분당제생병원 재활의학과
이 태 임

# COMMON PAINFUL CONDITIONS OF PEDIATRIC FOOT

# CASE

- M/12
- CC
  - Insidous onset of heel pain
  - 축구를 좋아해서 많이 했다.
  - 걷거나 뛰면 더 아프다.
- PE
  - pes planus
  - heelcord tightness
  - Tenderness over the posterior calcaneus
  - Sqeeze test ; positive

# Sever's Disease

- First described in 1912

  ; as a cause of heel pain and tenderness
  localized to the posterior aspect of the calcaneus
  in physically active, overweight children and adolescents.
- Apophysitis of the calcaneus
- Common, 2-16% of musculoskeletal injuries in children
- Before or during the peak growth spurt in boys and girls
  ( Girls ; 8-10yrs, Boy ; 10-12yrs)
- Often shortly after they begin a new sport or season.
- Running and jumping sports, esp. soccer
- Intermittent or continuous heel pain with weight bearing
- Bilateral or unilateral

# Development

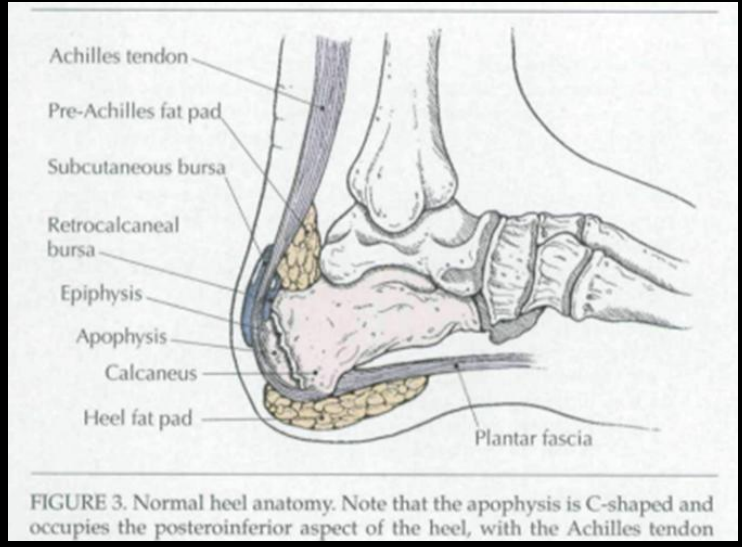


FIGURE 3. Normal heel anatomy. Note that the apophysis is C-shaped and occupies the posteroinferior aspect of the heel, with the Achilles tendon

- Secondary calcaneal center begins with the ossification of several fragments and eventually forms a vertically oriented C-shaped growth plate at the posterior border of the calcaneus.

- Fusion of the epiphysis to the main body of the calcaneus occurs between the ages of 12-15yrs.

# Etiology of Sever's disease

- Has not been established.
- During gastrocnemius contractions, Strong shearing forces on calcaneal insertion of achilles tendon ,
  Mc. During the early part of accelerated growth spurt.

- Main predisposing factors
  - Abnormal stress at the epiphysis
    ( inflexibility related prepubertal long bone growth spurt exceeding muscle and tendon growth )
  - Biomechanical abnormalities of the foot
    ; poor shock absorption
    ( forefoot varus, hallux valgus, pes cavus, pes planus )
  - Overactivity with resultant microtrauma
    ( repetitive loading of the heel, soccer or running )
- Violent heel strike
  in a basketball player or a gymnast – may trigger

# Sever's Disease

## *A Prospective Study of Risk Factors*

**Rolf W. Scharfbillig, PhD***
**Sara Jones, PhD***
**Sheila Scutter, PhD***

**Background:** Sever's disease, also known as calcaneal apophysitis, is thought to be an inflammation of the apophysis of the heel, which is open in childhood. This condition has been commented on and looked at in a retrospective manner but has not been examined systematically. We assembled the most commonly cited theoretical causative models identified from the literature and tested them to determine whether any were risk factors.

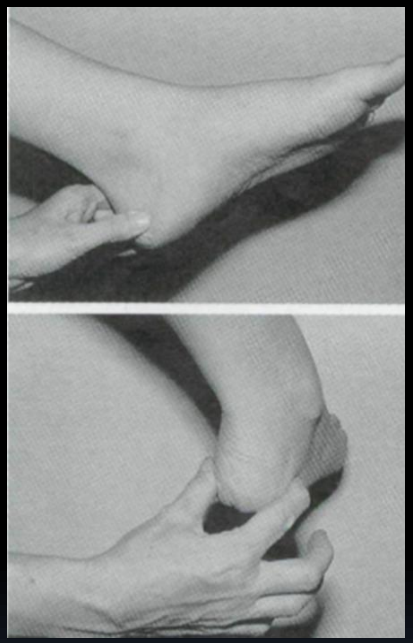
**Methods:** Children with Sever's disease were compared with a similarly aged nonsymptomatic population to determine whether identifiable risk factors exist for the onset of Sever's disease. Areas raised in the literature and, hence, compared were biomechanical foot malalignment, as measured by Root et al–type foot measurements and the Foot Posture Index; ankle joint dorsiflexion, measured with a modified apparatus; body mass index; and total activity and types of sport played.

