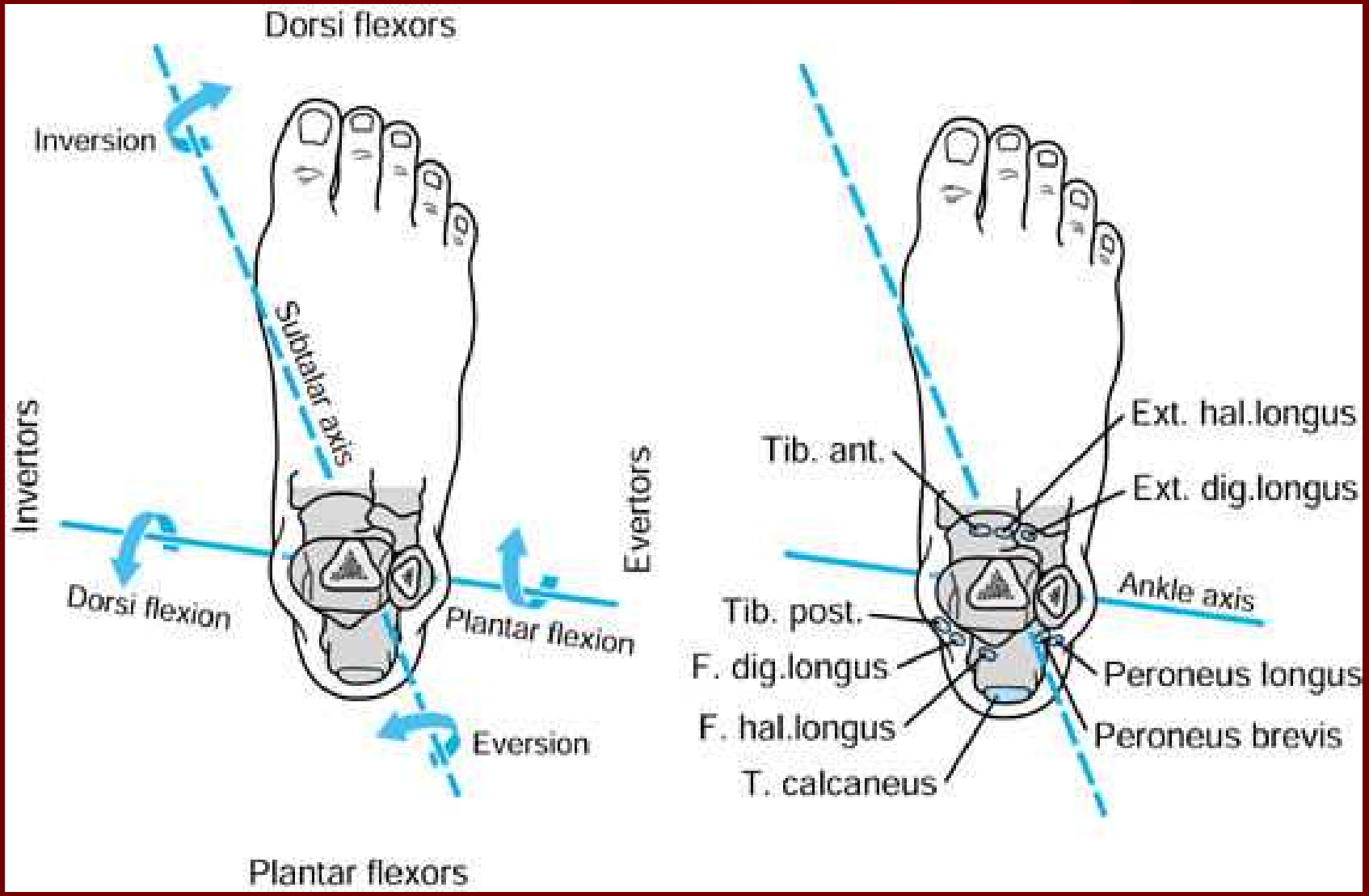
Foot and Ankle Tendon Pathology

Overview

- Peroneals
- Flexor Hallucis Longus
- Achilles
- Anterior Tibialis
- Extensor Digitorum Longus and Extensor Hallucis Longus

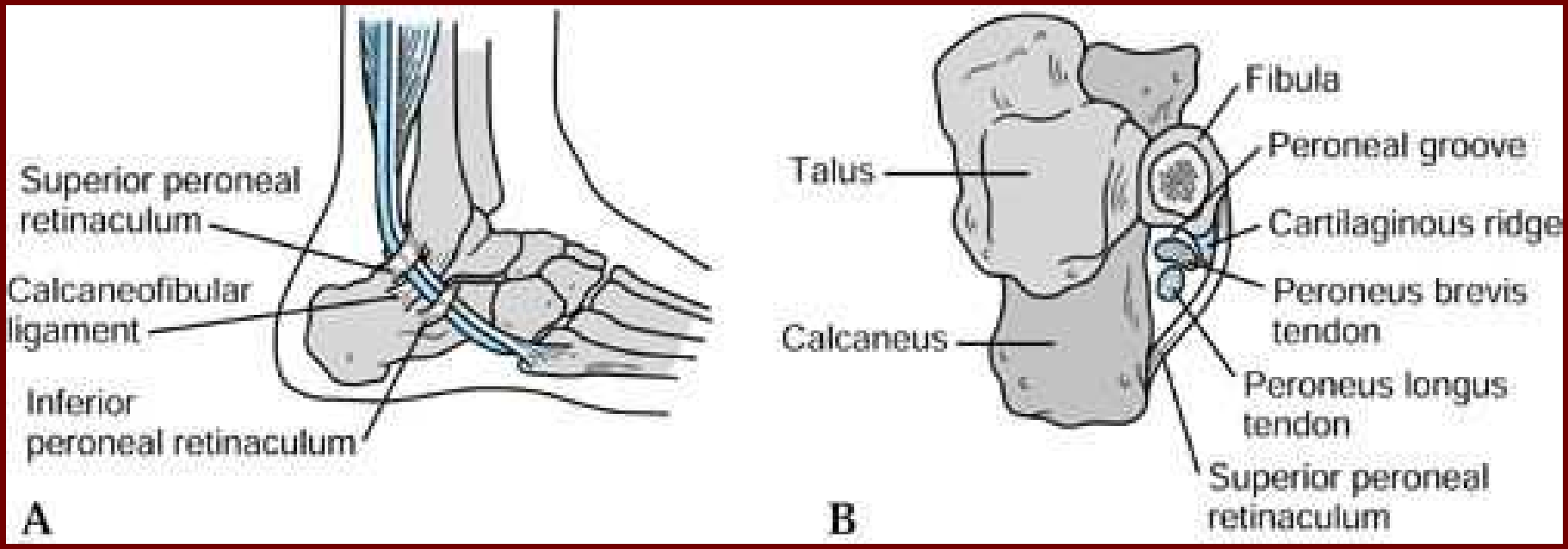
Tendon Moments



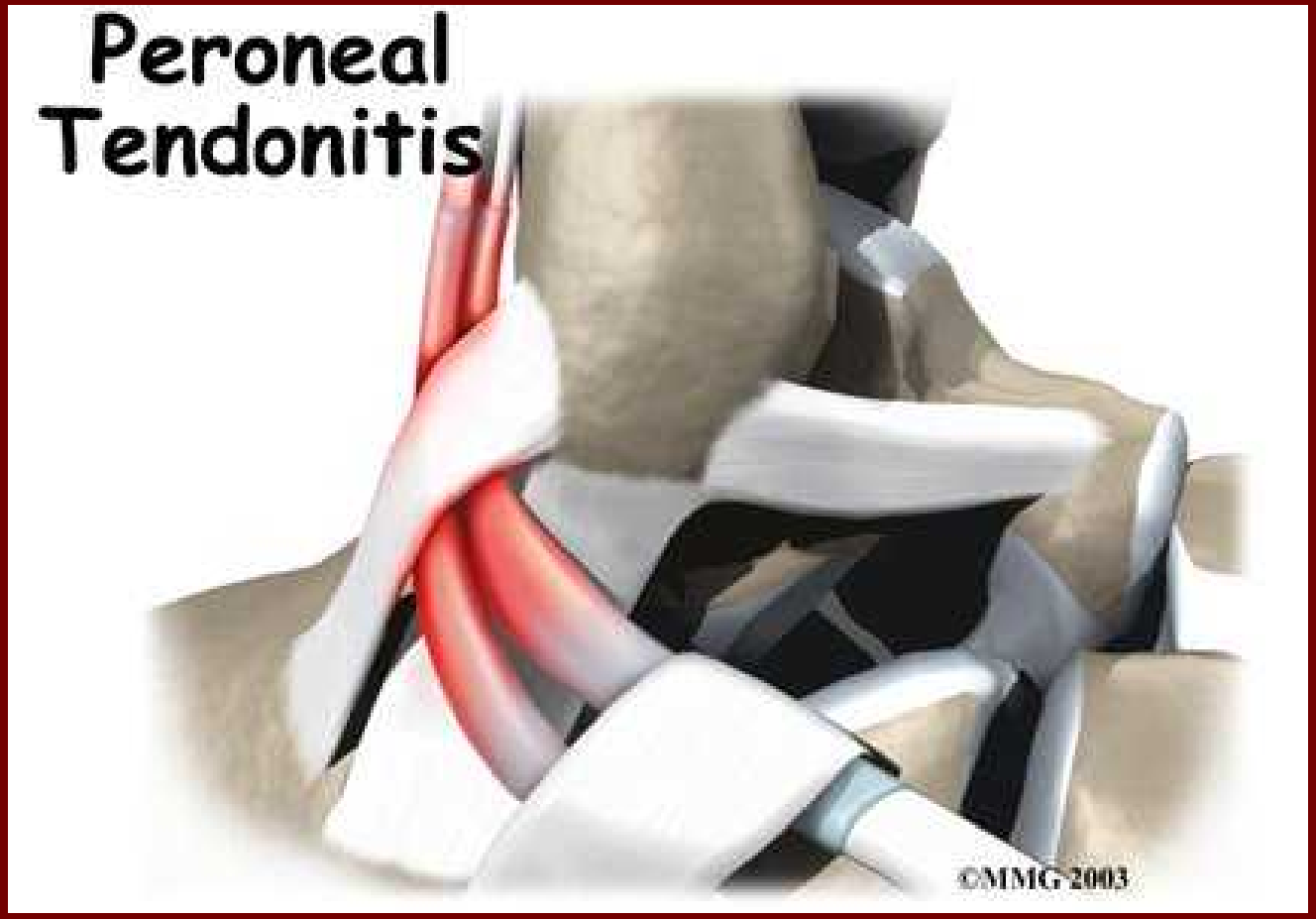
Peroneus Longus and Brevis

- Anatomy
  - Ankle
    - Superior Peroneal Retinaculum (SPR)
      - From Posterolateral ridge of fibula to lateral calcaneus or Achilles sheath
    - Fibular groove (retromalleolar sulcus)
      - Flat or concave in 18-28% of the population
    - Brevis runs anterior and medial at this level
    - Peroneus Brevis has an avascular zone at this level

Anatomy of Fibular groove



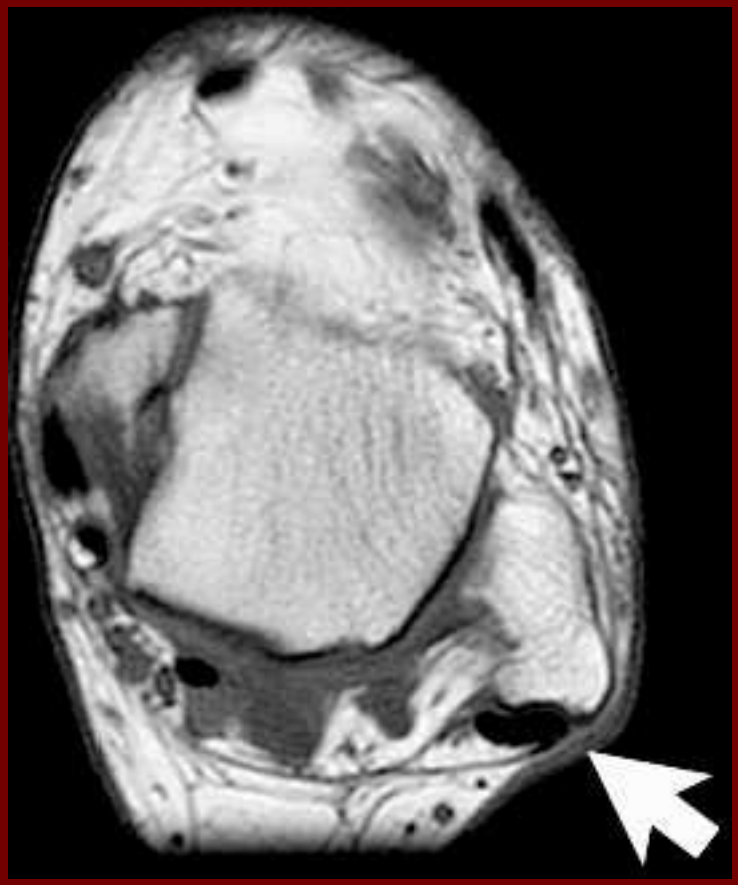
Anatomy of SPR



Peroneus Longus and Brevis

- Anatomy
  - Foot
    - Brevis
      - Above peroneal tubercle of calcaneus
      - Inserts on base of 5th MT
    - Longus
      - Below tubercle
      - Makes 90° bend at calcaneocuboid joint
      - Os peroneum at this bend
      - Inserts on 1st MT base and Medial Cuneiform

Normal Anatomy

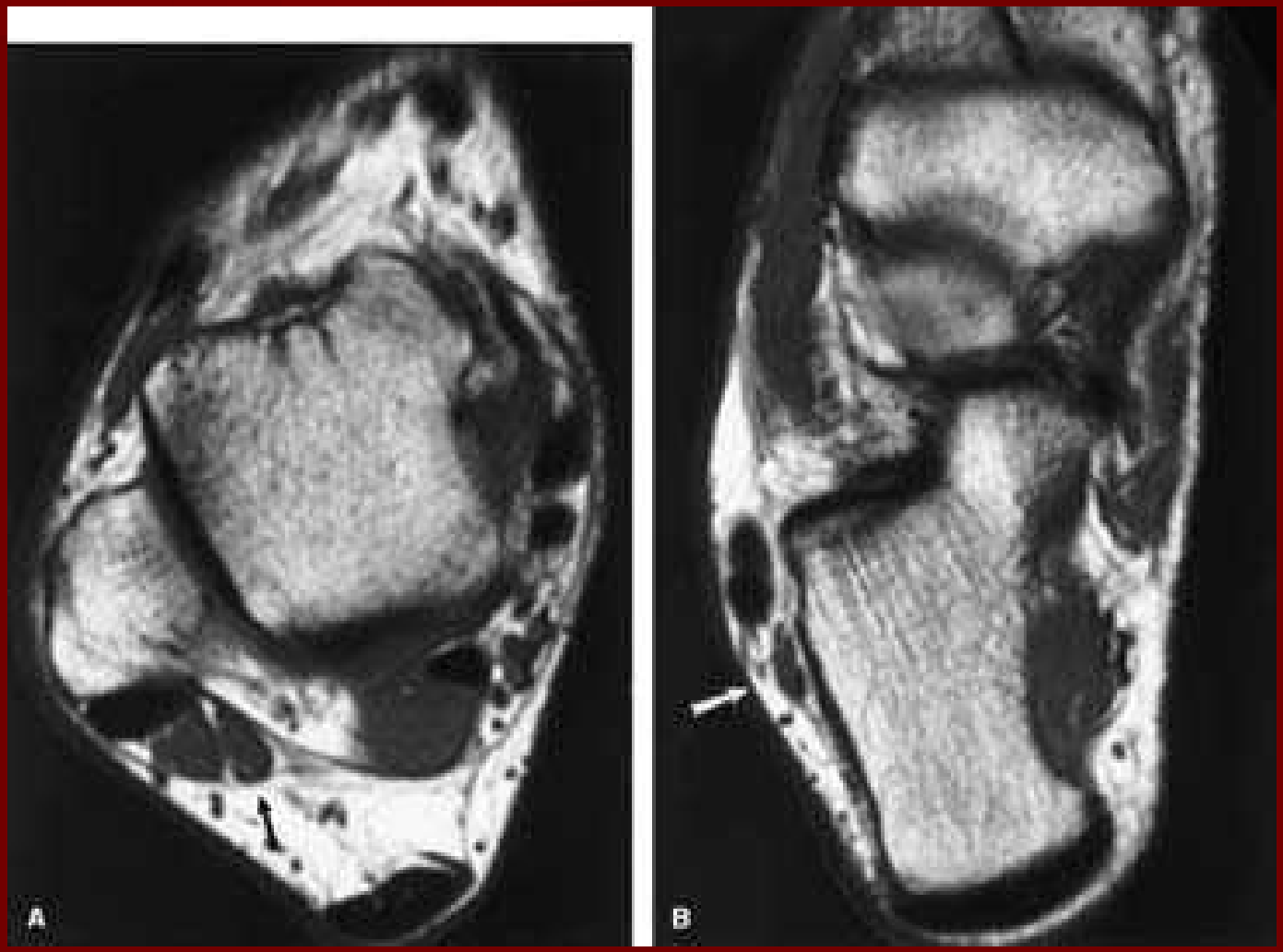


Normal Anatomy

Peroneals

- Peroneus quartus
  - Variation present in 10-20%
  - Originates from PB muscle
  - Inserts on lateral calcaneus
  - Causes crowding in the fibro-osseous tunnel, pain, attenuation of SPR, and tendon subluxation
- Low-lying Peroneus Brevis muscle belly
  - Also causes crowding

