscopic views confirm pin position and depth, then the Z-Post or clamp is tightened over the pins.





EXTERNAL FIXATOR APPLICATION

CALCANEAL FIXATION

- A single, centrally-threaded 5.0mm pin is placed through a small stab incision, predrilled and placed medial-to-lateral under lateral fluoroscopic imaging.
 - This pin should be placed more posteriorly and superiorly within the calcaneal tuberosity to intentionally avoid the trajectory of the nail and posterior calcaneal interlocking screw (depending on the TTC nail manufacturer).





EXTERNAL FIXATOR APPLICATION

FOOT PLATE APPLICATION

- The narrowest N-Plate should be placed anteriorly over the tibiotalar joint and fixed to the calcaneal pin at the most distant points on the N-Plate, ensuring the plate is at least on fingerbreadth off the skin.
- Additionally, the N-Plate should be tilted cephalad to avoid overlay of the tibiotalar joint which may obscure AP and lateral fluoroscopic imaging.



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EXTERNAL FIXATOR APPLICATION

COMPLETING THE FRAME

Two struts of appropriate length are connected from the Z-Post or multi-hole clamp to the anterior aspect of the N-Plate, spaced a few holes apart to give a favorable vector for reduction by being sufficiently medial and lateral, and avoiding overlay of the tibiotalar joint which may obscure AP and lateral fluoroscopic imaging.





EXTERNAL FIXATOR APPLICATION

OBTAINING THE REDUCTION

- Traction and reduction is applied to the ankle and the struts are completely fastened.
 - Super Struts permit fine-tuning of the reduction in the AP and medial/lateral planes

 Additional half-pins may be inserted off the N-Plate to influence the tibial shaft into favorable alignment, if necessary.



EXTERNAL FIXATOR APPLICATION

SECURING THE FOOT IN NEUTRAL

- ✓ A 4mm pin is placed anteromedial to posterolateral into the medial cuneiform or base of the first metatarsal, built off the N-Plate, and the foot is held plantigrade as the connectors are fastened.
- ✓ Final imaging is obtained, and any adjustments are made at this point.
- The ankle is now rigidly stabilized in a manner to permit passage of a hindfoot fusion nail with the external fixator in situ.
 - The frame also permits conversion to definitive external fixation should the surgeon/patient so desire.
- Pin sites are dressed with xeroform and Kerlex.
- Pins are cut flush with clamps and fasteners, and covers are used over the cut pins if prominent.



PATIENT POSITIONING AND OR SETUP

- ✓ The patient is positioned supine on a standard OR table with radiolucent foot.
- ✓ Bone foam is placed under the operative extremity.
- ✓ A thigh tourniquet may be used as well, but optional.
- ✓ The large C-Plate is positioned on the side opposite the extremity.
- Pre-operative fluoroscopic imaging is obtained to verify:
 - The tibiotalar joint is reduced and appropriately aligned on AP and lateral fluoroscopic imaging.
 - At this point, fine adjustments can be made to the struts.
 - The foot is in an automatically neutral position with the talus centered to slightly posterior in the mortise and the foot in slight external rotation.
- \checkmark The extremity is prepped to the thigh.
- The external fixator is left in place and prepped in.



MX STAGE TWO | TTC NAIL APPLICATION

- Joint preparation of the tibiotalar +/- subtalar joint may be performed at this point, if necessary, through a minimally invasive approach.
- The guide pin for the nail is introduced retrograde through the heel under AP/lateral fluoroscopic views.
 - The pin is advanced across the subtalar and tibiotalar joints and into the distal tibia.
 - An incision is made over the plantar foot through which a reamer and soft tissue protector is introduced and used to over-ream the guide wire.
 - If placement of the calcaneal pin was appropriate, this should not interfere with reaming.
- The reamer and guidewire are removed, and a ball-tipped guidewire is passed retrograde and measured.
 - The guidewire should not interfere with the proximal tibial pins for short and intermediate nails and may be measured to confirm.
- Reaming is sequentially performed in 0.5-1mm increments until the adequate chatter is felt, ensuring the nail is not excessively wide and the reduction is maintained as the reamer is passed.
 - The ball-tipped guidewire is exchanged for a smooth guidewire.