**Results:** Statistically significant but small odds ratios were found in forefoot to rearfoot determination and left ankle joint dorsiflexion.

**Conclusions:** This study suggests that there is no evidence to support that weight and activity levels are risk factors for Sever's disease. The statistically significant but clinically negligible odds ratio (0.93) on the left side for decreased ankle joint dorsiflexion and statistically significant and clinically stronger odds ratio bilaterally for forefoot to rearfoot malalignment suggest that biomechanical malalignment is an area for further investigation. (J Am Podiatr Med Assoc 101(2): 133-145, 2011)

# Physical Examination

- Heelpain may be mild to severe
- Tenderness to palpation , at or just anterior to the insertion of the achilles tendon along the posterior border of the calcaneus.
- Positive squeeze test



- Tight heelcords
- Standing on tiptoe ; may aggravate the heel pain
- Skin change ; erythema, swelling are uncommon -- suggest different pathologic processes

# High peak pressure in Sever's disease

**Table 2. Peak Pressure, Percentage of Body Weight Supported by Each Foot, and Plantar Surface Contact Area in the Symptomatic and Asymptomatic Feet in the Sever's Disease Group and the Corresponding Feet in the Control Group**

| Variable | N | Mean ± SD | Minimum | Maximum | 95% CI | *P* Value |
|---|---|---|---|---|---|---|
| PP (kPa) | | | | | | |
| Sever's symptomatic foot | 22 | 57.41 ± 4.45 | 52.30 | 62.40 | 22.93 to 29.78 | |
| Control corresponding foot | 24 | 31.05 ± 6.73 | 19.40 | 43.60 | 22.98 to 29.73 | <.001[a] |
| Sever's asymptomatic foot | 22 | 35.00 ± 12.45 | 15.30 | 52.30 | –2.27 to 9.30 | <.001[a] |
| Control corresponding foot | 24 | 31.48 ± 6.28 | 22.40 | 43.60 | –2.50 to 9.53 | .227[b] |
| PBW (%) | | | | | | |
| Sever's symptomatic foot | 22 | 62.24 ± 9.22 | 46.50 | 79.40 | 7.90 to 17.90 | |
| Control corresponding foot | 24 | 49.33 ± 7.58 | 38.20 | 66.10 | 7.85 to 17.96 | <.001[a] |
| Sever's asymptomatic foot | 22 | 37.75 ± 9.22 | 20.60 | 53.50 | –17.90 to –7.90 | <.001[a] |
| Control corresponding foot | 24 | 50.66 ± 7.58 | 33.90 | 61.80 | –17.96 to –7.85 | <.001[b] |
| PS ($cm^2$) | | | | | | |
| Sever's symptomatic foot | 22 | 24.68 ± 6.25 | 18.00 | 49.00 | –1.41 to 4.61 | |
| Control corresponding foot | 24 | 23.08 ± 3.64 | 15.00 | 30.00 | –1.50 to 4.70 | .291[a] |
| Sever's asymptomatic foot | 22 | 24.36 ± 6.14 | 10.00 | 35.00 | –2.66 to 3.80 | .829[a] |
| Control corresponding foot | 24 | 23.79 ± 4.69 | 17.00 | 39.00 | –2.71 to 3.85 | .723[b] |

Abbreviations: CI, confidence interval; PP, peak pressure; PBW, percentage of body weight supported; PS, plantar surface area in contact with the pedobarograph.

[a]Versus Sever's symptomatic foot.

[b]Versus Sever's asymptomatic foot.