Peroneus Quartus



Peroneals

- Acute injury
  - Rupture
    - Rare
    - Acute repair probably best

Peroneals

- Acute injury
  - Subluxation/dislocation
    - Mechanism
      - Violent contracture of tendons in dorsiflexed position
    - Diagnosis
      - Confused with lateral sprain
      - Occasionally tendons stay dislocated

Peroneals Acute Issues

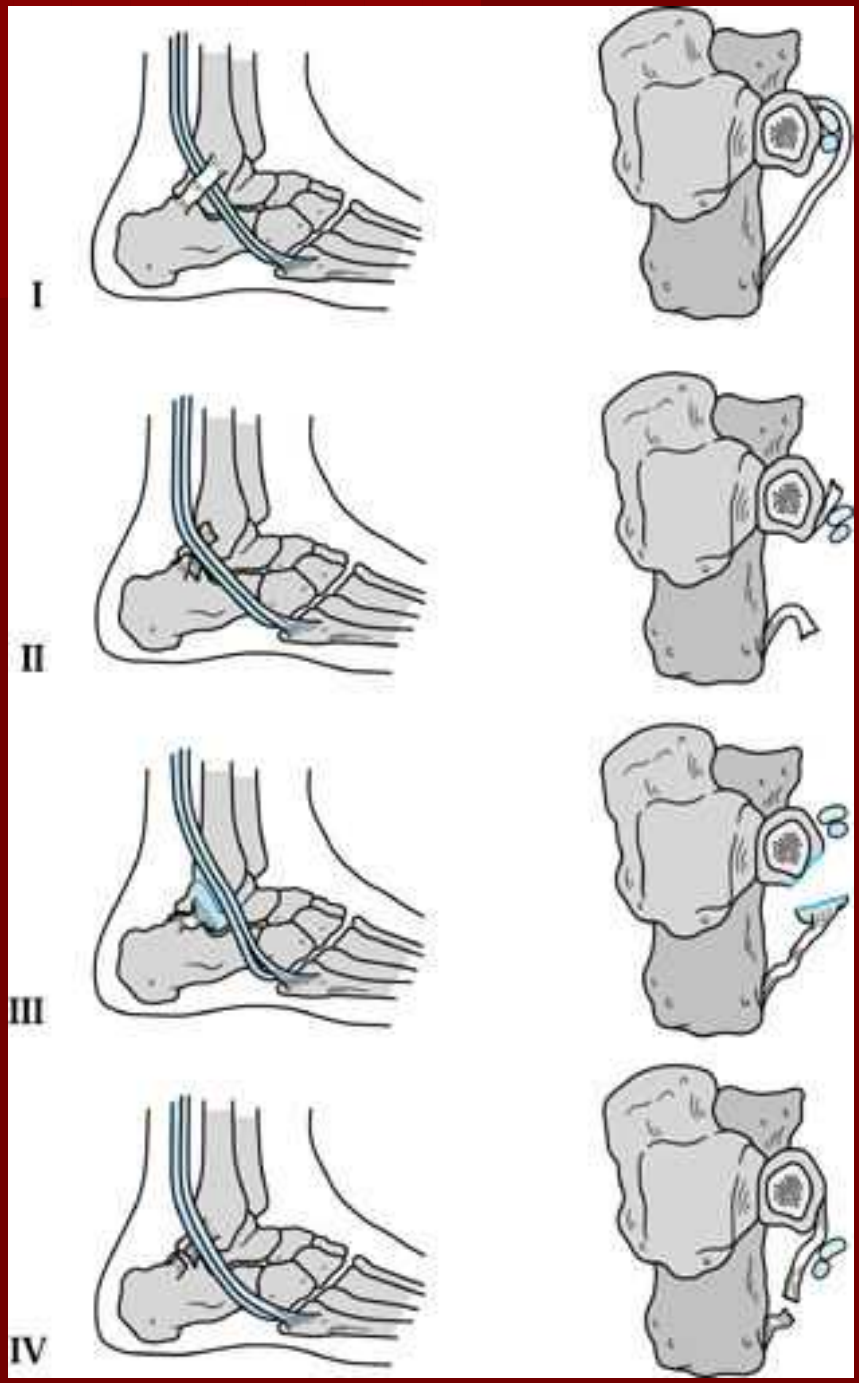
- Subluxation/dislocation
  - Diagnosis
    - Provacative maneuvers
      - Pt moves foot from plantarflexed to everted and dorsiflexed position against resistance while palpating groove
      - Pt circumducts the ankle while palpating groove
      - Compare, as some subluxation may be physiologic

Classification

- Eckert and Davis
  - Grade I
    - Avulsion of Anterior attachment of SPR with cuff of periosteum
  - Grade II
    - Avulsion with fibrocartilaginous rim
  - Grade III
    - Avulsion with bony fragment

Classification

- Oden
  - I. Periosteal degloving
  - II. Soft tissue fibular avulsion/rupture
  - III. Bony fibular avulsion
  - IV. Soft tissue calcaneal avulsion/rupture



Conservative Management

- Compressive dressings or cast management
- Success rate less than 50%
- Appropriate for low functioning patients

Surgical Management

- Appropriate for most cases of acute instability
- Usually consists of direct repair with imbrication as needed

Primary Repair

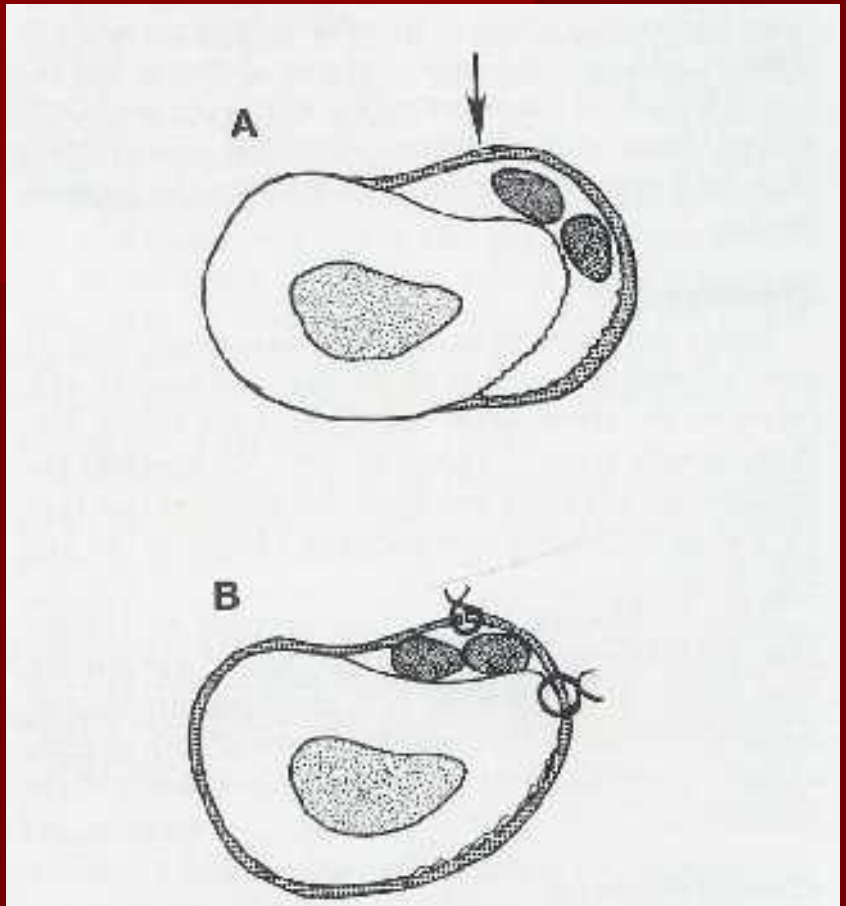


FIG 19–7.
Diagram of a transverse section of the cistal end of the left fibula viewed from above. **A,** false pouch formed by stripping of the periosteum from the lateral malleolus in continuity with the superior peroneal retinaculum. *Arrow* denotes the site for incision in the retinaculum. **B,** normal anatomy is restored by obliteration of the false pouch and closing the incision in the peroneal retinaculum. (Redrawn from DasDe S, Balasubramanium P: *J Bone J Surg [Br]* 67:585–587, 1985.)

Peroneals

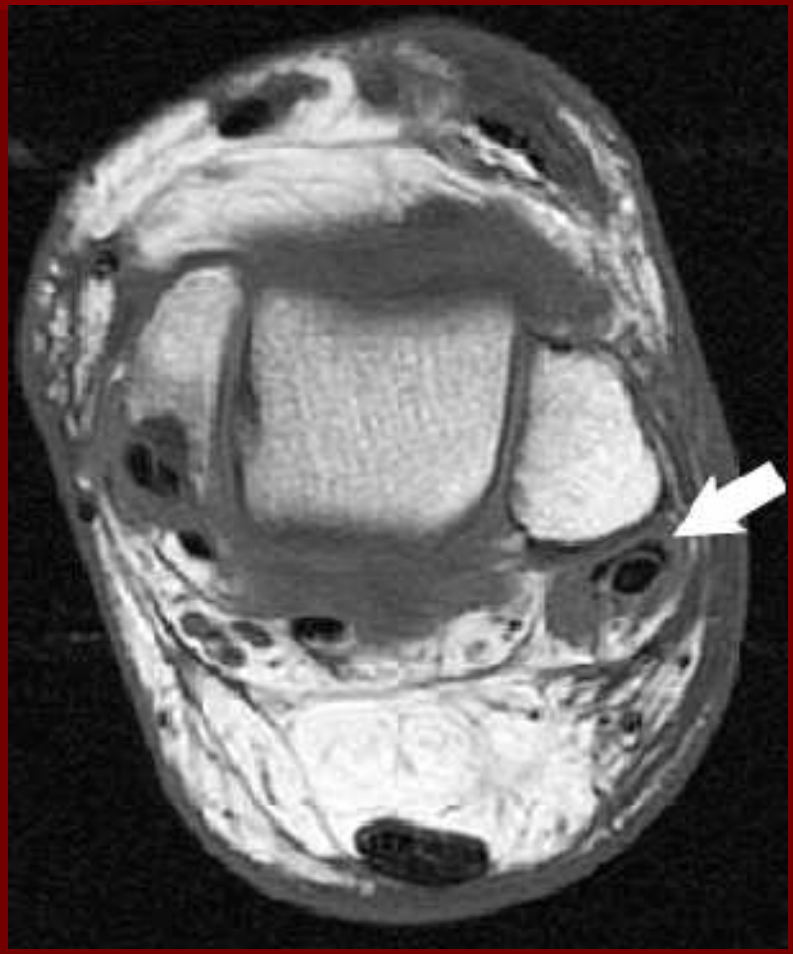
- Chronic problems
  - Instability
  - Tendinosis
  - Split tears
- Likely a continuum
  - Subluxation of the Brevis over corner of fibula with over-riding Longus leads to degeneration and eventual tears

Chronic Injuries

- Diagnosis
  - Lateral ankle pain - nonspecific
  - Subluxation
  - Peroneal tunnel compression test
    - Firmly palpate over SPR
    - Pt moves foot from plantarflexed/inverted to dorsiflexed/everted position
    - Positive if reproduction of symptoms

MRI

- Tendinosis
  - Increased signal on proton-density and T2
- Longitudinal split
  - Linear clefts
  - Wrapping around PL
  - Multiple tendon strips
  - Peroneus tertus



Chronic Peroneal Issues

- Reestablishing the SPR most important
  - Either repair/imbrication or reconstruction
- Peroneus tertus
  - Excise
  - Can use for reconstruction of SPR
- Low-lying PB muscle belly
- Often coexistent lateral ankle instability that must be addressed

Chronic Peroneal Issues

- PB longitudinal split tears
  - Central tears
    - Debride and retubularize with 3-0 to 4-0 absorbable
  - Peripheral tears
    - Can debride up to 50%
  - Near complete tears
    - Proximal and distal tenodesis to PL