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TTC NAIL FIXATION

- \checkmark The nail may then be inserted over the guidewire and completely seated.
 - Reduction is confirmed on AP/lateral fluoroscopic imaging.
 - The nail is confirmed to be seated with the plantar calcaneus on lateral fluoroscopic imaging.
- The nail can be provisionally stabilized with a drill bit through the talar body, lateral-to-medial, using perfect circles (or through the jig in the N-Plate is sufficiently narrow to permit the jig to swing laterally around the frame).
 - This is to ensure the rotational alignment is not lost should the fixator be manipulated or removed.
- ✓ At this point, the fixator may be 1) used to compress across the subtalar and tibiotalar joints maximally through the fastening of struts, 2) loosened, or 3) removed altogether.
- The tibial nail interlocks may then be placed medial-to-lateral, using perfect circles (or through the jig if the N-Plate is sufficiently narrow to permit the jig to swing medially around the frame).



TTC NAIL COMPRESSION

- The fixator may now be 1) loosened or 2) removed. Compression is applied through the nail across the tibiotalar and subtalar joints using built-in dynamic compression mechanisms.
- The final lateral and subsequent posterior calcaneal interlocks are pre-drilled and placed through the jig, locking the compression.
 - If the calcaneal pin was placed correctly, neither should interfere with the pin or pin tunnel (if the fixator was removed).
- At this point, if the fixator is in place, it may be removed in its entirety after closing sterile surgical wounds.

✓ The surgical sites are dressed, and soft compressive dressings are applied.



CASE ONE

COMPLICATED DIABETIC ANKLE FRACTURE *FIRST ITERATION*



CASE SUMMARY

- History: This is a 65yo female with uncontrolled diabetes complicated by end organ dysfunction to include advanced peripheral neuropathy who presents with a subacute ankle fracture-dislocation. She had fractured her ankle 6 weeks prior to presentation while ambulating around her house and had been ambulating on the injured side in a dislocated position due to insensitivity. She began to develop a medial ulcer at which point she decided to present to the emergency setting. She denied any pain at that time. She was a household ambulatory with low functional demand.
- Exam: The right ankle was grossly deformed and unstable with palpable bony crepitus. The medial soft tissue was compromised, with no full thickness ulceration but with early eschar formation. There was surrounding erythema. The ankle was non-tender and tibiotalar and subtalar range of motion was severely limited, like the contralateral side. The patient was insensate in a stocking distribution with a warm foot and palpable DP pulse.



CASE SUMMARY (CONTINUED)

- Radiographs confirmed a chronic bimalleolar fracture-dislocation with erosion of at least the lateral 50% of the tibiotalar joint and Charcot changes of the midfoot.
- Course: a Metalogix Rev-T external fixator was applied to stabilize the grossly unstable ankle and permit monitoring of the wound during treatment of the cellulitis, while management options were discussed with the patient. This included ORIF versus conversion to definitive external fixation (which the external fixator permitted) versus ankle arthrodesis (by way of tibiotalocalcaneal (TTC) hindfoot fusion intramedullary nail).
- ✓ The decision was made to proceed with TTC nail with the goal of early mobilization, weight-bearing, and avoidance of wound complications associated with open approaches to ORIF as well as high risk of infection and hardware failure with ORIF.





AP and lateral radiographs of a subacute bimalleolar fracture-dislocation. There is pseudoarticulation of the lateral talus with the distal fibula.



STAGE ONE

FRAME APPLICATION





The first iteration of the TTC precursor frame is applied. NOTICE: There is not 1st metatarsal pin to maintain the foot plantigrade.





Additional view showing drilling of calcaneal pin on stack of blue towels to avoid binding of drapes. Fluoroscopy is used to confirm adequacy of reduction.







AP and lateral fluoroscopic images of the ankle following closed reduction and ankle-spanning external fixator application.



STAGE TWO

TTC NAIL APPLICATION







The frame is prepped in sterilely. The guidewire is introduced and drilled under AP and lateral fluoroscopic imaging.





Imaging demonstrates how the frame does not obscure visualization of the appropriate starting point, subtalar, or tibiotalar joints on AP or lateral fluoroscopic imaging. The panel shows introduction of the guidewire percutaneously and advancement in line with the tibial shaft, across the subtalar and subsequently tibiotalar joints.





The guidewire is then over-reamed with an entry reamer (right image). A ball-tipped guidewire is inserted and then over-reamed (left image).

*Note that without the 1st MT pin off the N-Plate, the foot must be held plantigrade by the surgeon or assistant to avoid fixation in plantarflexion.