(J Am Podiatr Med Assoc 101(1): 17-24, 2011)

# Treatment

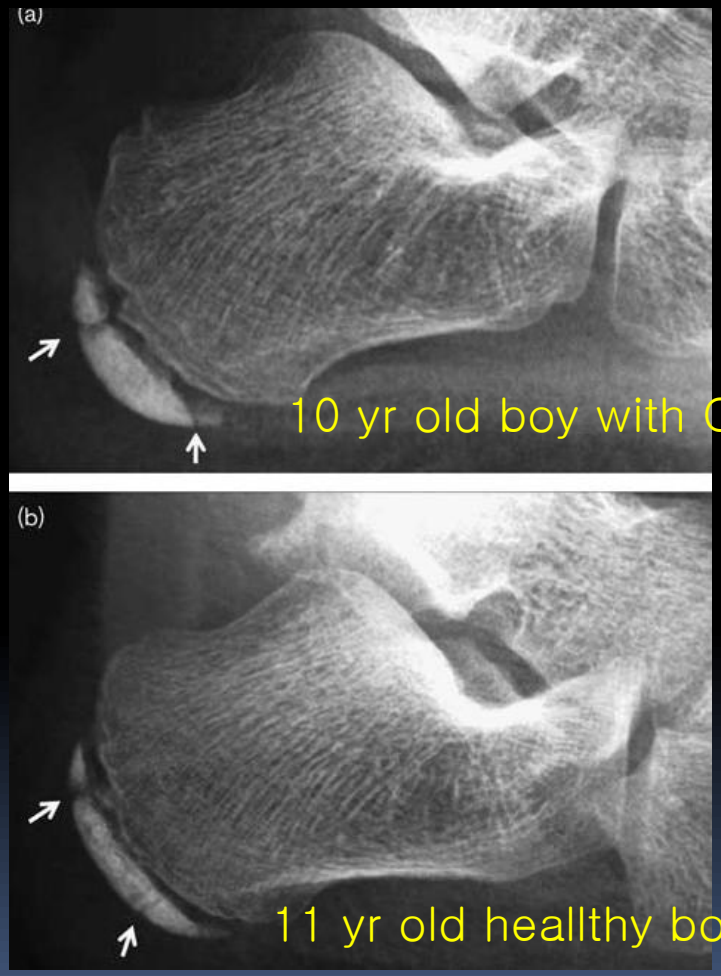
- Responds well to Conservative treatment

- Rest and ice application
- Heel lifts , Heel cups or Insole
- stretching and strengthening exercise,
- NSAIDs

- Usually resolves two weeks to two months

# Can we make a diagnosis with radiographic examination alone in calcaneal apophysitis (Sever's disease)?

Ozkan Kose, Mustafa Celiktas, Seyhmus Yigit and Bulent Kisin




10 yr old boy with Calcaneal apophysistis

11 yr old heallthy boy

Increased density of the apophysis
Increased apophyseal fragmentation

**Table 1 Summary of the results**

| | First assessment | | Second assessment | | |
|---|---|---|---|---|---|
| | Normal | Apophysitis | Normal | Apophysitis | κ-value |
| Observer A | | | | | |
| Normal | 10 | 38 | 12 | 22 | 0.369 (fair) |
| Apophysitis | 20 | 12 | 18 | 28 | |
| Observer B | | | | | |
| Normal | 18 | 12 | 16 | 14 | 0.253 (fair) |
| Apophysitis | 12 | 38 | 14 | 36 | |
| κ-value | 0.190 (slight) | | 0.039 (slight) | | |

*J Pediatr Orthop B 2010*

# X-ray

- increased density, irregularity, fragmentation, sclerosis at the calcaneal apophysis
- But, cannot be diagnosed radiographically.
- To rule out other pathology
  - tarsal coalition
  - fracture
  - bone cyst
  - osteoid osteoma

# Neglected Sever's Disease as a Cause of Calcaneal Apophyseal Avulsion Fracture: Case Report

Kyung Tai Lee, MD; Ki Won Young, MD; Young Uk Park, MD; Shin Yi Park, MD; Ki Chun Kim, MD
*Seoul, Korea*

- 4 cases of calcaneal apophyseal avulsion fractures in soccer player
  - Long history of heel pain 2-4 yrs
  - Mild heel pain to limping gait, variable
  - Possibility,

    progression from Sever's disease
    due to incomplete protection and repetitive trauma

