Role of the Deltoid in Valgus Malalignment

1) The Deltoid

a. Four Branches (Boss and Hintermann, FAI, June 2002)
   i. Deep posterior tibiotalar
      1. Resists external rotation
   ii. Superficial tibiocalcaneal
      1. Resists eversion
   iii. Tibial spring and tibial navicular

b. Role in valgus
   i. Evolves from acute injury
      1. Severe sprain
      2. Ankle fracture (SER IV, PER, Masionneuve)
   ii. Evolves from chronic attenuation
      1. Posterior tibial tendon insufficiency (Stage IV)
      2. Prior triple arthrodesis with valgus malunion

c. Noted points
   i. Sectioning the deltoid leads to 43% less tibiotalar contract surface
      1. Increased contract stresses can lead to arthritic changes
         within the ankle joint, emphasizing the need to
         reconstruct this ligament
   ii. Tibiotalar motion effect of fibula displacement and deltoid transection (Sasse, et.al, FAI 1999)
      1. In dorsiflexion or plantarflexion, an intact lateral malleolus is not
         necessary for physiological talar tracking
         a. With intact deltoid ligament
      2. In fibula fracture with significant injury to the deltoid ligament, healing
         of the delto id at its resting length is crucial to restoring physiological
         talar rotation
   iii. Evaluating the need for acute surgical repair (Harper, CORR, 1988)
      1. Functional results appeared satisfactory provided surgical reduction of
         the medial joint space and lateral malleolus were accurate
      2. In depth
         a. 42 patients
         b. 20 SER IV
         c. 18 PER
         d. 4 Masionneuve
      3. Initial reduction deemed good in all but one patient
      4. Only 36 of 42 were followed for 1 year
         a. 8 (20%) had changed from good to fair
         b. In 3 of these the reduction of the medial joint space changed
            from good to poor
         c. Subjectively 28 good, 7 fair, 1 poor
d. Thus, is it possible that primary repair would have benefit in deltoid injuries to prevent late term valgus?

2) Correction
   a. Acute
      i. Primary repair of the deep posterior tibiotalar ligament may be difficult due to short resting length and lack of available tissue
         1. Surgeon MUST expose this ligament deep to the posterior tibial tendon
         2. May allow end-to-end repair, or anchor to medial malleolus
         3. Superficial repair critical and commensurate with deep repair
   
   b. Chronic
      i. Preferred method
         1. semitendinosis graft weaved on a continuum through drill hole at the intercollicular groove of the medial malleolus
            a. exiting at 45 degree angle at anterior distal tibia
         2. free ends of tendon anchored to lateral walls of talus and calcaneus through internal metallic button technology
            a. key is origin point inferior and posterior to medial malleolus in talus (deep) and sustentaculum tali (superficial)
            b. key is to not remove middle facet or sustentaculum while preparing surfaces for triple
            c. key is screw placement for triple
               i. avoid screws placed in proposed tunnel locations
            d. key is to measure graft length carefully
               i. calcaneal and talar tunnels
               ii. distal tibia tunnel (this number must be doubles, as the graft is looped upon itself).
               iii. distance between medial malleolus tunnel and deep and superficial insertion points (generally 3cm total)
               iv. add 4cm to ensure tendon loop exits superior tibial drill hole successfully
               v. subtract 2cm for the 1cm per limb attachment of button to tendon graft
         e. key is to orient guide wires for talar and calcaneal tunnels anteriorly (and inferiorly at calcaneus to avoid sinus tarsi)
            i. the latter tunnel should exit about 2cm proximal to calcaneocuboid joint

   ii. Experimental Results
       - Angular displacement at 2Nm torque was significantly greater in the sectioned group compared to the deltoid reconstruction group in both external rotation (p=0.006) and eversion (p=0.047).
       - No statistical difference in angular displacement between the native deltoid intact and the reconstructed group in external rotation (p=0.865) and eversion (p=0.470) tested at 2Nm.
       - Loading the specimens at 2Nm torque revealed the deltoid ligament reconstruction was 98.1% able to withstand angular displacement compared to native deltoid in external rotation.
       - Loading the specimens at 2Nm torque revealed the deltoid ligament reconstruction was 52.3% able to withstand angular displacement compared to native deltoid in internal rotation (though compared to
sectioned deltoid ability to withstand internal rotation at 2Nm was significantly improved (p=0.034).