TIBIAL SHAFT NONUNIONS

2013 OTA BOOT CAMP

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I. Definition
   a. A fracture that does not heal in the expected time
   b. Longer than twice the expected healing time
   c. A fracture that will not unite without intervention
   d. Minimum 6 months – no progress for 3 months

II. Incidence
   a. Most common long bone to have healing problems
   b. Range from 2-10% (closed fracture) to 25-40% (grade III B open fracture)
   c. Higher energy injury $\rightarrow$ longer time to healing
      i. Compartment syndrome – Increased healing fracture
      ii. Open fractures
      iii. Bone loss
      iv. Infections

III. Contributing Factors
   a. Infection
   b. Poor vascularity
   c. Fracture gap
   d. Fracture instability
   e. Soft tissue injury
   f. Host factors
      i. Increased age, DM, PVD, diet, smoking, medications

IV. Prevention
   a. Provide adequate stability
   b. No distraction at fracture site
   c. Biological enhancement when indicated
   d. Less invasive methods of stabilization
   e. If you do not think it will heal (bone loss) do something!

V. Diagnosis
   a. Develop anticipated time to healing
      i. Most 3-6 months
      ii. 6-12 months for severe fracture with bone loss
b. Pain with weight bearing at fracture site

c. Motion on exam

d. X-rays – centered on fracture site
   i. AP, Lat, and internal oblique
   ii. Gap at fracture site, lack of callous
   iii. Broken hardware
   iv. Evidence of motion

e. CT Scan
   i. Sensitive but not specific
   ii. Some fractures may be healed even with concerning CT Scan

VI. Classifying – helpful in directing treatment
   a. Aseptic versus septic
   b. Atrophic - oligotrophic - hypertrophic
   c. Stiff versus mobile

VII. Principles of work up/treatment
   a. Routine labs – vitamin D, Calcium, ERS, CRP, CBC
   b. Metabolic, systemic concern
   c. Nutrition
   d. Smoking cessation

VIII. General treatment principles
   a. Failure of biology
      i. Poor healing response
      ii. Atrophic or oligotrophic nonunion
   b. Failure of stability
   c. Deformity correction – fibular osteotomy often needed

IX. Nonunions that are minimally symptomatic and clinically well-aligned can be treated nonoperatively
   a. E-stim, Ultrasound
   b. Vitamin D replacement, Increased nutrition
   c. Extra corporeal shock wave treatment
   d. Teriparatide – off label

X. Common clinical scenarios
   a. Tibial nonunion after nailing
      i. Dynamization
         1. Fracture gapped
         2. Axial stable fracture
         3. Diaphyseal location
      ii. Exchange nailing
         1. not for metaphyseal location
         2. Not with bone loss – will not work
         3. Good success – increased size of nail 1-2mm
   b. Tibial nonunion after casting
i. Correction of deformity
ii. Consider open nailing for diaphyseal location

c. Plate fixation after nailing
   i. Metaphyseal location
   ii. Poor stability offered by nail
   iii. Open procedures
       1. Correction of deformity
       2. Bone grafting
       3. Absolute stability

d. Nonunion complicated by sepsis
   i. Remove all nonviable infected tissue
   ii. Durable soft tissue envelope
   iii. External fixation for temporary or definitive stabilization
   iv. Once infection resolved/controlled
       1. Stabilization
       2. Biologic enhancement