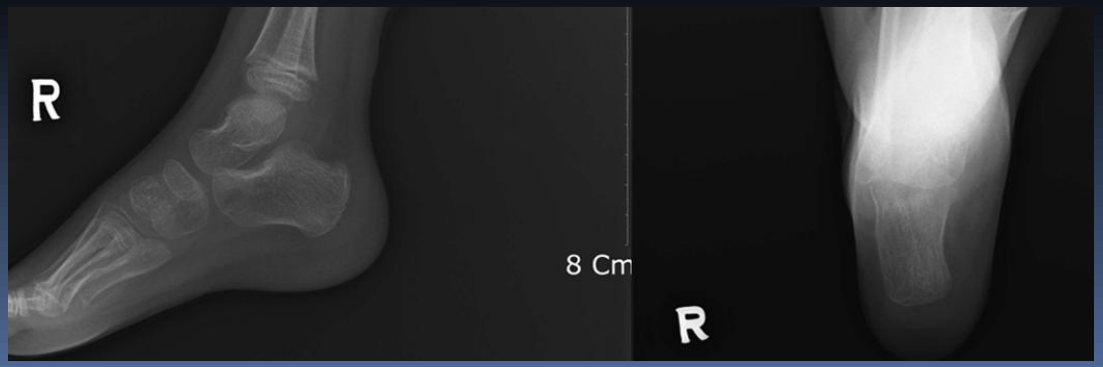

*Foot & Ankle International 2010*

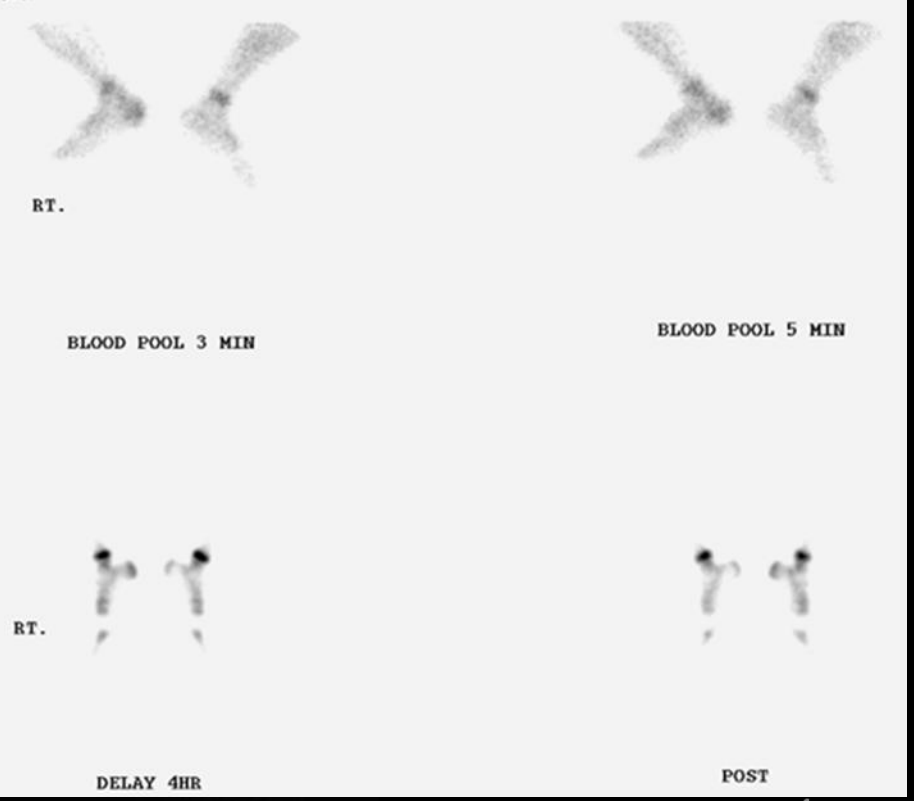
**FIGURE 1.** Unicameral bone cyst in patient presenting with chief complaint of heel pain.

# F/4Y11M

- Chief complaint: Rt. heel pain, limping gait
- Onset : 내원 3주 전
- No trauma history

- P/E ; pain, tenderness, swelling, redness on Rt. Calcaneal area without heating sense.






CBC 15400-11.5-292k 44.9%
CRP 0.16
ESR 40

Impression; Rt. calcaneus osteomyelitis

# Juvenile hallux valgus

- frequent among children and teen-agers.

  ( 22-39% of school age girls. )
- Many pts. Asymptomatic
- Deviations are often incidental findings.
- Mild symptom, occasional pain over the medial eminence
  but deformity is sometimes unsightly, progressive
  or worrisome for the parents
- Strong hereditary trait
- Deformity can be found at all ages, including the first months of life.
- MTP joint is usually congruous,
  the more pronounced deformities involve pronation of the toes and
  malalignment of the sesamoids is rare.

