الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيورسيتي إسلام انتارابغسا ملايسيا
Garden of Knowledge and Virtue

TILLAUX AND TRIPLANE FRACTURE

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IIUM Kuantan

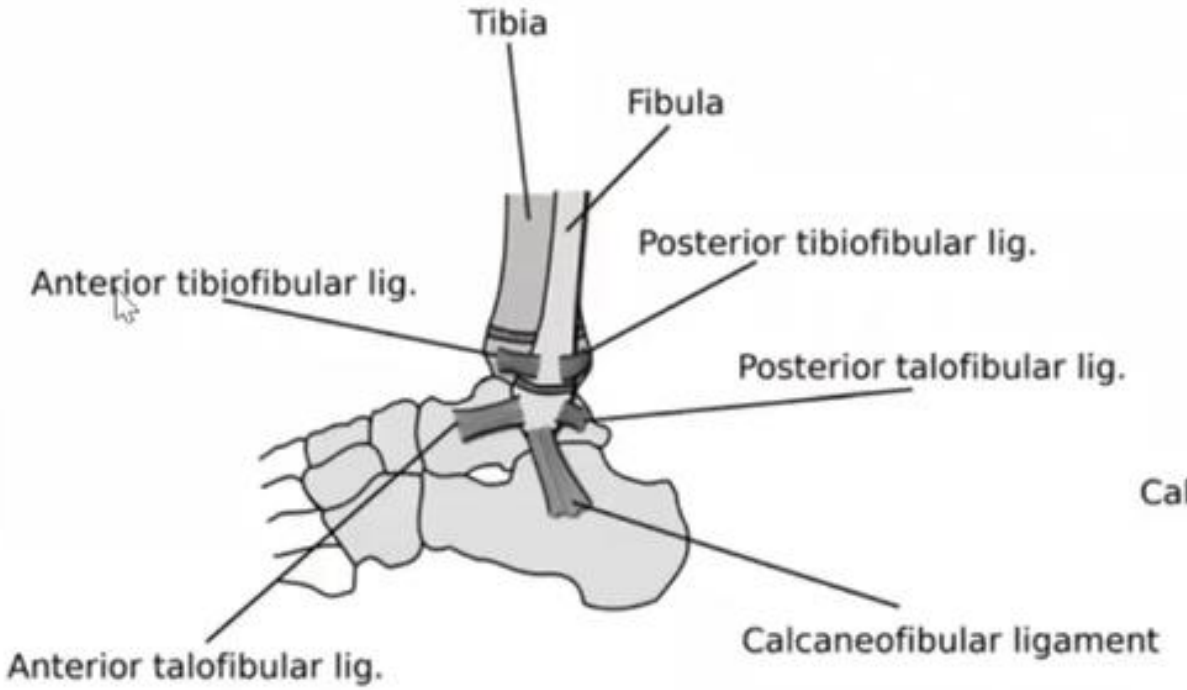
OUTLINE

- Introduction of physeal injury in paediatrics ankle
- Tillaux fracture
- Triplane fracture

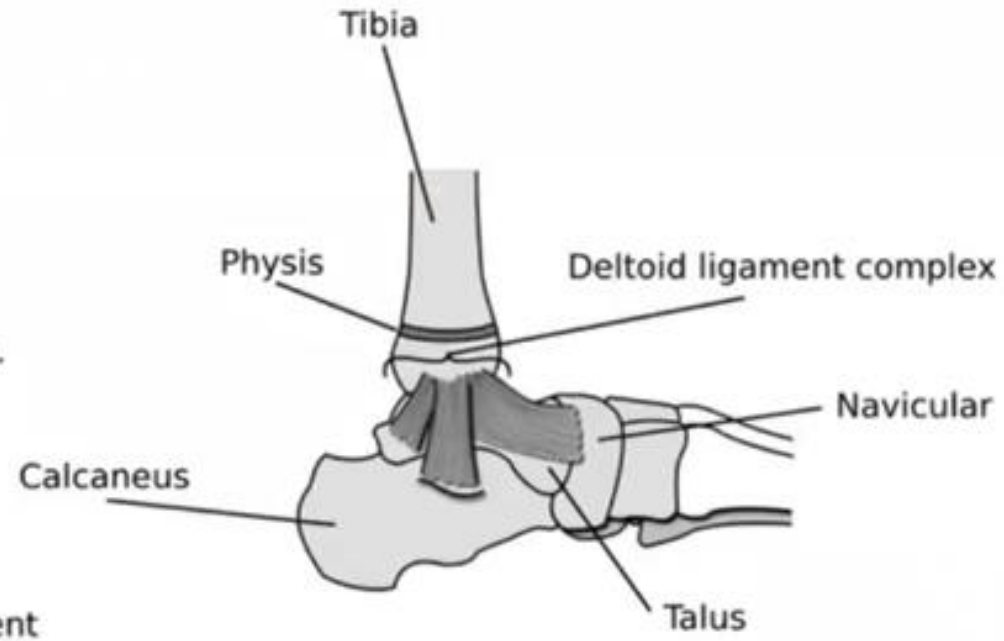
PHYSEAL INJURY IN PAEDIATRICS ANKLE

- **2nd** most after wrist and hand injury
- Distal tibia physeal ankle injury involved in **11%** of all physeal injury[2]

