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Posterior Tibial Tendon Dysfunction:

Stage III – Getting the Most Out of Your Triple Arthrodesis

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I. Understanding the Flatfoot Deformity with PTTD
   A. Stages of Clinical Presentation
      1. Stage I
         a. activity pain
         b. swelling, tenderness along PTT
         c. single limb heel rise (+/-)
         d. no deformity
      2. Stage II
         a. tendon disrupted/elongated with attritional failure of static hindfoot
            stabilizers (spring lig., long plantar ligament, interosseous T-C lig., deltoid)
         b. swelling, tenderness along PTT
         c. acquired asymmetric pes planovalgus
         d. single limb heel rise (+)
         e. (+/-) lateral impingement pain
         f. wide variability in presentation:
            Type 2A: mild deformity, primarily medial pain
            Type 2B: mod.-severe deformity, lateral impingement
      3. Stage III
         a. tendon disrupted/elongated with attritional failure of static hindfoot
            stabilizers (spring lig., long plantar ligament, interosseous T-C lig.,
            deltoid lig.)
         b. stiff, fixed deformity of subtalar or transverse tarsal joints (not passively
            correctable)
         c. lateral abutment pain(calcaneofibular, talo-calcaneal)
         d. DJD hindfoot
      4. Stage IV – PTTD deformity assoc. with valgus deformity of ankle
         a. Deltoid insufficiency
         b. Lateral ankle joint wear or collapse
B. Physical Exam
   1. Standing exam – assess heel valgus/forefoot abduction
   2. Seated exam – assess gastroc/soleus and forefoot varus
   3. Which components are flexible or fixed?

C. Radiographic Evaluation
   1. Standing Anteroposterior (AP) x-ray
      - Abducted/adducted forefoot
      - Lateral/medial subluxation talonavicular joint (TN coverage)
      - DJD talonavicular/calcanecuboid
      - Evaluate for bone loss/deficiency that may require interposition bone graft
   2. Standing lateral x-ray
      - Midfoot sag (T-N, N-C, C-MT joints)
      - Evaluate hindfoot and ankle DJD
      - If significant sag/cavus at midfoot, may require additional arthrodesis (medial column, 1st TMT)/osteotomy (midtarsal)
   3. Standing Anteroposterior ankle x-ray
      - Demonstrate calcaneofibular abutment
      - Rule out valgus tilt at tibiotalar joint (Stage IV)

II. Stage III Treatment Indications
Stage III (fixed deformity, DJD) = arthrodesis
   1. subtalar
   2. double (CC and TN)
   3. triple - usually required

III. Adjunctive Procedures for Restoring Foot Alignment
A. Concept of the foot “tripod”

B. Medial column procedures for correction of residual forefoot varus, procedure depends on location of deformity and status of involved joints:
   1. First TMT joint fusion – (for severe TMT instability or DJD)
   2. Plantarflexion opening wedge cuneiform-1 osteotomy with bone graft interposition (for normal or mild instability of TMT-I)
   3. Reduction and arthrodesis naviculocuneiform joints.

C. Medial Displacement Calcaneal Osteotomy (MDCO) for residual heel valgus following reduction of the lateral peritalar subluxation deformity at the subtalar joint.
   1. First, internally rotate the calcaneus back under the talus to correct heel valgus and pin the subtalar joint.
   2. Then assess congruity of the subtalar joint to determine if it has been “over corrected” in order to achieve the desired positional correction of the heel.

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3. Consider adding a MDCO if when the subtalar joint is adequately reduced, the heel is still in excessive valgus.
4. Patients with congenital underlying pes planovalgus are more likely to need a MDCO than patient that initially had a neutral heel prior to PTTD.
5. Make incision for MDCO parallel to subtalar joint incision, leave 4 cm skin bridge if possible and limit undermining of skin flaps or self retaining retractors to limit wound healing complications.

D. Soft-tissue reconstructions
   1. FDL tendon transfer to navicular or distal PTT stump for mild valgus talar tilt (Stage IV)
   2. Deltoid reconstruction for mild valgus tilt without significant ankle DJD: imbrication of ligament with suture construct reinforcement vs. allograft tendon reconstruction
   3. Lateral ankle ligament reconstruction ….not uncommon to have attritional degeneration of lateral ligaments with longstanding hindfoot valgus