# Radiologic Evaluation

- Intermetatarsal 1-2 angle ; NL 8° pathologic >12°
  (metatarsus primus adductus angle )
- Halux Valgus Angle ; Pathologic > 15°
  ( hallux abductus angle)
- Distal metatarsal articulation angle ; NL 0-8°

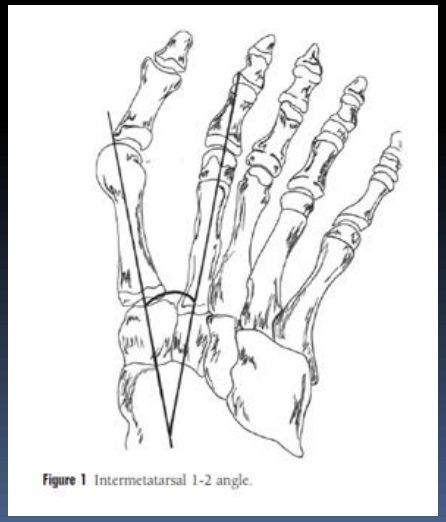


Figure 1 Intermetatarsal 1-2 angle.

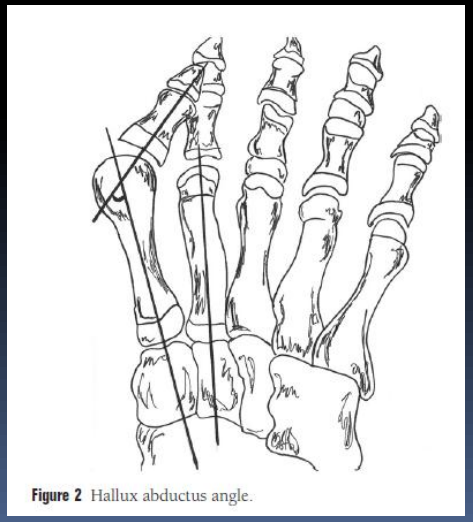


Figure 2 Hallux abductus angle.

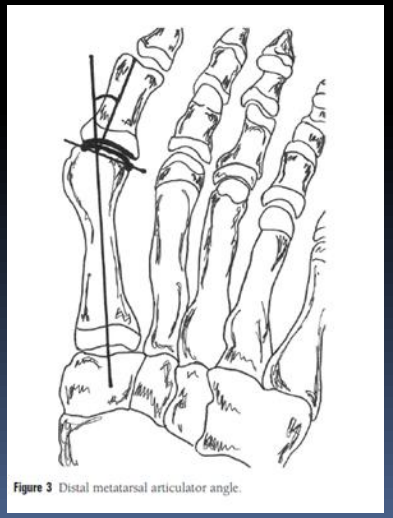


Figure 3 Distal metatarsal articulator angle.

# Difference with HV in adult

- No degenerative arthritic changes at the MTP joint
- Does not often demonstrate pronation of the hallux.
- Deviation of the toe is less pronounced.
- Medial eminence is smaller
- Bursal thickening, proliferation is rare
- Physes are still open.

- Structural factors
  - Metatarsus varus
  - Pes planus
  - Ligamentous laxity
  - Tight heel-cord
- Natural history
  - Congrous type of deformity ; remains stable
  - Deviated and subluxated joints
    are prone to deteriorate
    – candidates for prophylactic operations

# Non-surgical Treatment

*: Conflicting opinions about the usefulness of conservative therapy.*

- Orthosis
  - Use of a office-made low temperature thermoplastic splint at night
  - Commercial splint
  - Roomy footwear  or an arch support
- Active exercise
  - Stands with the feet slightly apart and attempts to touch on great toe with the other great toe without moving the feet.
- Achilles tendon stretching exercise
- Continue until bone maturation.

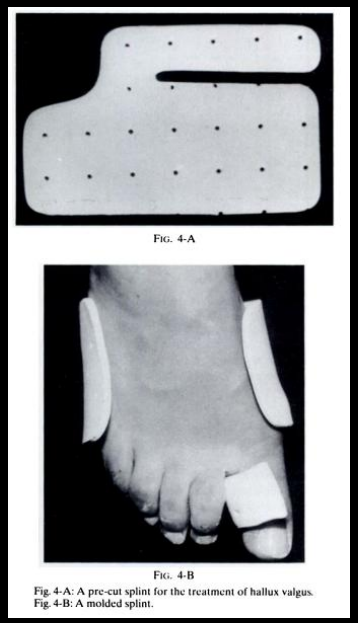


FIG. 4-A

FIG. 4-B

Fig. 4-A: A pre-cut splint for the treatment of hallux valgus.
Fig. 4-B: A molded splint.

