Intramedullary nail considerations

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Agenda

• Look at intramedullary rod fundamentals
• Look at current trends
• Look at recent advancements
Historically

- Initial IM concept
  - Prof Gerhard Kuntscher
  - IM nailing WWII 1940s
  - GI returning home
- Limited soft tissue damage
- Rigid fixation
- Early return for certain applications
Indications

- Severe DJD
- RA
- Deformity
- Muscle weakness
- Charcot
- AVN
- Severe comminution
- Geriatric fracture
- Failed arthrodesis
- Failed arthroplasty
Prior wounds may influence fixation
Bone quality may influence fixation
Important similarities

- Preparation
- Initial guide pin
- Reaming
- Distal screws
- Compression
- Proximal screws

- Nail size
  - Length
  - Diameter

- Nail length
  - What to consider
Guide pin

• Will set the stage
• Think about start point
  – Lateral column of calc
  – Mid talus
  – Mid tibial plafond
• Remember multiple planes

• Technique guide
  – C-arm lateral
Determining the Insertion Site for Retrograde Intramedullary Nail Fixation of Tibiototalocalcaneal Arthrodesis: A Radiographic and Intraoperative Anatomical Landmark Analysis

Thomas S. Roukis, DPM, FACFAS

Plantar incision

- Ideally in strongest part of calcaneus
- Want to avoid NV structures
- Draw out with fluoro
Plantar incision

2nd Toe Midpoint

Junction Anterior and Middle Third of Heel Pad
Insertion point

- Start plantar in lateral column of calcaneus
- Aim for center of talus/ankle joint in all planes
- Need to get into canal of tibia central aspect
- Reamer will take easiest path from there
• Use C-arm
• Different for some nails
  – Straight v bent
• Need to think about getting purchase in calcaneus
  – Transposing calc
  – VS bent nail
Medialize the talus/calc to line up with tibia
Problem with straight nail and start point
Guide pin
Straight v bent nail
Once have guide pin, open the canal
Get access to canal, exchange for ball tip guide
Exchange for ball tip guide... Ream
Ream. Why ball tip? Why no reverse?
Pearls for reaming

- 1 ½ mm over diameter of nail
  - Template pre-op
  - Ream until chatter then decide on size of nail
- Ream past isthmus
- Flexible so will follow easiest path
- Tourniquet?
Lateral xray will determine diameter of isthmus
After the isthmus, the canal opens again
Get nail/jig ready. Always check nail.
Place the nail and begin screw placement
Older nails

- Limited lengths
- Limited diameters
- Straight
- M-L, L-M screws
First changes in distal screws allowed for distal P-A
P-A screw adds stability

- 10 fresh cadaver limbs
- Biomet nail
  - 5 L-M screw
  - 5 P-A screw
- P-A screw significantly increased stiffness

Tibiotalocalcaneal arthrodesis: a biomechanical analysis of the rotational stability of the Biomet Ankle Arthrodesis Nail.

Mann MR, Parks BG, Pak SS, Miller SD
Foot Ankle Int. 2001 Sep;22(9):731-3.
Angled distal screws

- Angled in sagittal plane
  - Cross STJ

- Angled in transverse plane
  - Cross CC

- Problem
  - Not all calcaneus have inclination
  - Not all feet have talus
Longer nails

- Helps with stress risers
- Free hand proximal screws can be unfamiliar
• All distal tibial screws the same
  – Cuts down on confusion
  – Keeps jig “true”
• Can place most proximal free hand
Locking proximal tibia, free hand
Calcaneal fixation

- For osteoporotic bone
- Locking technologies
- Blade
  - Can place screw instead
Blade, screw posterior
Compression techniques - external

- External
Compression techniques - external
Compression techniques - internal

Compression Screw

5mm

47mm

19.5mm

7.5mm

Endcap
Augmentation with large compression screw
Remember dynamization is available. Which is dynamic?

Static

Dynamic
Dynamizing the rod

- 33 consecutive IM rods
- All one screw placed proximal in dynamic slot
- 88% fusion
- Average compaction 2.3mm

- Of note, short rods caused significant cortical hypertrophy
Argument for longer nail

- 5 matched cadaver pairs
- 15cm nail v prox tibial metaphysis
- Strain measured
- 15cm nail 5.3 times more strain on tibia
- “Standard” length nail causes concentrated stress at isthmus

Tibiotalocalcaneal Arthrodesis With a Retrograde Intramedullary Nail: A Biomechanical Analysis of the Effect of Nail Length

Timothy Noonan, M.D.; Michael Pinzur, M.D.; Odysseas Paxinos, M.D.; Robert Havey, M.D.; Avinash Patwardhin, Ph.D.