Repair Split Tears

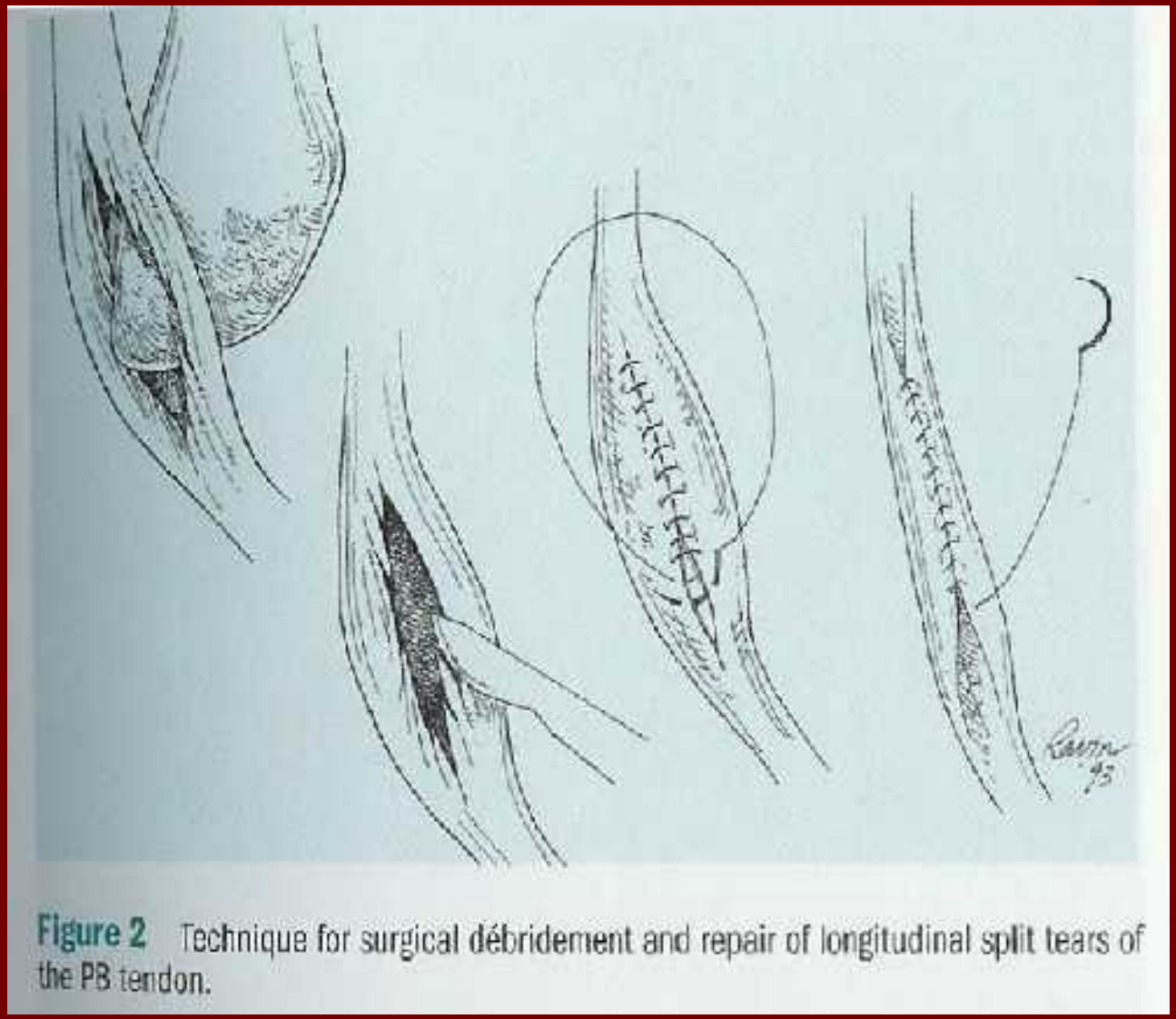
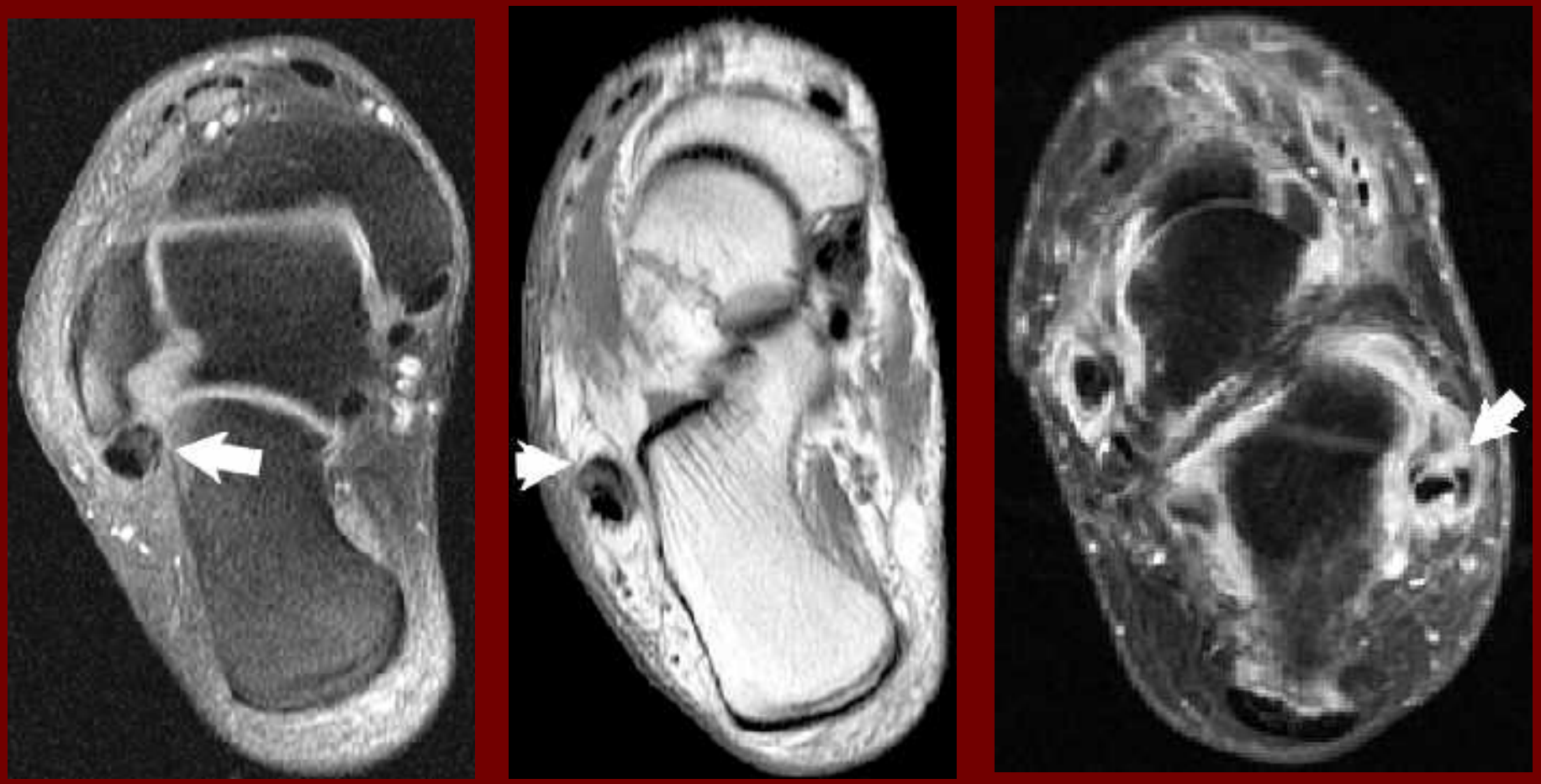


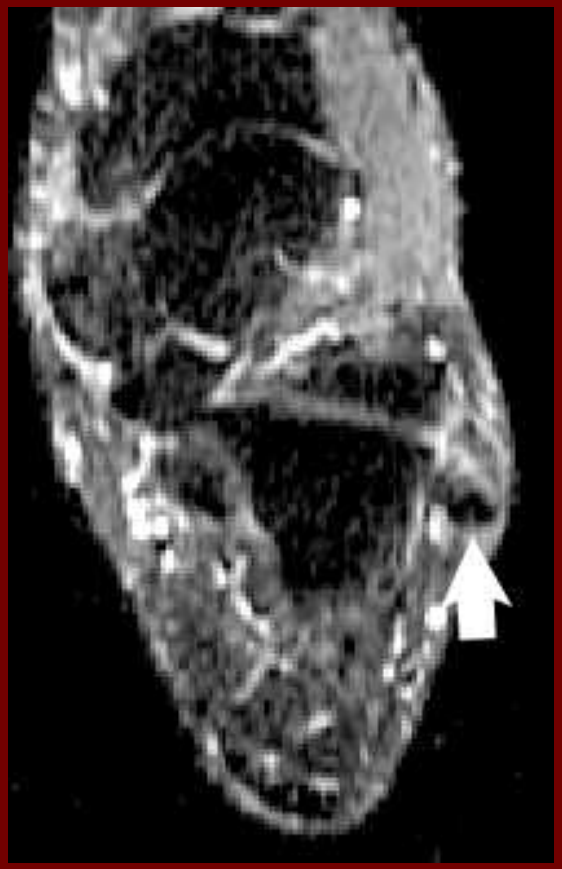
Figure 2 Technique for surgical débridement and repair of longitudinal split tears of the PB tendon.

Peroneus Brevis Split Tears



PB Split Tears

PB Split Tears



Chronic Peroneal Subluxation

- Surgical options
  1. Direct repair or reattachment of SPR
  2. Reconstruction of SPR
  3. Bone block procedures
  4. Groove-deepening procedures
  5. Rerouting procedures under the calcaneofibular ligament

Soft Tissue Reconstruction

- Ellis-Jones reconstruction
  - Uses flap of Achilles tendon
- Evan's lateral ankle reconstruction
  - Sacrifice Brevis for sling
- Anomalous muscle sling
  - Peroneus tertius
- Plantaris sling

Soft Tissue Reconstruction

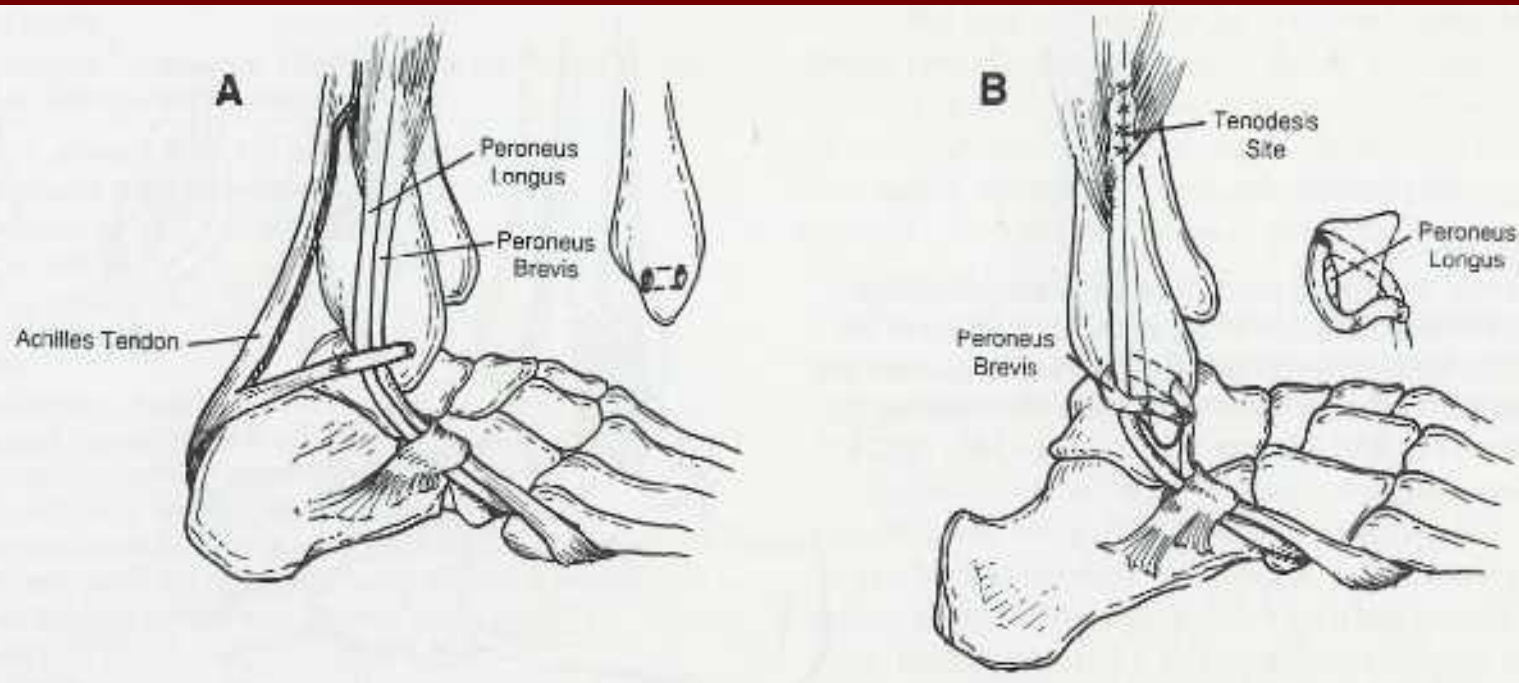


FIG 19–8.
Reconstruction of peroneal retinaculum. **A,** Ellis-Jones reconstruction of peroneal retinaculum employing the Achilles tendon. **B,** Allmans' modification of the Evans lateral ankle reconstruction. (Redrawn from Arrowsmith SR, Fleming LL, Allman FL: *Am J Sports Med* 11:142–146, 1983.)

Bone Block

- Sliding wedges of distal fibula

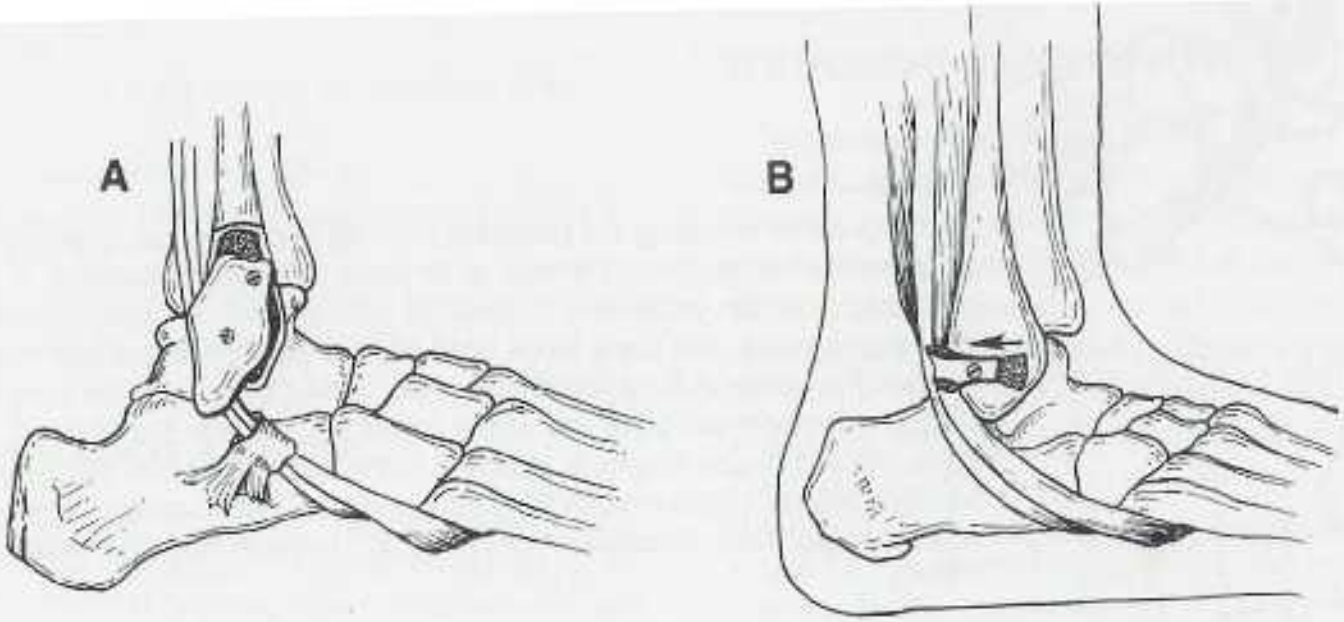
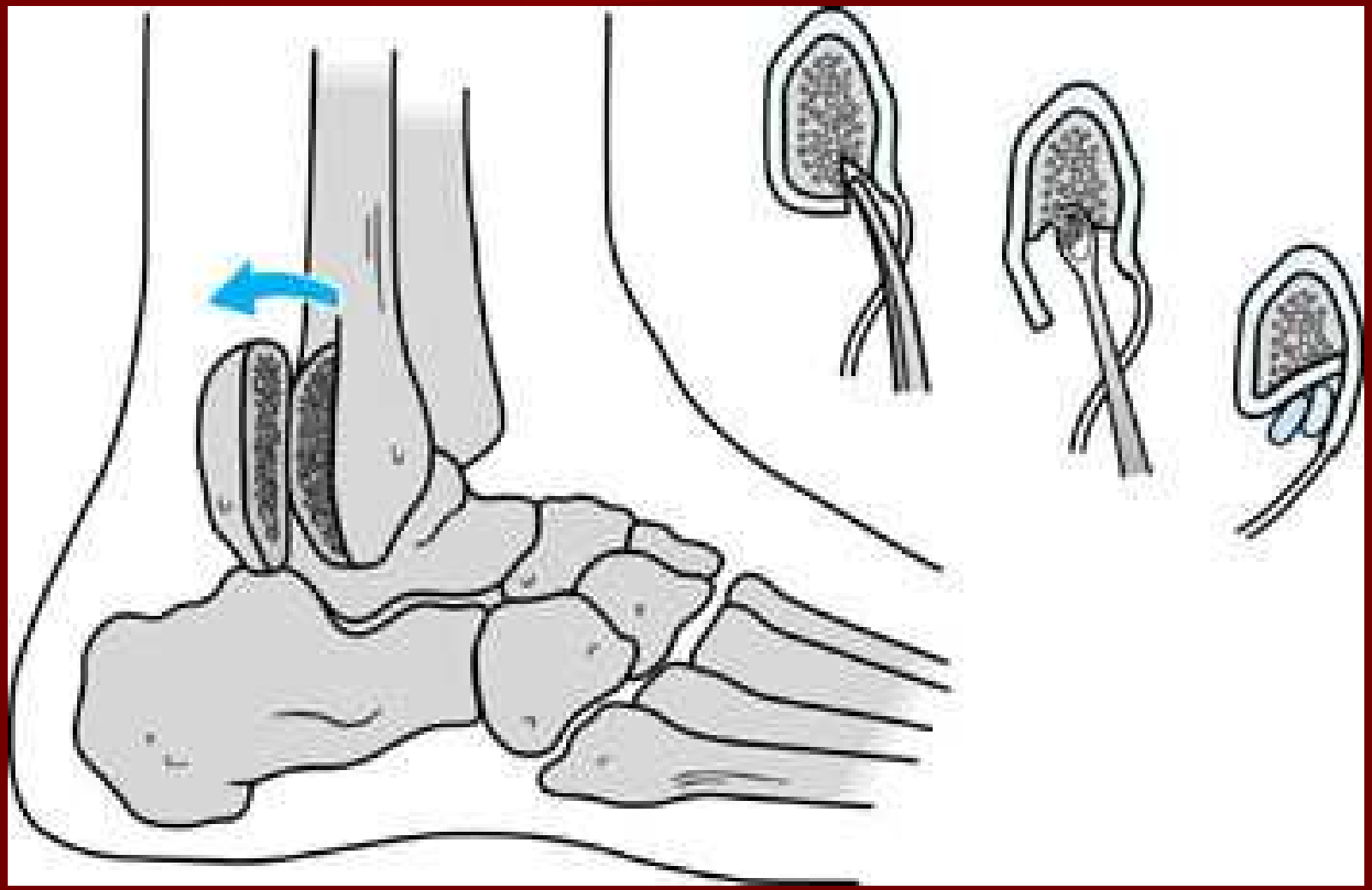


FIG 19–9.
Bone block procedures for repair of subluxing peroneal tendons. **A**, Kelly's first technique for deepening the retromalleolar sulcus. **B**, DuVries modification of Kelly's second technique, employing dovetail cuts to stabilized the sliding graft. (Redrawn from Arrowsmith SR, Fleming LL, Allman FL: *Am J Sports Med* 11:142–146, 1983.)