The ball-tipped guidewire is shown being introduced with frame in place (left image) and then measured on lateral fluoroscopic imaging (right) image.

Reaming over the guidewire is performed and nail length and diameter are then selected.





After exchanging the ball-tipped for smooth guidewire, the nail is inserted over the guidewire, using the frame for counterpressure.





The nail is completely seated, at which point, the frame may be removed, if so desired.

A screw or drill bit should be placed lateral-to-medial through the jig or through perfect circles (if the frame is removed at this point) to lock the rotation of the talus and medial-tolateral into the tibia through the dynamic proximal interlock prior to frame removal.

This locks rotation and permits compression, which can be applied through the frame prior to removal or through the nail and jig if removal of the frame is necessary or desired.





Compression is applied and the nail is locked through the remaining proximal and distal calcaneal interlocks, first lateral to medial then posterior to anterior.

The jig is removed, and once surgical incisions are closed, the pins can be removed, and pin sites irrigated and approximated.



CASE TWO

OPEN COMPLICATED DIABETIC ANKLE FRACTURE *SECOND ITERATION*



CASE SUMMARY

- History: This is a 70yo female with uncontrolled diabetes, also complicated by end organ dysfunction to include early peripheral neuropathy, prior cranial nerve palsy, and stroke, who presents with an acute grade III open trimalleolar ankle fracture-dislocation after MVC. She was a household ambulatory with low functional demand.
- Exam: The left ankle was dislocated, and the entire mortise was shot-gunned out through a 12cm transverse medial wound encompassing the medial hemi-circumference of the ankle at the level of the tibiotalar joint. There was gross contamination of the wound. The ankle was minimally tender, with intact but limited dorsi-/plantarflexion. The foot was insensate up to the malleoli with palpable pulses and a warm well-perfused foot.



CASE SUMMARY (CONTINUED)

- Radiographs confirmed a trimalleolar ankle fracture-dislocation. The tibiotalar joint was well-preserved.
- Course: a Metalogix Rev-T external fixator was applied following debridement and irrigation to stabilize the fracture and permit monitoring of the wound while management options were discussed with the patient. This included ORIF versus conversion to definitive external fixation (which the external fixator permitted) versus ankle arthrodesis (by way of tibiotalocalcaneal (TTC) hindfoot fusion intramedullary nail).
- ✓ The decision was made to proceed with TTC nail with the goal of early mobilization, weight-bearing, and avoidance of wound complications associated with open approaches to ORIF as well as high risk of infection and hardware failure with ORIF.





A large transverse medial wound with exposed, mortise is evident.







AP and lateral fluoroscopic imaging shows a severely displaced comminuted trimalleolar fracturedislocation of the left ankle.



STAGE ONE

FRAME APPLICATION





The wound is irrigated and closed. The ankle is re-draped sterilely.

The proximal tibial pins are placed as specified in the surgical technique.

The Z-Post with loose struts of appropriate length are finger-tightened, leaving the Z-Post two fingerbreadths off the anterior tibial skin.





The strut lengths are adjusted grossly and the narrowest N-Plate is selected and applied obliquely over the tibiotalar joint, connecting the end holes to the calcaneal pin with wing nuts and pin fixation bolts.





The closed reduction is performed, and a medial cuneiform pin is built off the N-Plate to lock the foot in a plantigrade position.

The rotation and alignment are verified to be appropriate under fluoroscopy.







The final construct once pins are cut.





Fluoroscopic imaging again demonstrates appropriate reduction and the frame permit visualization of the joints.



STAGE TWO

TTC NAIL APPLICATION





Previous steps are outlined in the prior case. The traumatic medial wound was opened and tibiotalar joint was prepared in this case.

Here we see that once entry was obtained following guidewire, entry reamer, and introduction of a ball-tipped guidewire, which is measured, begin sequential reaming.

No assistant is required at this point to hold the foot in dorsiflexion.





The nail is again inserted following guidewire exchange.





The lateral talar body screw is placed, the medial dynamic tibial screw is placed, and compression is applied through the Rev-T frame, then the nail, placing the final tibial screw and two remaining distal calcaneal screws after compression is maximized and with the frame in place.





The frame is removed following fixation and closure of the sterile surgical wounds.

Notice here the medial malleolus was excised due to prominence under the traumatic medial wound.

The alignment is anatomic, with appropriate position of the talus, a plantigrade foot, and appropriate rotation and calcaneal valgus.



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