IV. **Reduction maneuvers for stiff valgus hindfoot deformity correction and fusion**
A. Key is to understand the anatomy of deformity (See Schon and Hansen ref.)
B. Manual Technique: With hands, stabilize talus with one hand while internally rotating calcaneus in relation to talus.
C. Lamina Spreader Technique
   1. Place lamina spreader between anterior superior process of calcaneus and anterior process of talus (not in the posterior facet).
   2. Open lamina spreader to increase distance between anterior calcaneus and lateral process talus.
   3. Avoid over-reduction causing incongruity at TN joint.
D. Transverse midfoot “handle bar” maneuver
   a. Place 1/8 steinman pin across cuboid and cuneiforms
   b. Use pin protruding out each side of foot as a “handle bar” to reduce the transverse tarsal joint by forceful adduction and rotation of foot to correct forefoot varus.
E. Beware of overcorrection – carefully evaluate post reduction intraoperative images
   a. Evaluate lateral radiograph for subtalar congruency – should still have some overlap of the anterior calcaneus on the talar neck
   b. Evaluate AP radiograph for talonavicular congruency – often there is some gapping on medial side of TN joint due to erosion of medial side of the navicular or developmental changes of the joint over time.
V. Correction of all components of the deformity is critical to success.  
A. Ask yourself these questions before you leave the OR:  
1. Is talus reduced?  
2. Is forefoot abduction corrected?  
3. Is Meary’s line restored?  
4. Is calcaneal pitch increased?  
5. Is height of hindfoot increased?  
6. Is Tripod of foot restored with a plantigrade forefoot and full correction of the forefoot varus?  
7. Is the ankle stable?  

VI. Results of Operative Treatment  
A. Results of Stage 3 Treatment - Triple Arthrodesis  
1. Graves, Mann & Graves (JBJS, Mar. 1993)  
   • 18 feet (17 pts) with variety of Dx (PTT rupture, RA, neuropathic arthropathy, trauma, polio, stroke), average age 66 y/o  
   • 3.5 yrs average follow-up  
   • Average radiographic change Pre → Post  
     ▪ Talus-1st metatarsal angle: 22° → 9°  
     ▪ Lateral talocalcaneal angle: 38° → 26°  
     ▪ AP talus 2nd metatarsal angle: 36° → 16°  
   • Complications  
     ▪ 3 feet with nonunions  
     ▪ 7 feet with progressive degenerative ankle disease  
     ▪ 7 feet with progressive degenerative foot disease  
     ▪ 2 feet with infections  
     ▪ 1 foot collapse 2°/2 pre-mature, unauthorized WB  
     ▪ 1 foot subtalar joint staple impingement on tip of fibula → staple removal  
   • Patient satisfaction  
     ▪ Satisfied: 15 feet  
     ▪ Dissatisfied: 3 feet  
     ▪ All 17 patients had less pain postoperatively  
     ▪ 11 patients still had some discomfort  
   • Conclusions  
     ▪ Use only as salvage operation because of technical difficulty and postoperative complications  

2. Fortin & Walling (CORR, Aug. 1999)  
   • 32 feet with Stage III or IV adult acquired flatfoot, average age 63 y/o  
   • Standardized technique with BG and rigid internal fixation → 4.3 yrs average follow-up
• Average radiographic improvement
  ▪ Lateral talus-1st metatarsal angle: 18°
  ▪ Lateral talocalcaneal angle: 13°
  ▪ AP talus-1st metatarsal angle: 15°
  ▪ Navicular height increase: 17mm

• Complications
  ▪ 1 nonunion & 2 residual varus malunions
  ▪ 4 patients postoperative varus heel position
  ▪ 2 treated with shoe modification
  ▪ 2 Dwyer closing wedge osteotomy
  ▪ 1 patient progressive N-C joint sag → no Tx
  ▪ 2 patients plantar heel pain → screw removal
  ▪ 1 of 2 Stage IV feet → progression of ankle Sxs → subsequent ankle arthrodesis

• AOFAS hindfoot score ↑ 36 points

• Patient satisfaction
  ▪ Satisfied: 22 feet
  ▪ Satisfied with reservations: 2 feet
  ▪ Dissatisfied: 2 feet
  ▪ All but one patient would undergo procedure again

• Conclusions
  ▪ Acceptable treatment for late stage deformities
  ▪ Must be aware of long-term compensatory/degenerative arthritic changes of the ankle and midfoot

3. Pell, Myerson, & Schon (JBJS, Jan. 2000)
• 132 feet with a variety of deformities and preoperative diagnoses (95/132 feet planovalgus or pes planus)
• Triple arthrodesis with rigid screw fixation and joint realignment without wedge resections → 5.7 yrs average follow-up
• Average radiographic improvement
  ▪ Lateral talus-1st metatarsal angle: 14°
  ▪ Talocalcaneal coverage angle: 26°
  ▪ AP talus-1st metatarsal angle: 14°

• Complications
  ▪ 4 superficial wound problems
  ▪ 3 nonunions
  ▪ 1 superficial peroneal neuritis
  ▪ 1 Charcot-like neuroarthropathy
  ▪ 1 Achilles tendon rupture
  ▪ 1 peroneal tenosynovitis
Patient satisfaction
- Average AOFAS postoperative ankle-hindfoot score 60.7 points
- Significant increase in postoperative ankle arthritis – though not associated with patient satisfaction
- 91% stated they would have the procedure again
- Overall patient satisfaction 8.3 (10 = completely satisfied) – significant association with postoperative alignment
- 20% required modified shoes or AFO at follow-up

Conclusions
- Effective in relieving pain and improving functional deficits
- High prevalence of subsequent ankle arthritis

REFERENCES