Groove Deepening Procedures

- Decancellization of the fibula
  - Trapdoor technique
    - Corticotomy of posterior distal fibula
    - Curet cancellous bone
    - Close trapdoor
    - Difficult and risky
  - Drillhole technique
    - 4.5 or 5 mm drill under cortex
    - Impact posterior cortex into defect

Trapdoor Decancellization



Rerouting

- Pass tendons under calcaneofibular ligament
- Osteotomy
  - Fibular attachment
  - Calcaneal attachment
- Divide and reattach tendons

Rerouting Procedures

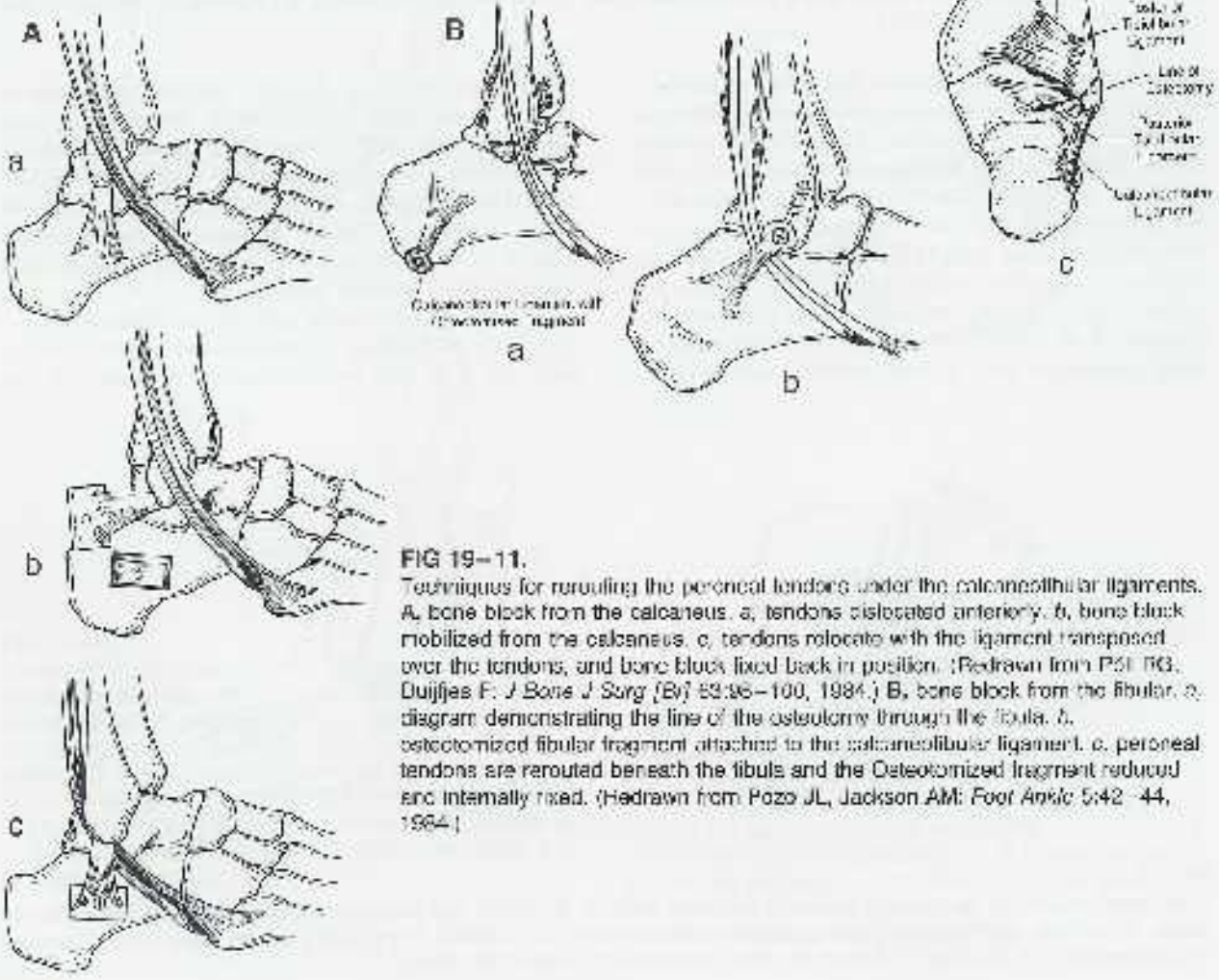


FIG 19–11.
Techniques for rerouting the peroneal tendons under the calcaneofibular ligaments. A, bone block from the calcaneus. a, tendons dislocated anteriorly. *b*, bone block mobilized from the calcaneus. c, tendons relocate with the ligament transposed over the tendons, and bone block fixed back in position. (Redrawn from PSI FIG. Duijfjes F: *J Bone J Surg [Br]* 62:96–100, 1984.) B, bone block from the fibular. a, diagram demonstrating the line of the osteotomy through the fibula. *b*, osteotomized fibular fragment attached to the calcaneofibular ligament. c, peroneal tendons are rerouted beneath the fibula and the Osteotomized fragment reduced and internally fixed. (Redrawn from Pozo JL, Jackson AM: *Foot Ankle* 5:42–44, 1984.)

Flexor Hallucis Longus

- Anatomy
  - Origin posterior Tibia and Fibula
  - Passes deep to flexor retinaculum
  - Runs in fibro-osseous tunnel along posterior talus between medial and lateral tubercles
  - Under sustentaculum tali
  - Deep to FDL at knot of Henry.

Anatomy

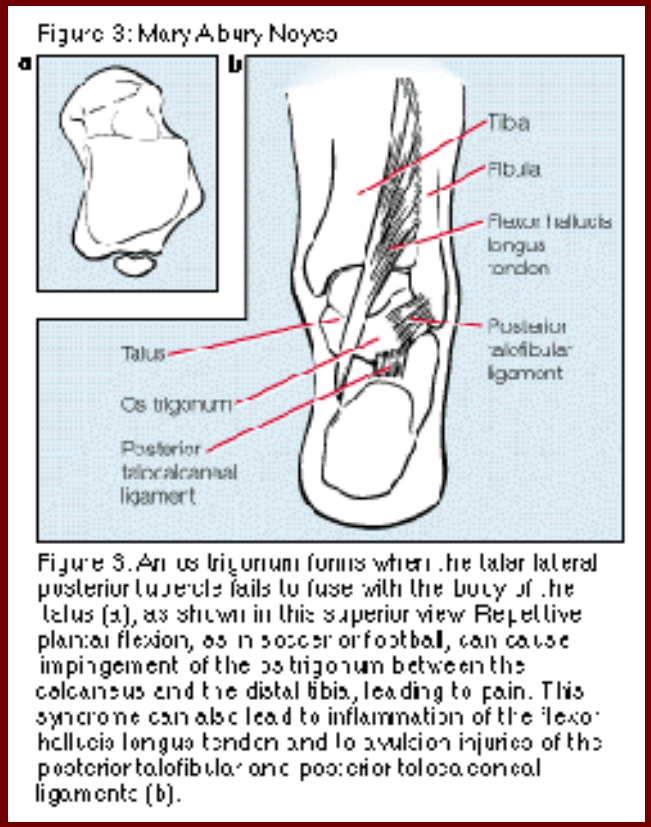
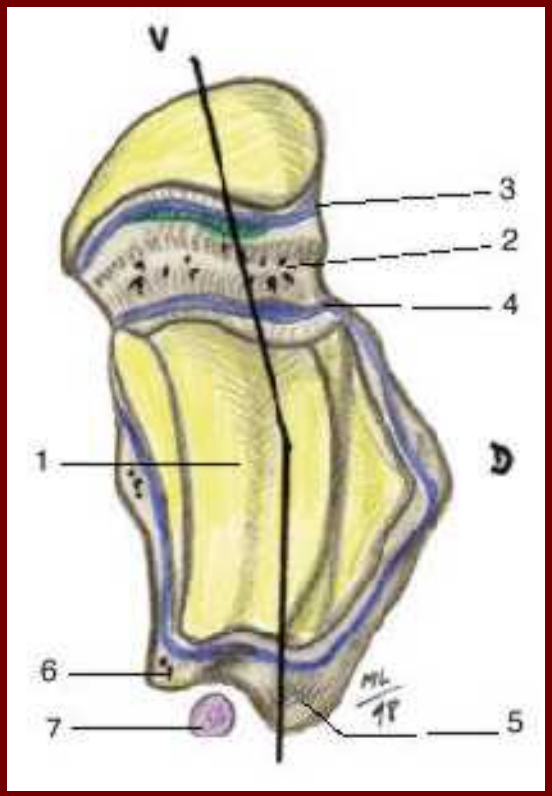
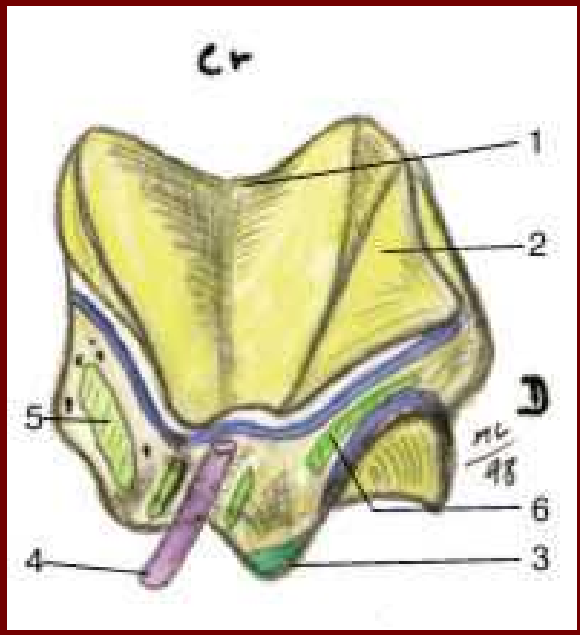


Figure 3. An os trigonum forms when the lateral posterior tubercle fails to fuse with the body of the talus (a), as shown in this superior view. Repetitive plantar flexion, as in soccer or football, can cause impingement of the os trigonum between the calcaneus and the distal tibia, leading to pain. This syndrome can also lead to inflammation of the flexor hallucis longus tendon and to avulsion injuries of the posterior talofibular and posterior talocalcaneal ligaments (b).





FHL

- Acute Injury
  - Usually lacerations
  - Rarely closed rupture
  - Probably only need to repair if FHB also injured

FHL

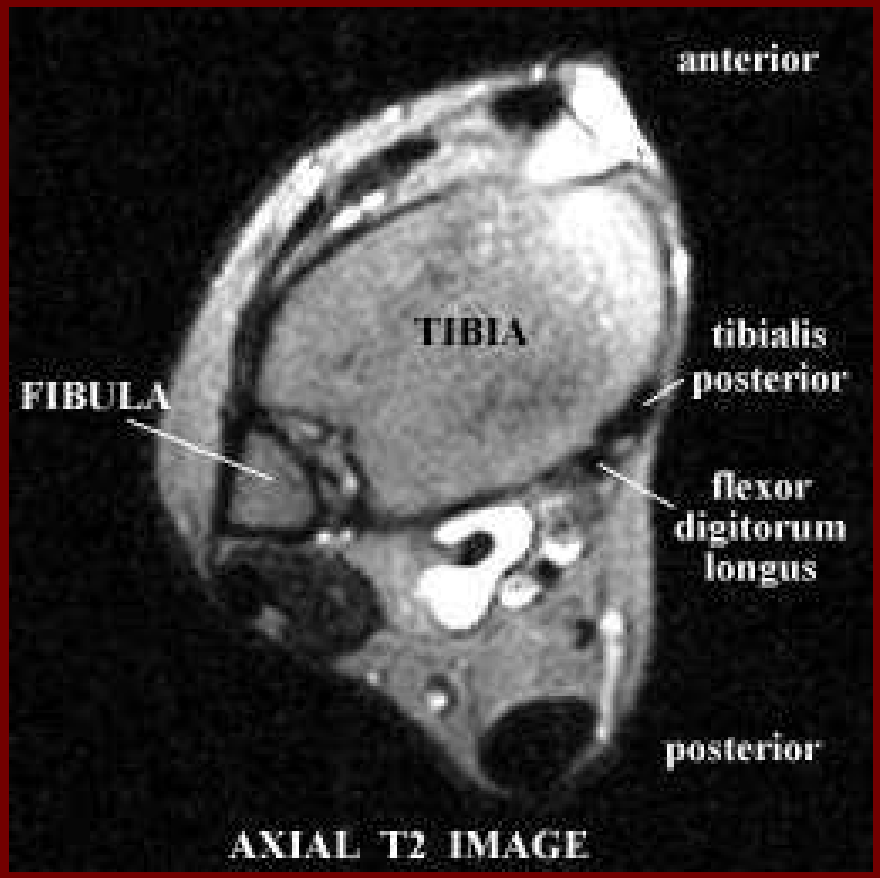
- Chronic
  - Tendonitis or stenosing tenosynovitis
  - Classically in ballet dancers, other dancers and gymnasts
  - Especially those who dance en pointe or demi-pointe

