Orthopaedic Trauma Boot Camp
Session VI: The Struggle is Real
Nonunion: When, What & How

Lessons Learned: Top 10 Tips for Treating Nonunions

Correct pre-op determination of “what you have”… ANALYSIS OF NONUNION

1. **Appropriate x-ray evaluation.**
   - Long alignment film
   - Determine mechanical axis malalignment
   - Hypertrophic vs Atrophic vs bone loss vs infected nonunion

2. **Relative value of adjunctive studies**
   - MRI
   - Nuclear med studies.
   - CT

3. **Infection work-up**
   - WBC, WSR, CRP, intraop frozen section
   - Combination of risk factors used to calculate overt infection risk

4. **Host status:**
   - *Metabolic bone disease work-up*

   **Cierny – Mader clinical staging of osteomyelitis**
   - Type 1 *Medullary* osteomyelitis and is primarily an endosteal lesion
   - Type 2 *Superficial* infection, which involves only the outer portion of the cortex
   - Type 3 *Localized* osteomyelitis involving cortical sequestration with cavitation extending into the medullary cavity
   - Type 4 *Diffuse* osteomyelitis is a permeating, circumferential, and through-and-through lesion with extensive involvement of the medullary cavity

   Host status: A, B or C host

Operative intervention

5. **Staged reconstruction**
   - Debridement of all infected material and hardware
   - In cases where you do not suspect infected hardware……still consider staging the reconstruction

6. **Dead space management**
   - AB spacers
   - AB beads
   - Negative pressure dressings
   - Soft tissue coverage
7. IM nails: best for hypertrophic, well aligned nonunion
   Exception may be for humeral nonunions…..

   Tibial nonunion after 1\textsuperscript{st} nailing, other clinical scenarios include:
   - Nonunion after casting
   - Nonunion complicated by infection

   Dynamization
   - Allows compression across distraction / fracture site
   - Must be axial stable fracture
   - ? Destabilize fracture
   - Autodynamization common…
     ..ride it out
   - Perform early…6 -12 weeks…. 
   - May not work after 4-6 months

   Indications for tibial nail Rx of nonunion
   - Canals in relative continuity
   - Minimal deformity < 15\textdegree
   - Relative contraindications
   - Prior infection
   - Excessive shortening
   - Caution with prolonged external fix

   Exchange nailing
   - Over-ream canal and place larger diameter nail…(2mm If Possible)
   - Locking screws?
   - Dynamic locking slot
   - Must be rotationally stable
   - Fibular osteotomy
   - Assess rotational stability.. Pre…cut
   - Perform if distraction at tibia
   - Match resection to tibial distraction
   - Not at same level as tibial nonunion

   Tibial exchange nails success rate…..92% + (Johnson , Watson et.al…1989)
   - Limited with bone defects  (?size)
   - More than 30-50% of cortex over 2cm
   - Increase diameter of prior nail ave. 2 mm
   - Results diminished after 2 prior nailings
   - Heavy smokers may require graft augmentation
   - Must minimize any distraction at fx / nonunion site (nail dynamization)
8. **Tension band plating**
   Good deformity correction
   Upper / lower meta-diaphyseal peri-articular nonunions +, - *bone graft*
   Failed exchange nailing (multiple attempts) with large canal especially for repeat
   Femoral revisions.

   Plating can correct mechanical axis
   Proximal femur / tibia
   Distal femur / tibia
   Mid diaphyseal (rarely)

   When to consider Plate vs ex fix
   Degree of deformity to be corrected
   Acute vs gradual correction (infection)
   Associated problems
   Bone loss

9. **External fixation**
   Best deformity correction
   Correct all axis of deformity
   Re-establish limb length
   Segmental defects
   Bone transport
   Sepsis

10. **Orthobiologics**
    Autogenous bone graft
    RIA
    Masquelet’ techniques
    Vascularized bone grafts
    Composite bone grafts
    BMAC + DBM + allograft + porous ceramic
    BMP’s (only 1 currently FDA approved for nonunion which was taken off
    Market.)
    Ultrasound / E-Stim