Foot & Ankle International/Vol. 26, No. 4/April 2005
Argument for longer nail

- May not be necessary to measure
- Just ream past the isthmus
- Select patients may do better with longer nail
  - Osteoporosis
  - Weight
  - Previous hardware, fixator
Advancement in anatomic fit ie. “bent nails”
Bent nail vs medializing foot
Straight v bent
Valgus bend

- Eliminates “medializing”
- Places rod and fixation in strongest areas

- Does have some disadvantages
  - If no talus
  - Too much valgus
  - Need for R and L
  - Complicates jig
Difficulty with bend and no talus
Knowing each nail helps give versatility

- Length
- Width
- Bend
- Fixation
- Compression
- With fixator
- With allograft
- Fibular onlay
- Increasing indications
With fixator
Permanent antibiotic impregnated intramedullary nail in diabetic limb salvage: a case report and literature review

Jason B. Woods, DPM\textsuperscript{1}, Nicholas J. Lowery, DPM\textsuperscript{2} and Patrick R. Burns, DPM FACFAS\textsuperscript{3*}

Diabetic Foot & Ankle 2012, 3: 11908
Antibiotic rod
Abx coated nail
Abx coated nail

- Can achieve stability and local Abx delivery
- May decrease re-operation
- Chronic wounds
- Hx of wound
Complications
Intra-op complication
Post-op
Stage IV PTTD
Intra-op
Propagation plantar
JK

- 44 y/o male
- DM, HTN, blind
- Leg hurt while passenger in MVA

- Consider
  - Length DM
  - Complicated v non-complicated

- Other info requested
• Describe xray
• Classify
  – SER IV

• What makes this difficult?
  – Neuropathy
  – Osteopenia
  – Blind

• Remember Stage 0 Charcot
  – How does that change tx?
• “Superconstruct”
• Extra fixation
  – Locking plates
  – Transarticular pin
  – Multiple syndesmotic

• See twice as often
• See twice as long
• Long term bracing
• 11 weeks later presents with continued swelling

• What do you notice?
  – Fixation issues?
  – Movement in position

• Concern staring to fail
• 4 weeks later
• Progressive failure, breakdown

• Consider
  – Infection?
  – Charcot?

• No open wounds clinically
  – Tests?
    • ESR, CRP
  – Imaging
    • ?
• Going varus, short
• Becoming worse
• Labs show no markers for infection

• Surgical planning
  – Removal hardware
  – Cultures, frozen sections
  – Bone graft
  – New hardware
2 months out
Some delayed wound healing lateral
Allograft to help cover fibula
Alignment appears to be stable
• Wound continues 2 more months
• Swelling progresses

• Comes to office with abscess formation medial
• No systemic signs

• Xray shows collection medial, collapsing in to valgus
• Note soft tissue changes around ankle
  – Infection
  – New Charcot event?

• Decision for admit
  – Work-up
  – Consults
  – Stage salvage
• Labs ordered
  – WBC 11500
  – CRP 6.0
  – ESR 110

• OR frozen section
  – 8 WBC/hpf

• Plan
  – IM rod replaced with abx
  – Exfix for temp stability
  – Abx per ID
• Wounds heal
• Finishes Abx
• Taken back week 6
  – Exchange Abx rod
  – New frozen section
    • 3 WBC/hpf
• Ex fix removed to allow pin sites to heal

• Final step
  – New hardware
  – When?
• New IM rod
• Abx placed around round
  – Gent, vanco
• Abx placed in wound
  – Vanco powder
• Longer rod to skip over previous holes
• Monitor closely
• 52 y/o female referred for deformed left ankle

• Hx “sprain” two years prior
• Treated with boot

• New injury sustained “fracture” of ankle 8 months ago
  – Tripped over dog
  – Treated conservatively again due to DM
• Recently placed in CROW
• No wound
• PMHx
  – Type 1 DM 46 yrs
  – Neuropathy
  – Retinopathy
  – CAD
• PSHx
  – R hallux amp
  – CABG
• All: Morphine
• Meds correspond
• Social negative
Xrays brought to the office
Thoughts about x-rays

- Shortened
- Anterior displacement
- Medial displacement
- Late stage Charcot
  - Coalesed
  - Destruction to distal tibia, talus
- See calcification artery
  - Remember OPG-RANKI

- Options
• Debride tibia, talus
• Get good, flat bone
• Femoral head allograft
• IM rod
• Fibular onlay

• Rod needs to go above previous fracture 2 diameters
Long term issues?
• External fixator
• Maintains stability
• Maintains alignment
• Allows soft tissue to heal
Fixator removed
Healed bone and soft tissue
Need to make it permanent
Role of primary fusion?

- DM, neuropathy, ESRD
- Friend’s uncle

- What do you notice
  - Trimalleolar

- What else do you notice
  - Vasc calcification
  - Raise any concerns?
• Options?
• Cast
• CROW
• ORIF
• Fusion
Primary fusion
• IM rod
• Augmented with 2 screws
• Remember post-op course
Final thoughts

• Many companies produce intramedullary devices
• Important to know the differences and specifics about each
• Be aware of the complications specific to IM devices
• Tailor nail to your needs
  – Length
  – Compression
  – Valgus bend
  – Fixation designs