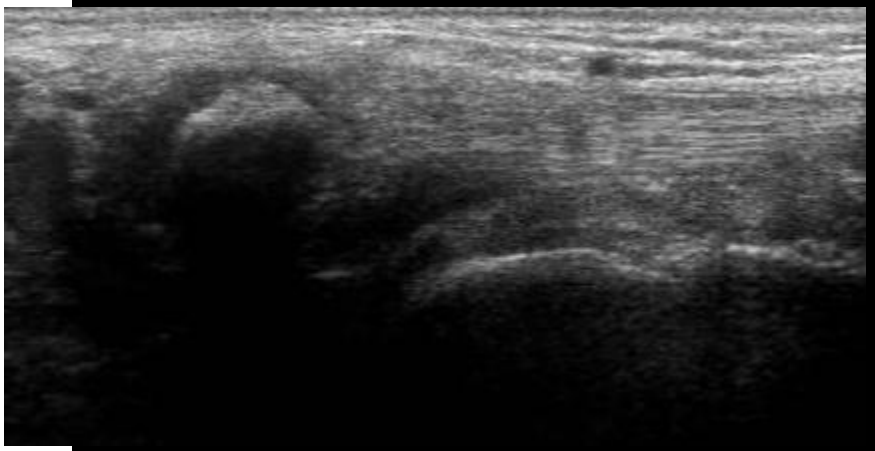
# Surgical Treatment

- No consensus on optimal age and procedure
- Advisable to postpone operative treatment until the completion of bone maturation, as earlier operative intervention has been associated with a high rate of recurrence.
- High recurrence rate ; 61% ( Ball and Sullivan) 47% ( Geissele and Stanton), 45.7% ( Helal),
- Complications
  - revision, hypertrophic scars, cramps, narrowing of the metatarsal head, metatarsalgia, stiffness of the MTP joint, overcorrection, shortening of the first metatarsal.

# Accessory Navicular bone

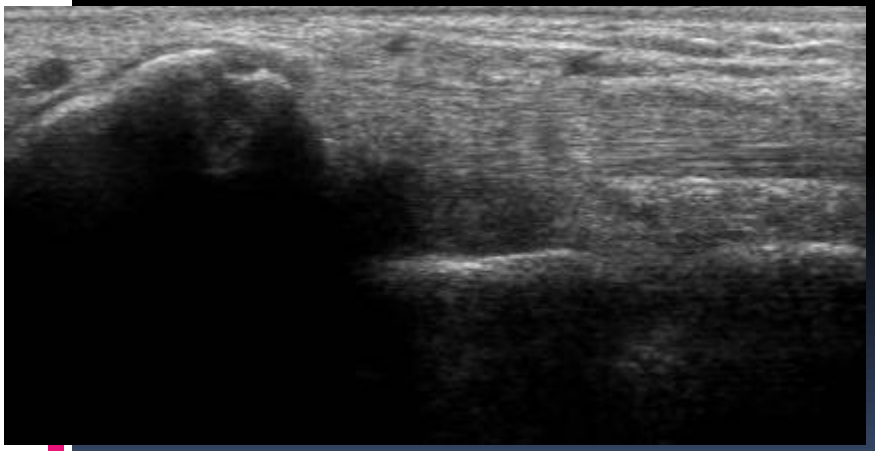
- Congenital anomaly caused by aberrant ossification
- Relatively common, 4-14% of the population
- Usually asymptomatic
- Occasionally, become symptomatic,
  as chronic
  or acute on chronic medial foot pain

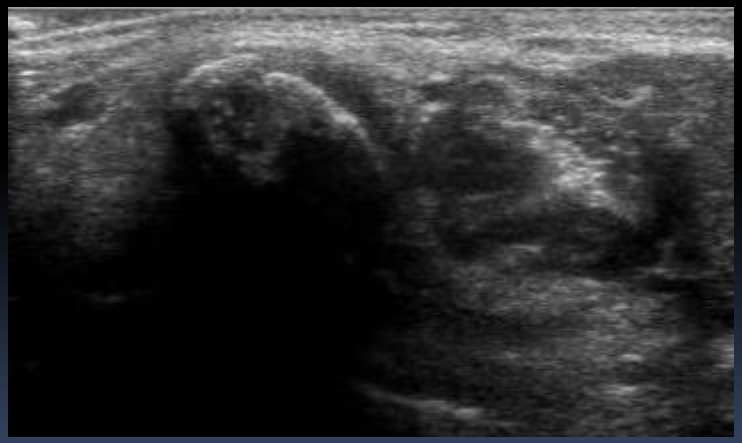
# Types of Accessory Navicular



**Type I** ; os tibiale externum
enclosed within TP tendon
2-6 mm in size
asymptomatic

**Type II** ; navicular bone의
accessory ossif. center
9-12 mm
synchondrosis with navicular
asso. w painful syndrome
higher incidence of tendon rupture