Pointe and Demi-Pointe

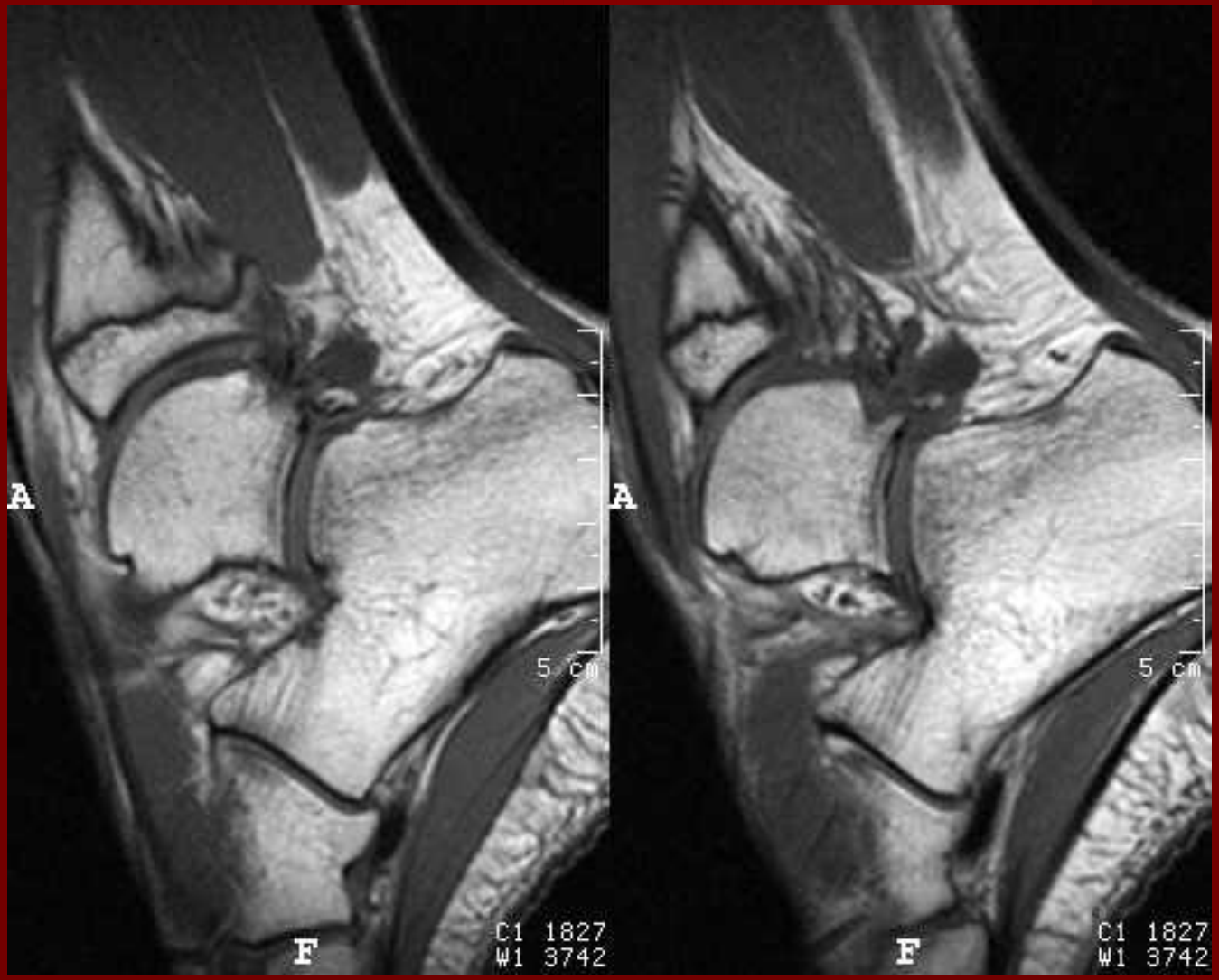
FHL Chronic

- Diagnosis
  - Posteromedial ankle pain
    - Exacerbated by activity (especially en pointe)
  - Triggering can occur
  - Exam
    - Pain with motion of hallux
    - Tenderness over sheath
  - Distinguish from Posterior impingement due to os trigonum or large posterior tubercle

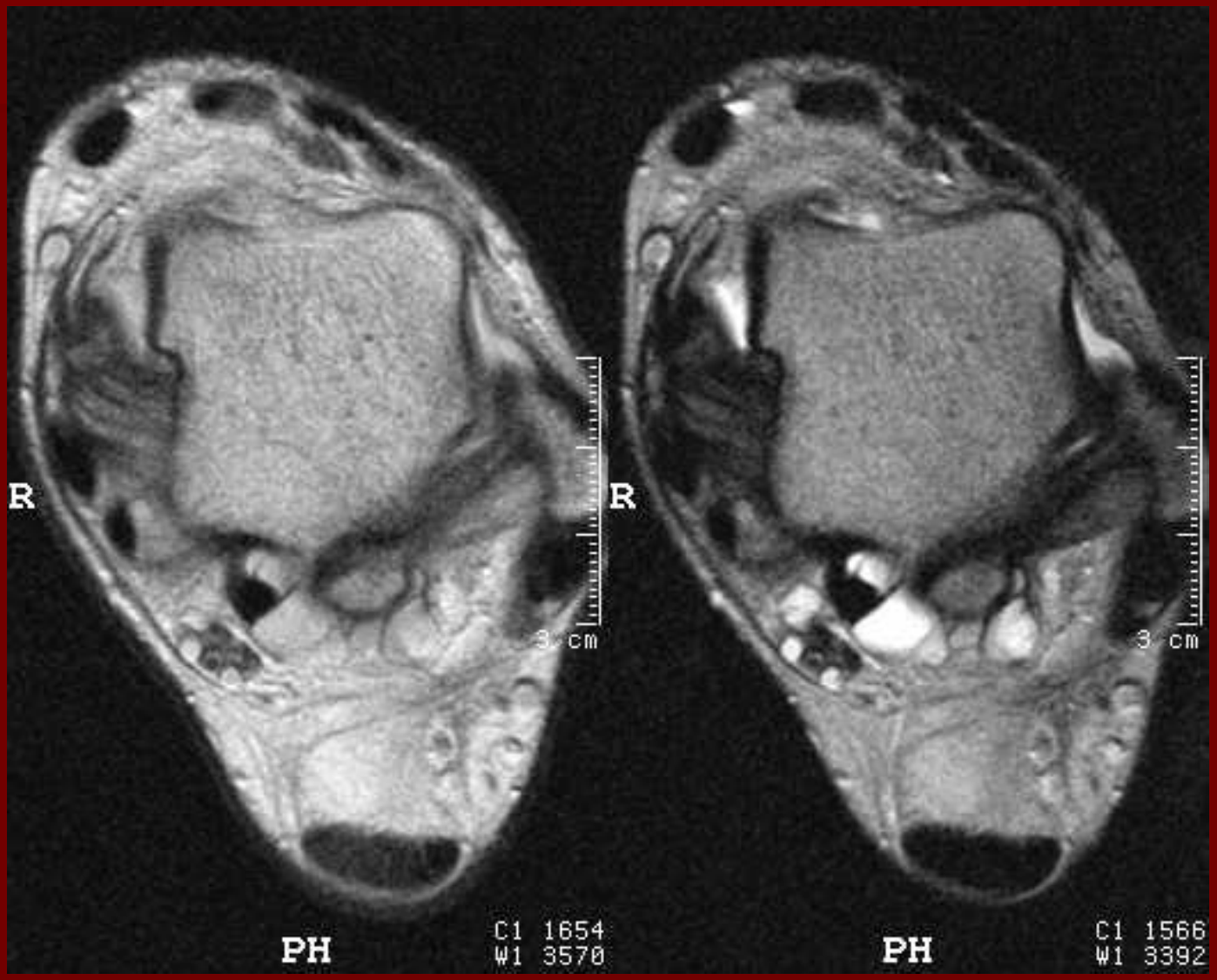
MRI Tenosynovitis



Os Trigonum



Os trigonum



Treatment

- Conservative
  - NSAIDS, Ice, PT
  - Avoidance of pointe and demi-pointe
  - Usually successful

Treatment

- Surgical
  - Indicated after 3-6 months of nonsurgical
  - Posteromedial approach
  - Longitudinal release of sheath
    - Tenosynovectomy PRN
  - Excision of os trigonum or trigonal process
  - Debridement and repair of split tears
  - Debridement to normal diameter of cysts, etc

Achilles Tendon Problems

- Basics
  - Largest tendon in the body
  - 6-10 times body weight during running
  - No synovial lining
    - Instead enveloped by stretchy paratenon
  - Retrocalcaneal bursa anteriorly and Achilles tendon bursa posteriorly
  - Inverts the hindfoot as well as plantarflexing

Vascularity

- Proximally
  - Gastroc-soleus musculotendious vessels
- Distally
  - Calcaneo-Achilles network
- Avascular area
  - Starts 2-3 cm from insertion
  - Extends to 6cm proximally

Achilles Rupture

- Epidemiology
  - Usually with sports
  - Male to female ratio 2:1 to 19:1
  - Typical age 30 to 40
  - “Weekend warrior”

Achilles rupture

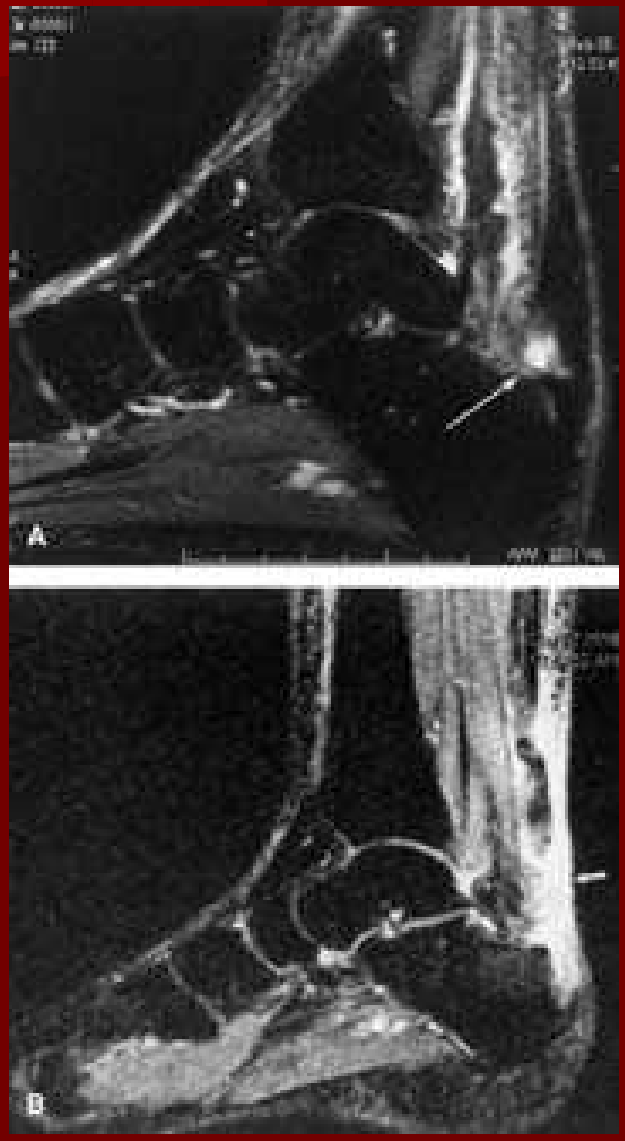
- History
  - 15% have prodromal pain, swelling, stiffness
  - Push-off or land on plantarflexed foot
  - Audible/palpable pop or feeling of kick to the back of leg

Achilles rupture

- Exam
  - Weak plantarflexion (some present due to secondary flexors)
  - Abnormal gait
  - Altered equinus tone
  - Echymosis often present
  - Palpable defect (usually 2-6 cm from the insertion)
  - Positive Thompson test
    - Squeeze calves with patient prone
    - Compare sides

Achilles Rupture

- Imaging
  - Rarely necessary
  - X-ray may show rare bony avulsions
  - MRI or ultrasound can evaluate tendon substance



Treatment of Acute Rupture

- Nonoperative
  - Technique
    - Probably needs to be initiated within 48 hours
    - Patient placed in equinus boot or cast
    - Position is moved toward neutral over 8-10 weeks
    - Heel lift continued for 3-6 months
    - Recent data suggest that functional bracing with earlier motion may reduce problems

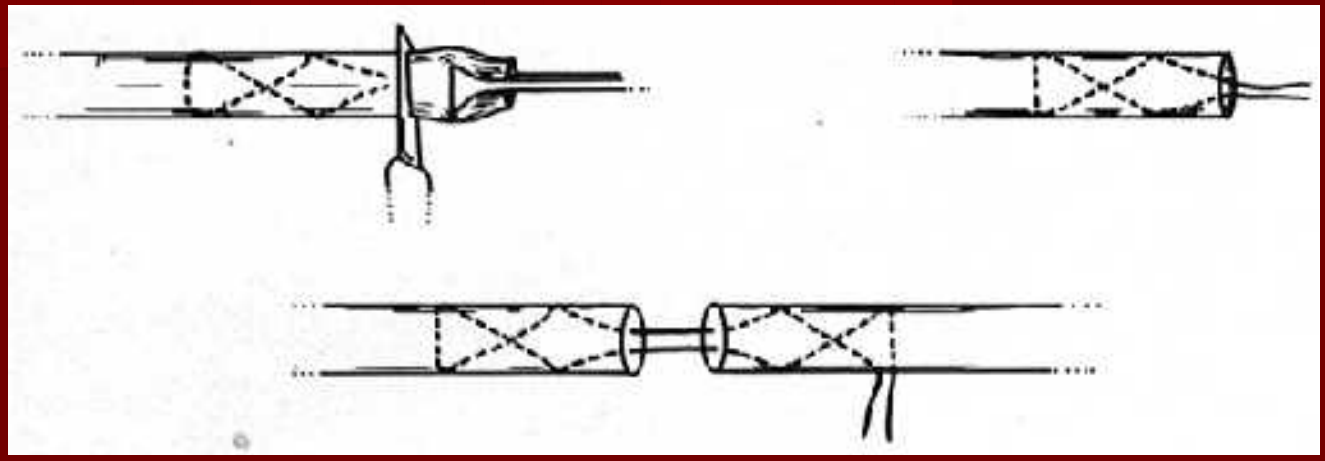
Acute Achilles rupture

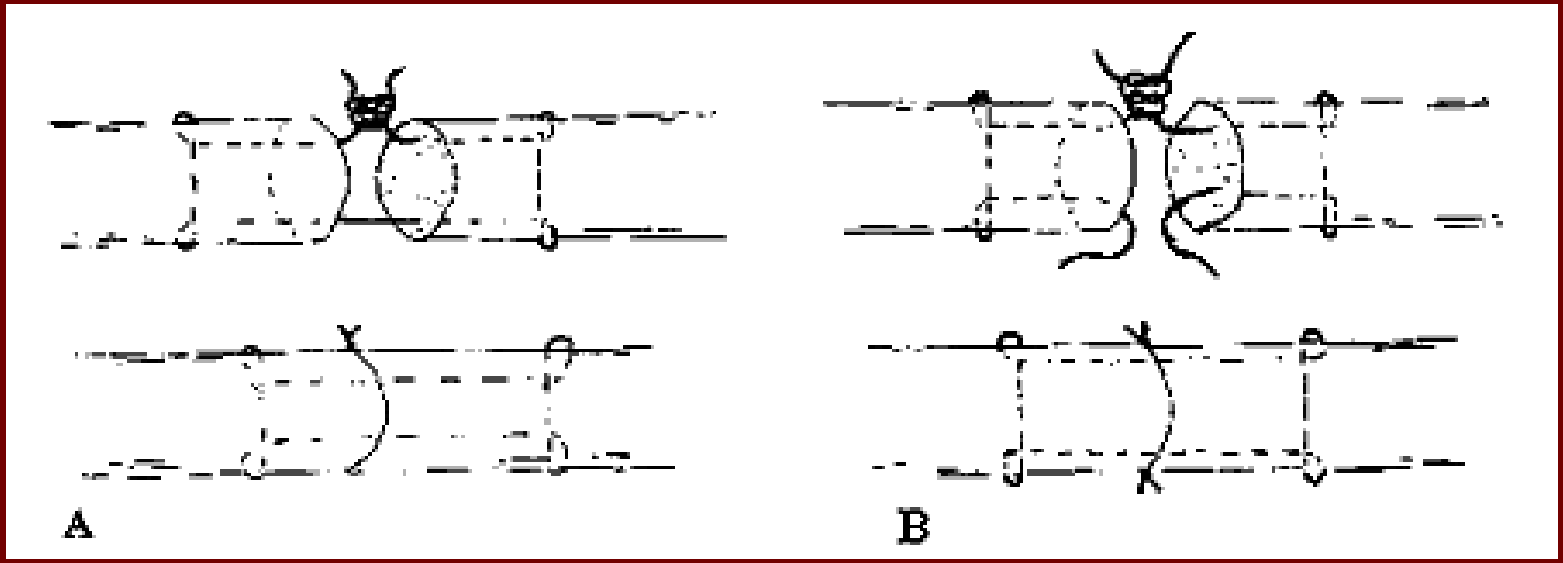
- Nonoperative treatment
  - Advantages
    - No risk of wound issues or sural nerve injury
  - Disadvantages
    - Higher rerupture rate (8-39% vs. 0-2% for repair)
    - Decreased strength (10-20%)
    - May result in later return to function

