I. Introduction
A. Relatively uncommon cause of persistent pain following “ankle sprain”
B. Calcaneonavicular tarsal coalition more common as a cause of pain in this setting
C. Mechanism: Disruption of fibrous/fibrocartilaginous coalition with twisting injury to foot/ankle
D. Two Common Scenarios:
   1. Active adolescent with complaint of recurrent sprains/stiff hindfoot
      a. “peroneal spastic flatfoot”
      b. “tibialis spastic varus foot”
   2. Adult with painful hindfoot after sprain and pre-existing painless tarsal coalition

II. Definition: developmental fibrous, cartilaginous or bony connection between two or more tarsal bones (usually calcaneus/navicular or talo/calcaneal) → often a relatively rigid flat appearing foot that can become painful

III. Etiology:
A. Failure of differentiation and segmentation of primary mesenchyme in the developing fetus
B. Usually an isolated finding, in an otherwise normal foot
C. Autosomal dominant inheritance: Of 1st degree relatives 33% of the parents and 46% of the siblings had coalition

IV. Incidence & Classification:
A. <1%, many are not symptomatic, male predominance, calcaneal-navicular likely to be bilateral, clinically calcaneonavicular more common than talocalcaneal; co-existence of two different coalitions, in same foot is possible; coalitions also can occur in talonavicular, calcaneocuboid, navicolocuneiform, navicolucuboid, and tarsometatarsal joints
B. Coalitions start as fibrous and cartilaginous tissue and evolve into osseous tissue (8-12 yrs for calcaneal/navicular and 12-16 for talo/calcaneal) and then become more symptomatic; Stormant and Peterson noted that ⅓ of their patients did not develop symptoms until adulthood

V. Pathomechanics/Clinical Findings:

Adolescent Presentation
A. As patient grows and/or coalition stiffens, hindfoot/midfoot activity related pain occurs in most &/or flatfoot in some; onset insidiously in second decade; often and early middle facet talocalcaneal coalitions will be painful medially and calcaneonavicular coalitions laterally; pain also secondary to increased stress at talonavicular/calcaneocuboid or subtalar joints
B. Flatfoot appearance that is a relatively rigid; hindfoot/midfoot stiffness on exam, noted lack of heel inversion on toe rise
C. Reactive peroneal spasm or tibialis anterior/posterior spasm is a secondary not a primary event due to involuntary reactive spasm of muscles due to (?spinal cord reflex pathway) a painful hindfoot/midfoot
**Adult Presentation** (CN Coalition)
A. Persistent lateral pain after inversion “ankle sprain” mechanism  
B. Physical findings demonstrate limited subtalar and or transverse tarsal joint motion. (Some may have normal inversion/eversion on exam!)  
C. Tenderness is located over CC joint area - more distal than typical ATFL location  
D. No reactive peroneal spasm

**VI. Imaging Studies**
A. Radiographs: Need both ankle and foot films to evaluate this following ankle sprain:
   1. Calcaneonavicular: A-P, and 45 degree medial oblique; pathologic bony/fibrous connection between navicular and calcaneus; on lateral x-ray look for elongated projection of calcaneus “anteater nose”  
   2. Talocalcaneal: A-P, lateral (posterior and middle facet narrowing); 45° Harris (axial view) of hindfoot (absent middle facet jt)  
B. CT scans: definitive for identifying talocalcaneal coalition typically obtain CT prior to resecting a calcaneonavicular coalition so as to rule out a second coalition

**VII. Treatment:**
A. Non-operative: symptoms in adolescents may resolve with (cast) immobilization, custom orthotics and/or activity modification  
B. Operative: surgical treatment indicated for patients with continued problematic pain.
   1. Primary goal: Improve pain  
   2. Secondary goal: restore motion & alignment as possible → improve function  
   3. Technique:
      a. Calcaneal-navicular coalition technique:
         1. oblique or longitudinal incision over anterolateral Chopart’s joint  
         2. distal reflection or splitting of ext. digitorum brevis  
         3. careful but extensive resection of coalition (avoid unnecessary damage to articular surfaces of CC or TN  
         4. complete resection; void is trapezoid, not a cone shape  
         5. void filled by insertion of ext. digitorum brevis or free posterior thigh fat graft  
   6. postoperative: immobilize with Jones bulky dressing; NSAID’s for six weeks post-op; at 10-14 days start intermittent range of motion (foot circumduction) and protect with walker boot with limited weight-bearing  
   7. progress to full weight-bearing and wean out of boot by 6-8 weeks

Harris & Beath
b. **Talo-calcaneal technique:**
   1. medial hindfoot approach, retract posterior tibialis dorsally; identify FDL and retract plantarward, along with NVB and FHL
   2. incise and reflect peristeum over coalition; shave off layers of bone over suspected location of middle facet and subtalar joint comes into view
   3. cover bleeding bone surfaces with bone wax and fill void created with posterior thigh fat graft

   —For problematic hindfoot valgus deformity, consider calcaneal osteotomy either neck lengthening or medial tuberosity slide at the same time as resection or staged in 3-6 months; correction of hindfoot valgus optimizes improvement after resection of a talocalcaneal coalition

   —Post-op care as above for calcaneonavicular

4. Arthrodesis may be indicated for failure of resection, fibrous coalition, very large bony coalition or DJD in older patients
   —isolated subtalar arthrodesis if deformity not too severe; if deformity severe consider triple arthrodesis

4. **Potential Pitfalls**
   a. Failure to recognize tarsal coalition as a pain generator in adult patient
   b. Failure to detect a second coalition (typically a talocalcaneal)
   c. Spastic cavovarus deformity with underlying calcaneal navicular coalition → resect coalition first, then cavovarus foot reconstruction (Stuecker & Bennett (*Foot Ankle*, 1993)
   d. Degenerative (fibrous) middle facet coalition; typically large patient with pes planus and painful degenerative subtalar arthrosis → do not resect; rather surgically treat flatfoot deformity with osteotomies or fusion. Luhmann et. al. (*Foot Ankle Int, 2000*)

**Bibliography**

3) Cohen BE, Davis WH, Anderson RB: Success of calcaneonavicular coalition resection in the adult population. *Foot Ankle Int* 17(9): 569-72, 1996