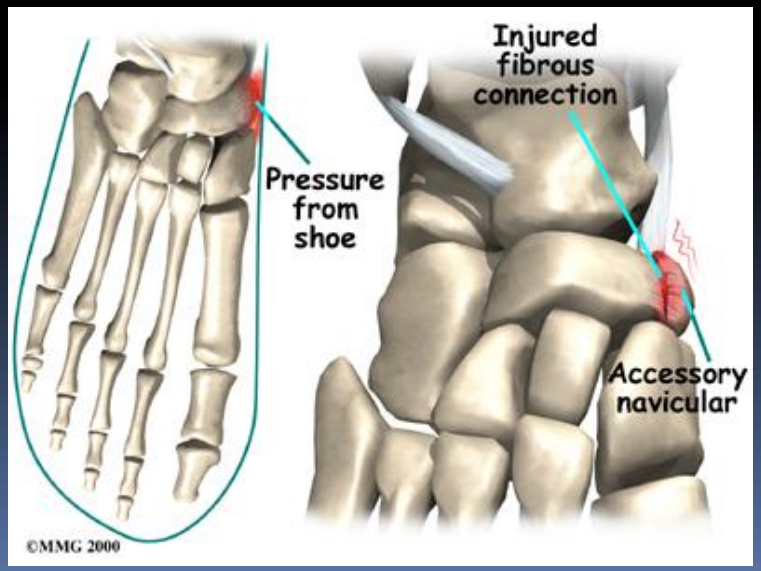




**Type III** ; cornuate accessory navicular
fused to main navicular by bony bridge

# Etiology of pain in accessory navicular

- Pressure or inflammation secondary to bony prominence
- Trauma to the synchondrosis between the accessory navicular and the parent bone
- Abnormal biomechanics of the foot
- PTT tendonitis

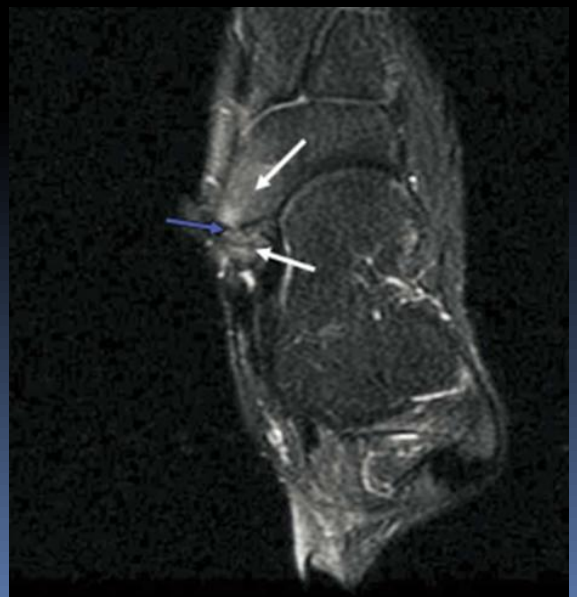


# TP teninitis

- Painful resisted contraction of ankle inversion with plantarflexion
- Loss of function in the PTT
  - Progressive flattening of the medial plantar arch
  - Valgus deformity of hindfoot
  - Abduction of the forefoot
  - Inability to single heel lift

# Imaging

- X-ray
  - 45° eversion oblique view of the foot
- Technetium bone scan
  - Focal increase in radioactivity
  - 100% sensitive , but only 50% specific for a symptomatic navicular bone
- MR imaging
  - bone marrow edema pattern for symptomatic navicular bone