Surgical Treatment - acute

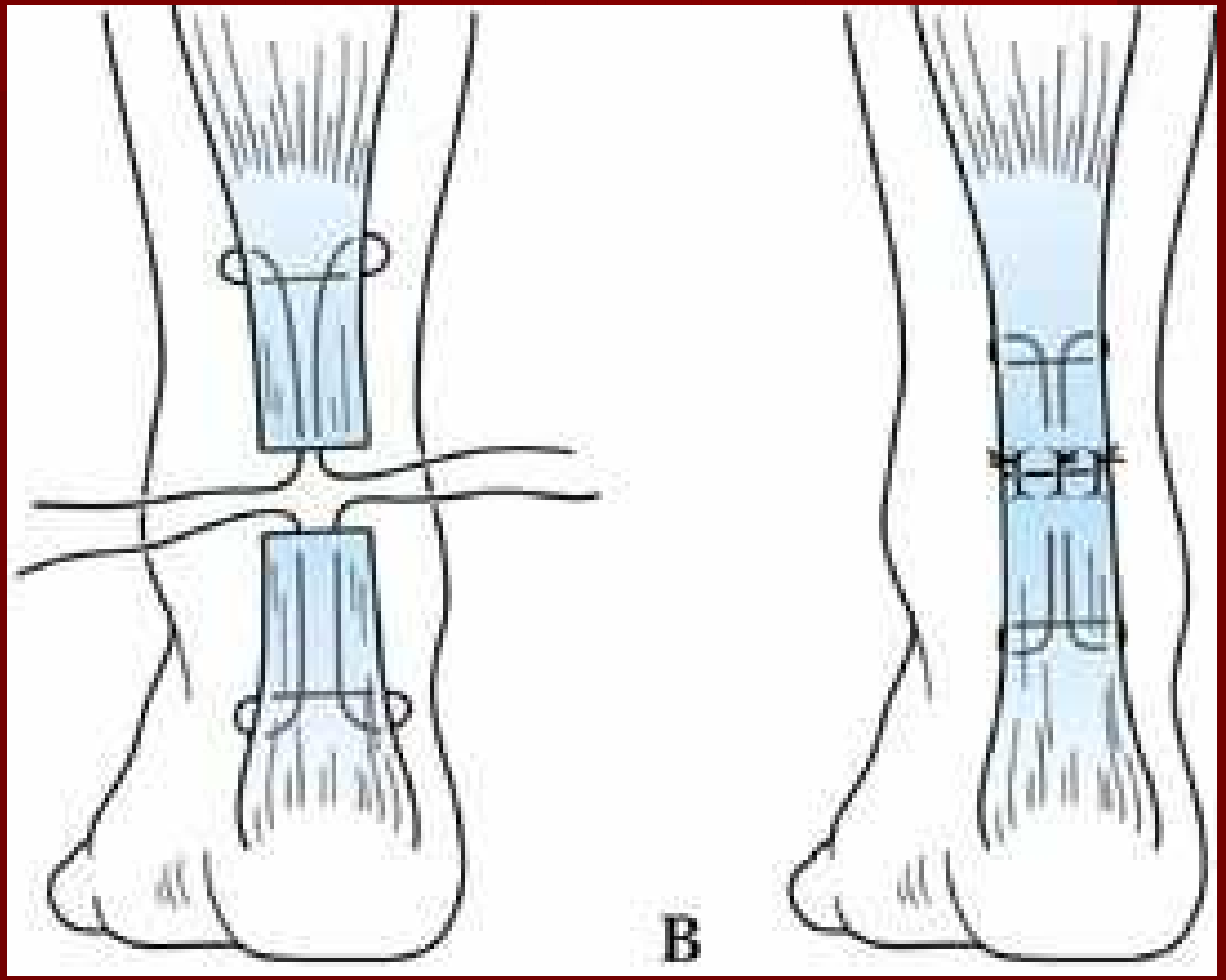
- May be used up to 3 months
- Posterior or posteromedial incision
- Various techniques
  - Bunnell
  - Kessler
  - Krackow
  - Pull-out wires

Direct Suture Repair





Direct Repair (Kessler)



Post-Operative Care

- Avoid prolonged immobilization
  - May be main drawback of non-op
  - Permanent weakness
- Early ROM
  - Greater spindle cells
  - Earlier reorganization of collagen
- Early stretching
  - Plastic deformation of neocollagen leads to maturation
  - Ehanced mechanical properties

Post-Op

- Immediate partial weight bearing in protected equinus
- ROM when wound is stable (~2 weeks)
- Eccentric loading exercises at 6 weeks
- Jog at 3 months
- Full sports at 6 months

Chronic Ruptures

- Defined as older than 3 months (maybe less)
- Void becomes filled with scar
- Shortening and degeneration

Chronic Rupture

- Exam
  - Often gap no longer palpable
  - Usually subtler exam findings
    - Strength
    - Equinus tone
    - Thompson test
  - May compensate with accessory plantarflexors
    - Results in dynamic clawing
    - May allow single leg toe rise

Treatment options

- Nonoperative
  - Physical therapy
  - AFO
  - Indicated for low demand patients

Surgery for Chronic Tears

- Procedures often require major dissection
- Wound problems are common and potentially serious

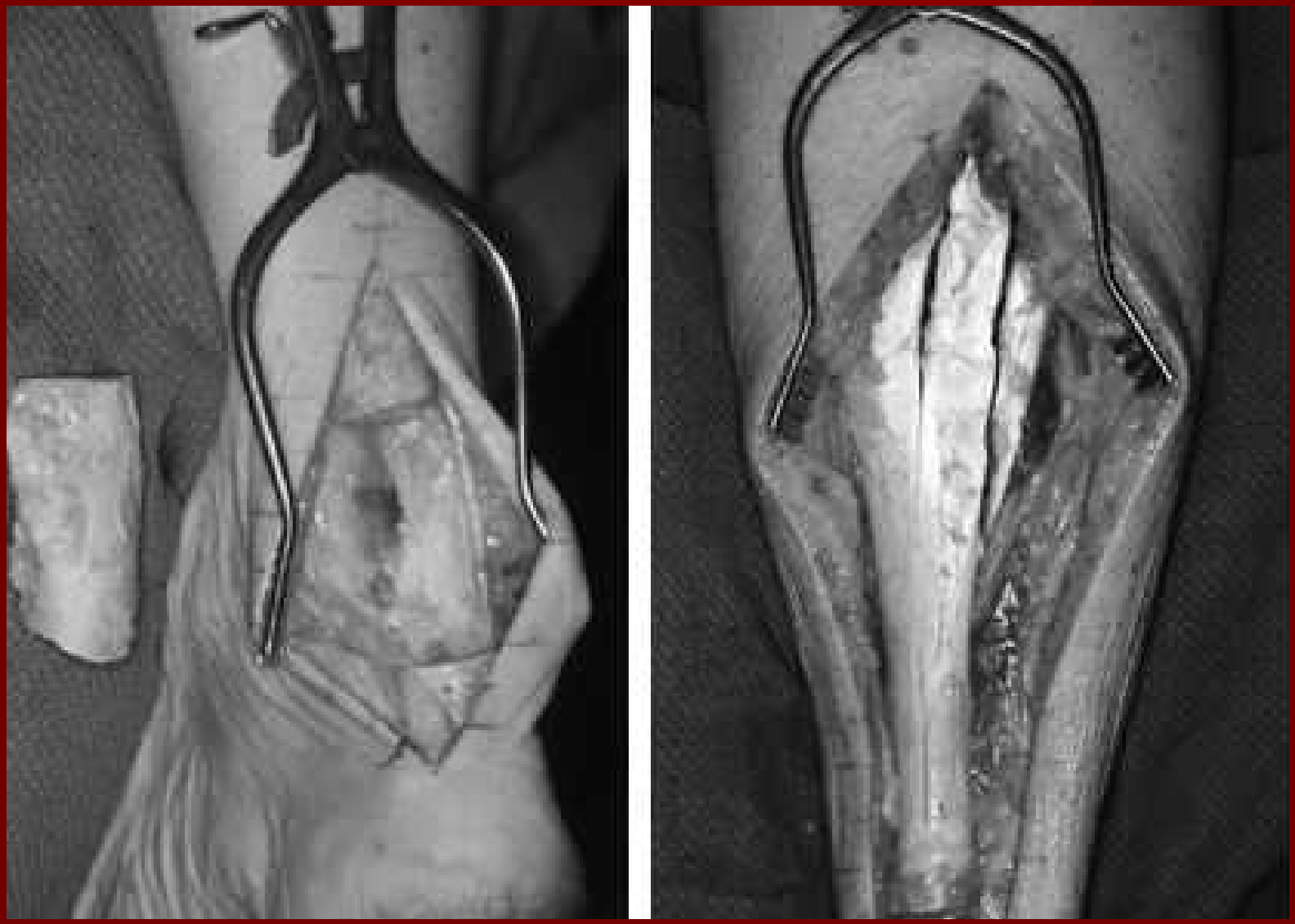
Surgery for Chronic Tears

- Tendon ends must be debrided
- Direct repair
  - For defects of 1-2 cm
  - Avoid undue tension
- V-Y advancement
  - Defects 2-5 cm
  - Tendon must be mobile
  - Inverted V in gastroc fascia
  - Arms of V should be 2x the defect

Turndown Procedures

- Indicated for gaps greater than 5 cm
- 1 cm wide segment
- Length - 2 cm of overlap proximally and 2 cm distally
- Tubularize strip and attach to distal stump or through drill holes

Turndown procedures

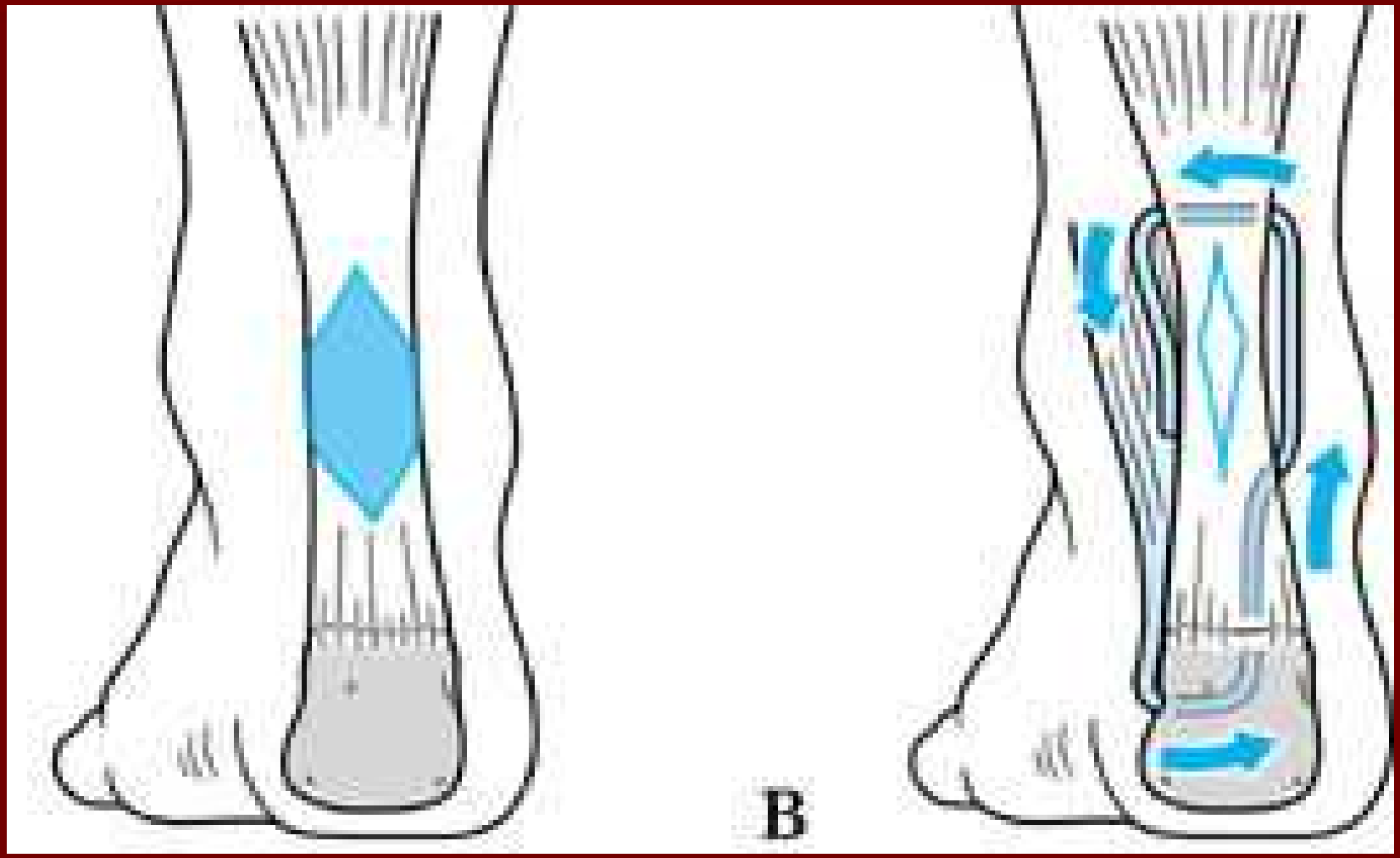


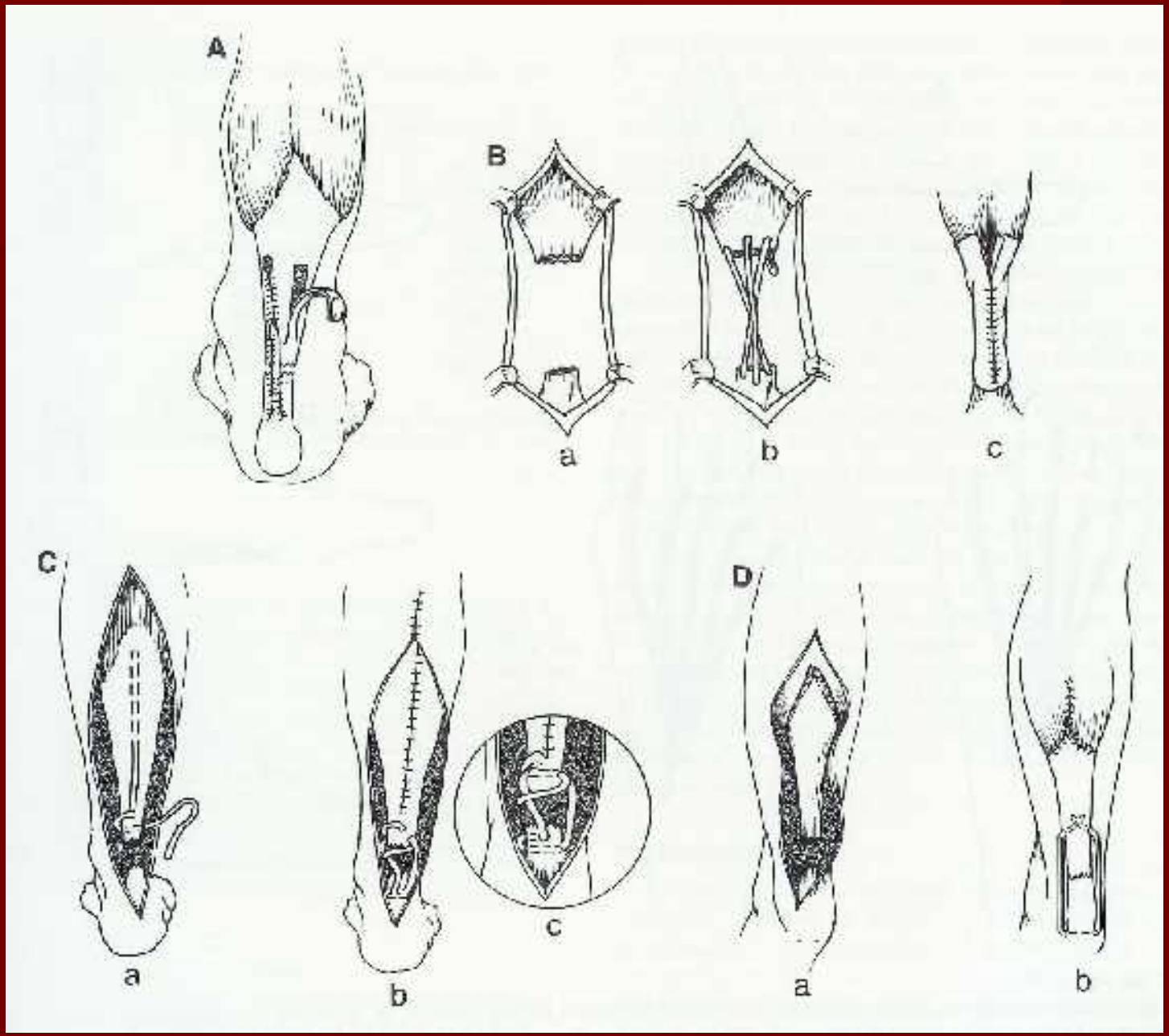
Turndown procedures

Flexor Hallucis Longus Transfer

- Can be used alone or along with above techniques
- FHL has ~30% of the strength of Gastroc-soleus
- Especially useful if poor excursion/muscle function
- Can attach proximally if some excursion
- Hallux function can be addressed by distal tenodesis to FDL

FHL Transfer Repair

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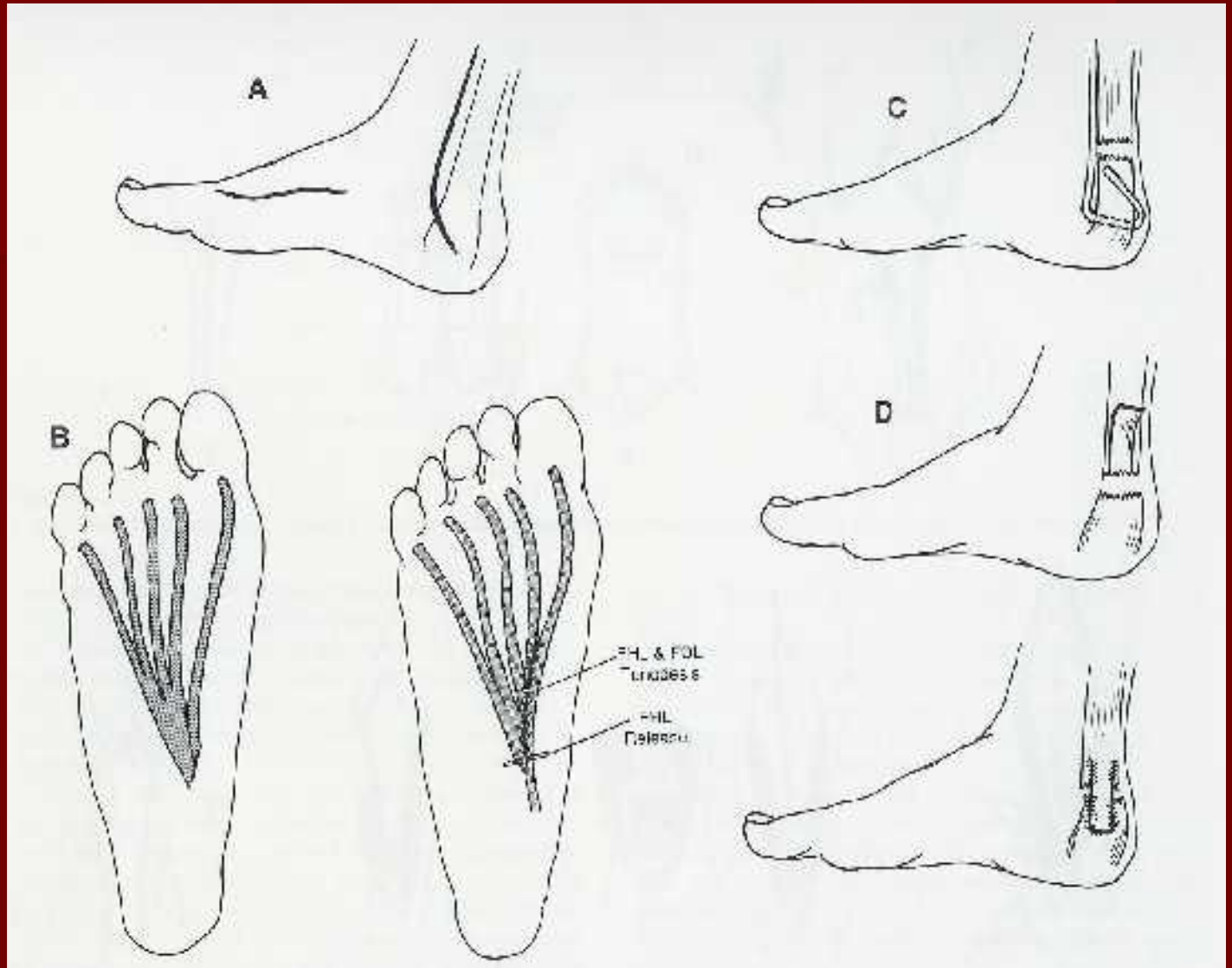
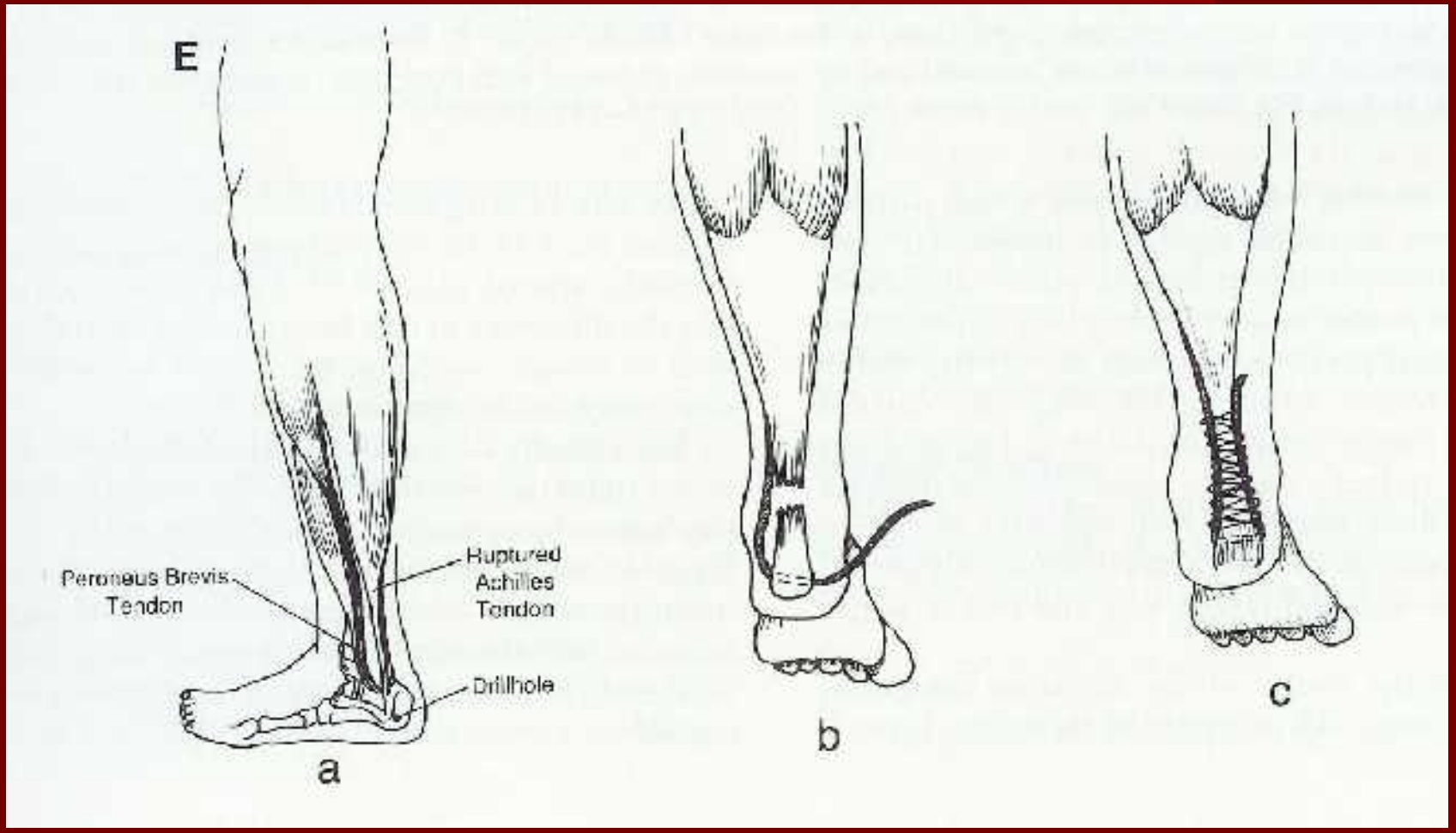


FIG 19–5.
Delayed repair of ruptured Achilles tendon using flexor digitorum longus transfer. A, operative technique demonstrating incisions. B, tenodesis of the flexor digitorum longus stump to the flexor hallucis longus. C, flexor digitorum longus pulled through drill hole in calcaneus. D, augmentation of spanned gap by turndown of fascial strip from gastroc soleus complex. (Redrawn from Mann RA, Holmes GB, Seale KS, et al: *J Bone J Surg (Am)* 73:214–219, 1991.)


E
Peroneus Brevis Tendon
Ruptured Achilles Tendon
Drillhole
a
b
c

Other Achilles Problems

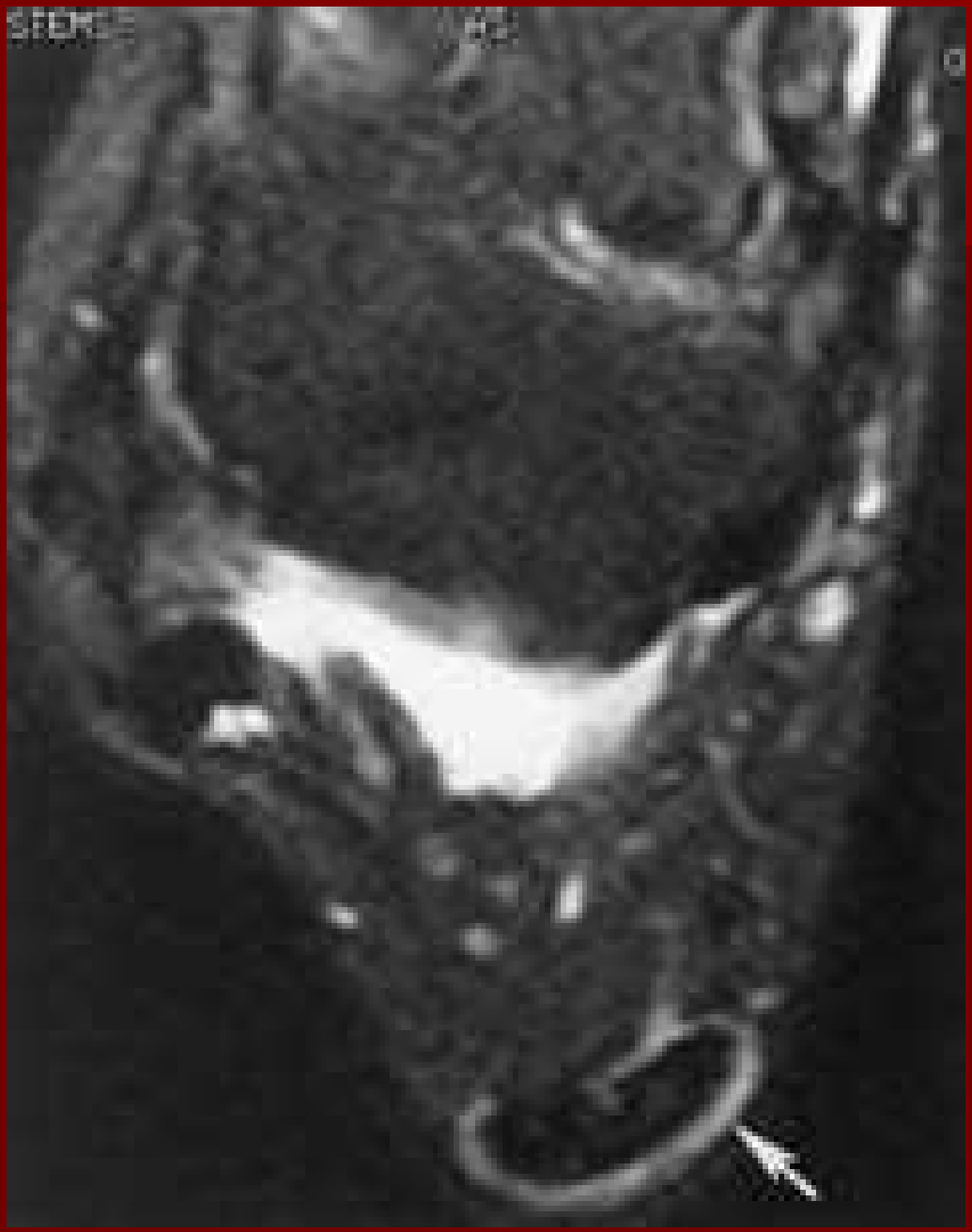
- Paratenonitis
- Tendinosis
- Insertional tendinopathy

Paratenonitis

- Description
  - Often referred to as Achilles “Tendinitis”
  - Inflammation actually in more vascular paratenon
- Etiology
  - Especially in long distance runners
  - Also in pushing off, cutting sports
  - Related to change in training
    - Frequency
    - Intensity
    - Duration
    - Shoes
    - Playing surface

Paratenonitis

- Symptoms
  - Burning pain and swelling after activity
- Exam
  - Fusiform swelling
  - Warmth
  - Tenderness
  - Pain worsened by compression of tendon during ROM
  - Swelling does not move with ankle ROM



Treatment

- Acute paratenonitis
  - RICE
  - Stretching
  - Modification of training
  - >90% effective
- After 3 months
  - Formal PT with U/S, iontophoresis, electrical stimulation