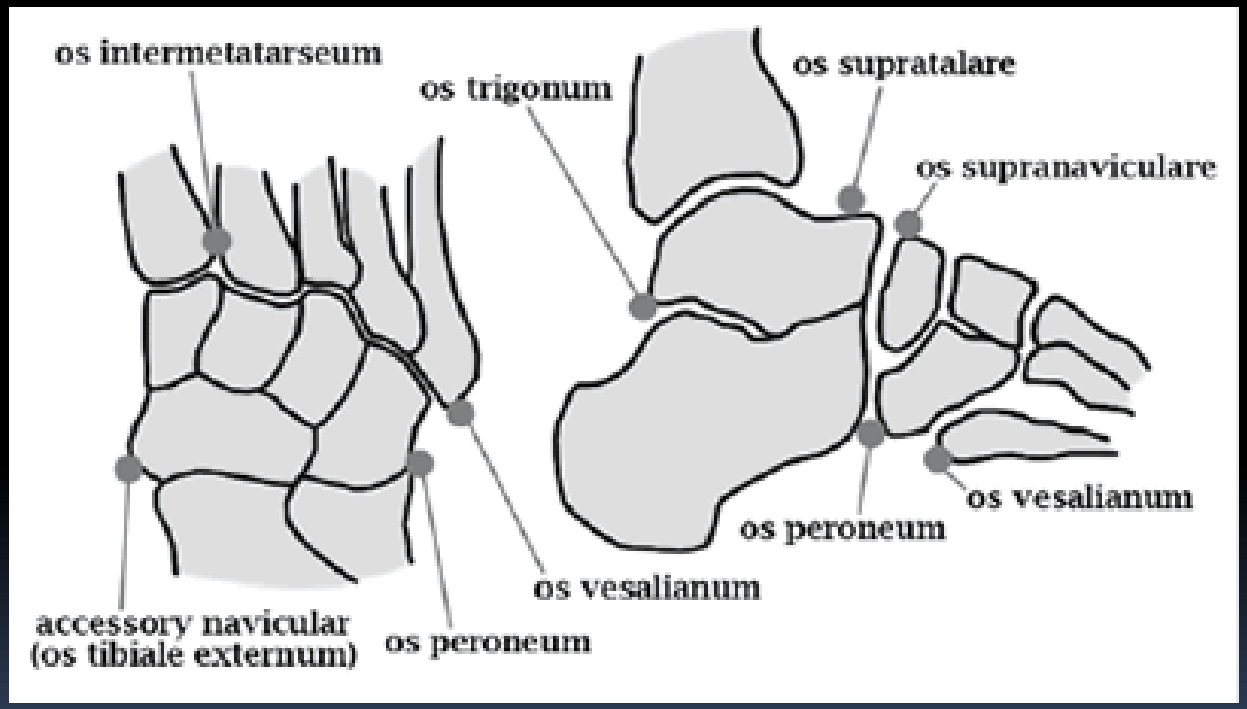


# Treatment of symptomatic accessory navicular bone

- Nonsurgical
  - Unna boot
  - Custom made orthosis
  - Cast immobilization
- Surgical excision
  - For young athletes – surgical repair

# Accessory Ossicles in Foot

- Possible to identify up to 21 accessory bones
- 20-30% of adults have one or more accessory bone




- May be confused with avulsion fracture

# Traction Apophysitis

- Involve growing tissue, particularly evident during the rapid growth during adolescence.
- Pain, swelling,
  occasional bony and cartilaginous overgrowth

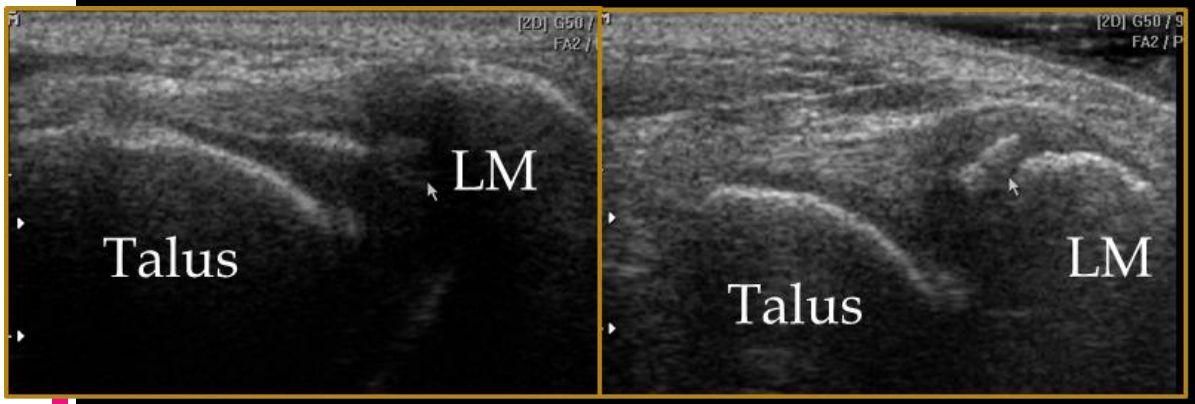
Iselin's disease
( traction apophysitis of the tuberosity of the 5th MT)

Avusion fracture of 5th MT base

Jone's fracture

# Avulsion fracture

M/8 Rt. Lateral ankle pain for 3months after inversion sprain




Lt. ATFL - uninjured Rt. ATFL

# Foot and ankle problems in the young athlete

- Congenital problem
  - Tarsal coalition ( 11-15 yrs )
  - Flat foot ( accessory navicular )
- Developmental problem
  - Bunions
  - Ossicles of the foot and ankle
  - Medial malleolus ossification center
  - Fragmentation of the distal fibular epiphysis
- Osteochondroses
  - Freiberg infraction ( 12-18 yrs )
  - Kohler syndrome ( 3-7 yrs )

경청해 주셔서 감사합니다.