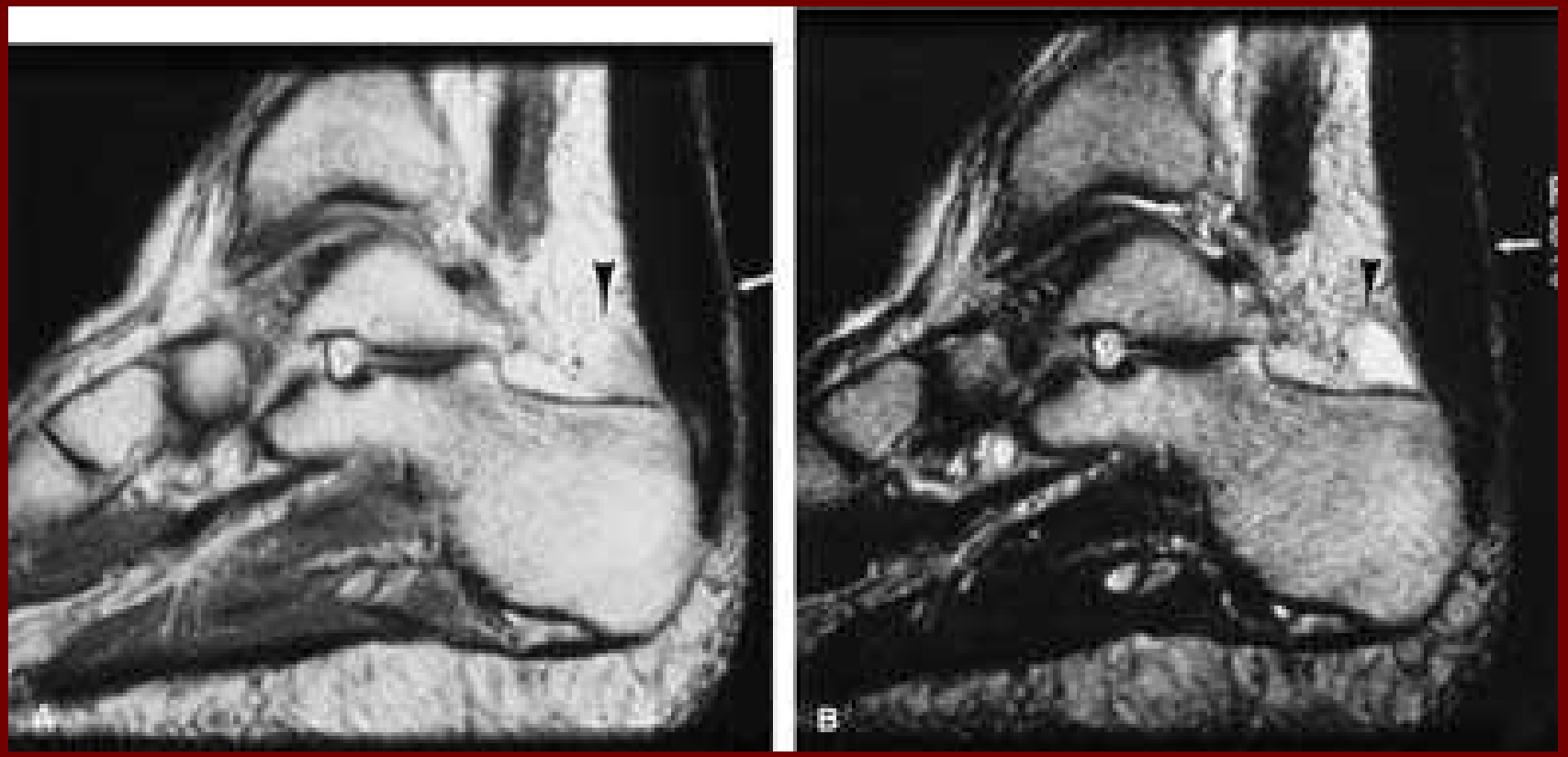
Treatment

- Chronic paratenonitis
  - Brisement
    - Infusion of 5-15ml of saline between paratenon and tendon
    - Lyse adhesions
  - Short term immobilization
  - Debridement of paratenon (only if resistant)
- **Avoid steroid injections**

Tendinosis

- Degenerative process
- Older patients
- Symptoms range from painless stiffness to severe, restricted, painful weight bearing
- Exam
  - Nodular thickening
    - Usually 6-8cm above insertion
  - Weak plantarflexion
    - Related to partial tears

Tendinosis



Conservative tendinosis treatment

- Initial treatment same as paratenonitis
- Advanced tendinosis or partial tear
  - Rocker-bottom walking boot
    - Heal lift or locked in equinus
  - Eccentric load excercises to promote revascularization

Surgical treatment

- Indicated after 3-6 months of non-op
  - Check MRI to identify exact location of degeneration
- Debride any areas of degeneration
  - Often centrally located
  - Retubularize remaining tendon
- If <50% of tendon remains augmentation or reconstruction is needed

Surgical Treatment

- Percutaneous surgery
  - 5 stab incisions
  - Ankle is ranged to allow five, one cm longitudinal tenotomies
  - Theoretically stimulates healing
  - Good results in distance runners
    - ? General population
  - Can do early ROM and weight bearing

Insertional Tendinopathy

- Degenerative changes at insertion (enthesis)
- May have associated retrocalcaneal or retro-achilles bursitis
- Bimodal age distribution
  - Young athletes and older sedentary patients with comorbidities
  - Average is 44 years (33 years for all tendinoses)
- Associated with seronegative arthropathies, gout, DISH, sarcoidosis

Insertional Tendinopathy

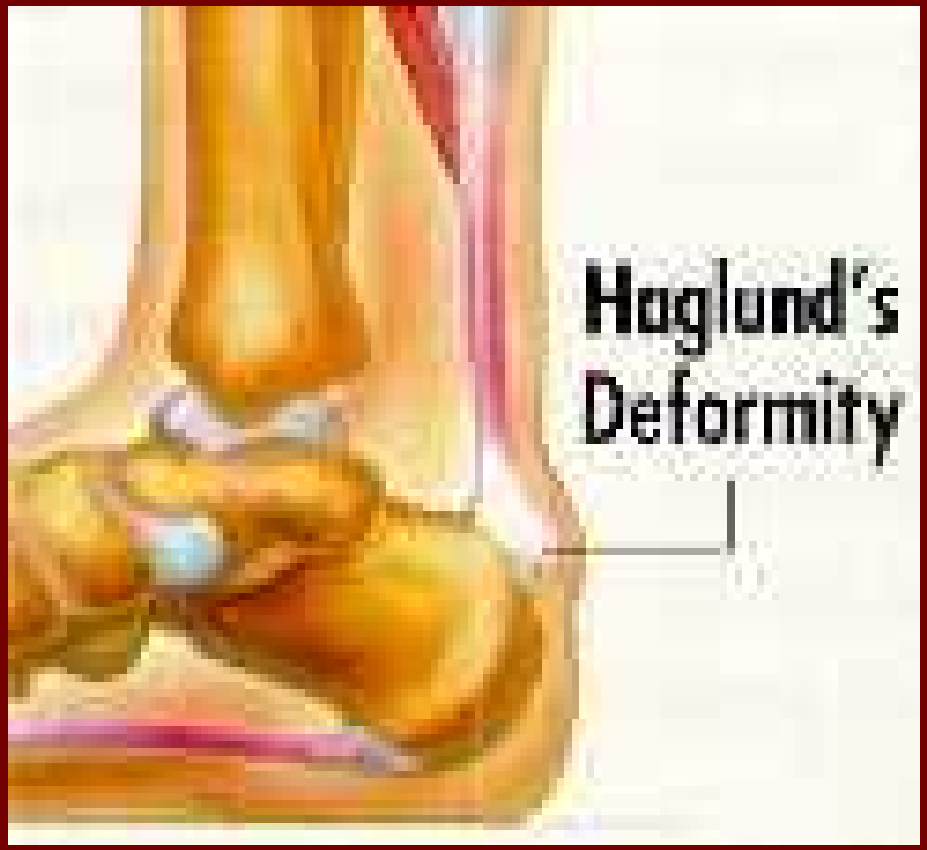
- Presentation
  - Pain at enthesis
  - Worse after activity
    - Gradually becomes constant
  - Worse with running on hills or hard-surfaces
- Exam
  - Tenderness posteriorly or posterolaterally over enthesis

Insertional Tendinopathy

- X-ray
  - 60% have calcification of the enthesis
    - Poor prognostic sign
  - 60% have Haglund's deformity
- MRI
  - Useful in clarifying bursitis, tendinopathy, impingement

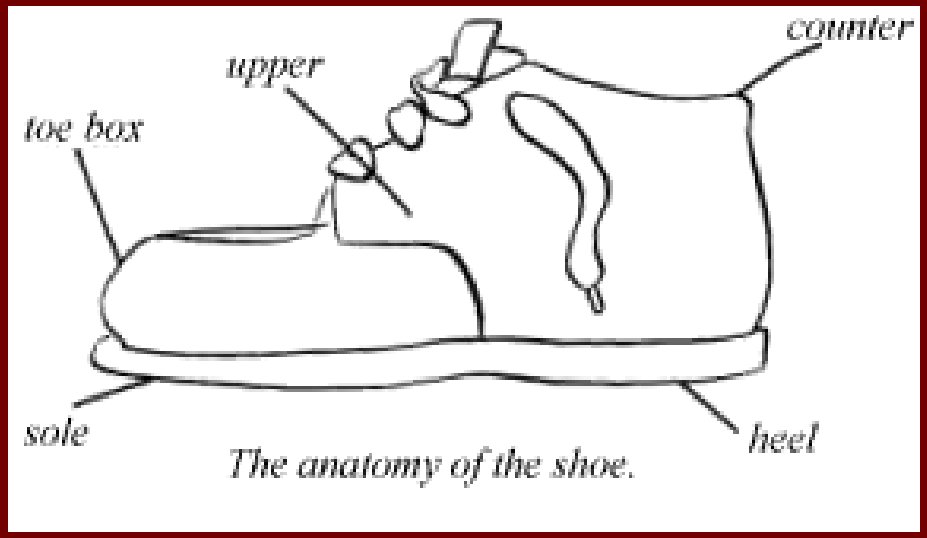
Insertional Tendinopathy

Haglund's deformity



Treatment

- Conservative
  - NSAIDS
  - Heel lifts
  - Stretching
  - Shoe modification
    - Wider, softer counter
- Resistant
  - Orthoses
  - Night splinting
  - P.T. inc contrast baths, iontophoresis



The anatomy of the shoe.

Surgical Treatment

- After 6-12 months of failed non-op treatment
- Surgery
  - Debride diseased insertion and inflamed bursa
  - Decompress bony spurs
  - Release gastrocnemius contracture
  - Reattach tendon or reconstruct as needed

Anterior Tibialis Tendon

- Primary dorsiflexor
- Allows foot to clear floor and avoid foot slap by eccentric contraction
- Passes under extensor retinaculi
- Inserts on base of 1st MT and Medial cuneiform

Acute Anterior Tibial Injuries

- Etiologies
  - Lacerations
  - Contusions
  - Closed Ruptures
    - Traumatic
      - Young patients with significant trauma or
      - Middle-aged, active patients with minor trauma
    - Atraumatic
      - Elderly, less active patients
      - Weakened by attrition, steroid injections, DM or inflammatory athritides

Lacerations

- Surgical repair
  - Indicated except in elderly low demand patients
- Direct repair
  - Most common
  - Bunnell, Kessler, Krakow, etc
  - Repair Extensor retinaculum to avoid bowstringing
  - If cannot repair primarily then options include EDL, plantaris, PB grafts, EHL transfer, VY slides, etc

Contusion

- Conservative treatment
  - Rest, Ice, NSAIDS
  - If trouble with clearance or foot slap
    - Walking boot or cast
    - PT

Closed Rupture

- Presentation
  - Pain in anterior ankle or lower leg
  - Usually transient
  - Mass
    - Retracted proximal segment
  - Altered normal contour with dorsiflexion
  - Gait abnormality
    - Steppage gait or foot-slap
  - Recruitment of toe extensors
    - Forefoot rotates into pronation and abduction

Figure 4 ATT rupture with typical appearance of the lower leg mass formed by the retracted proximal segment (arrow).

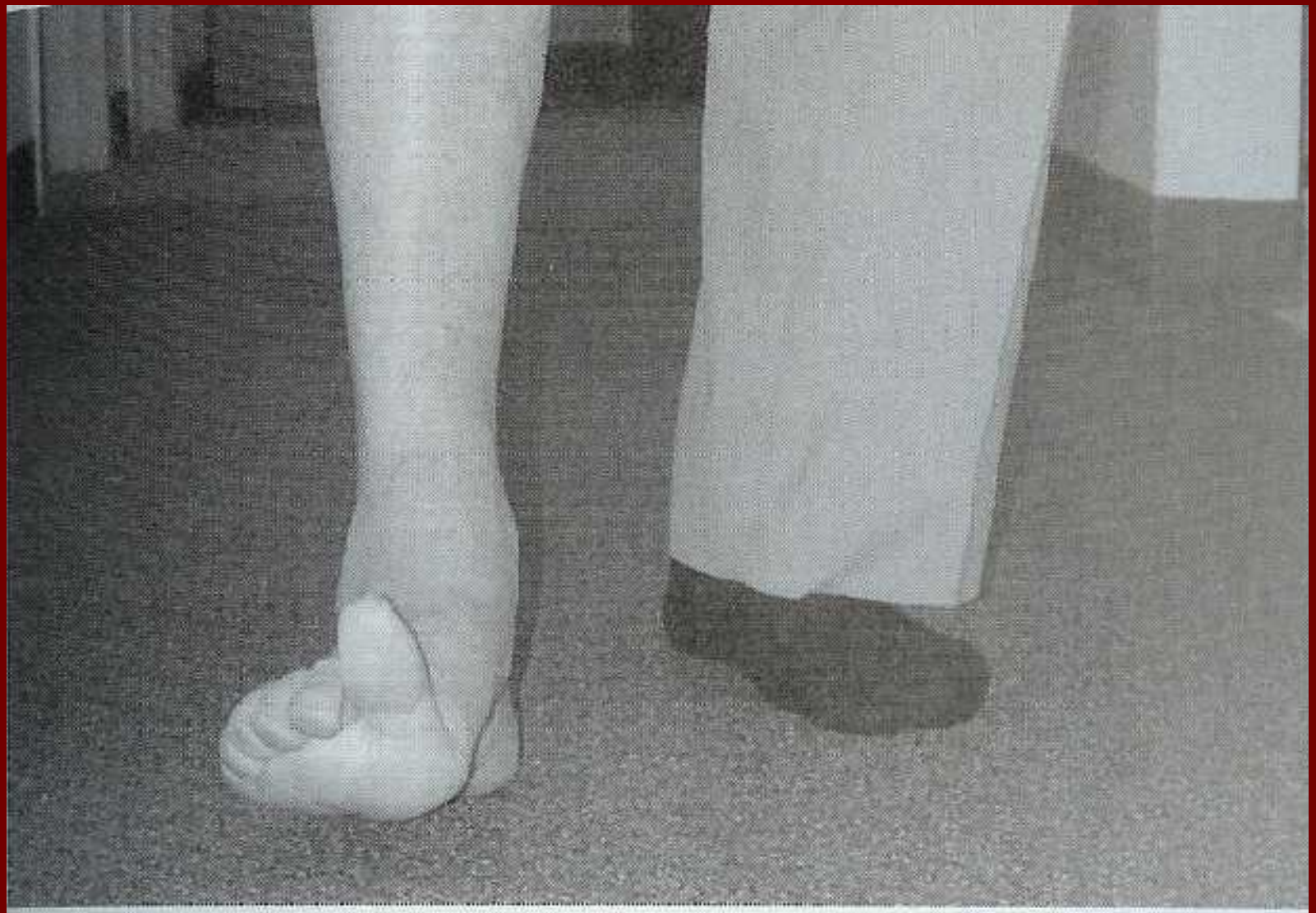


Figure 5 Secondary recruitment of the EHL and EDL tendons during swing phase in a patient with an ATT rupture.

MRI Anterior Tibialis Tear

Rupture

- Conservative treatment
  - Appropriate in low demand, elderly patients
  - May need AFO or double upright brace
- Surgery
  - Same as for laceration
  - More likely to need grafts, transfers, etc

EHL Tendons

- Mostly all lacerations (5 cases of closed rupture in the literature)
- If laceration is distal to MTP joint then closed treatment with extension taping is appropriate
- If more proximal repair is usually indicated

EDL Tendons

- All lacerations
- Controversial whether repair is necessary
- Probably repair in active people

References

- Richardson ED. OKU Foot and Ankle 3
- Mann RA and Coughlin MJ. Surgery of the Foot and Ankle.
- Google image.