- Ligaments stronger than bones
- Ligaments attached to epiphysis

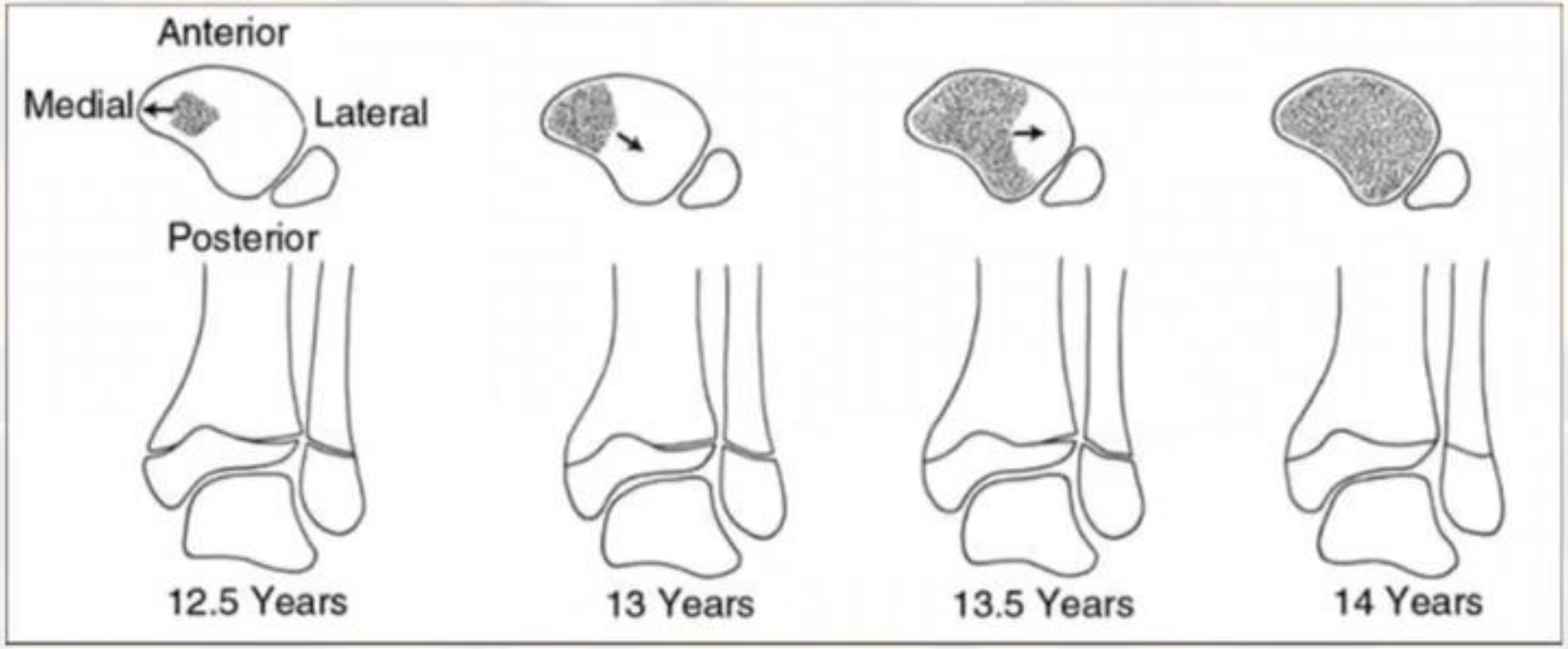


Lateral View



Medial View

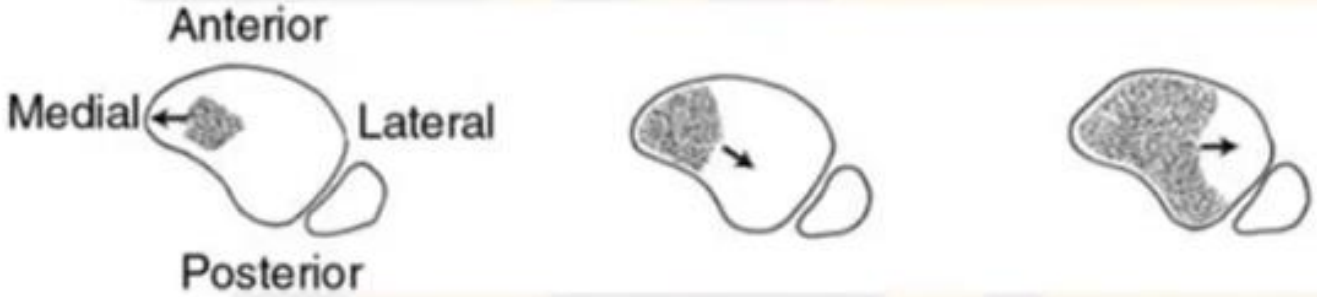
- Physeal closure
  - 16 in boys, 14 in girls
- Transitional period ~18 months in which the physis begins to close in a consistent fashion



- While the physis remains open, the lateral aspect of the distal tibial physis is weaker, which makes this area more susceptible to injury when it is stressed
- the weaker physis usually fails

  prior to the stronger ligamentous

  complex



= Transitional fracture

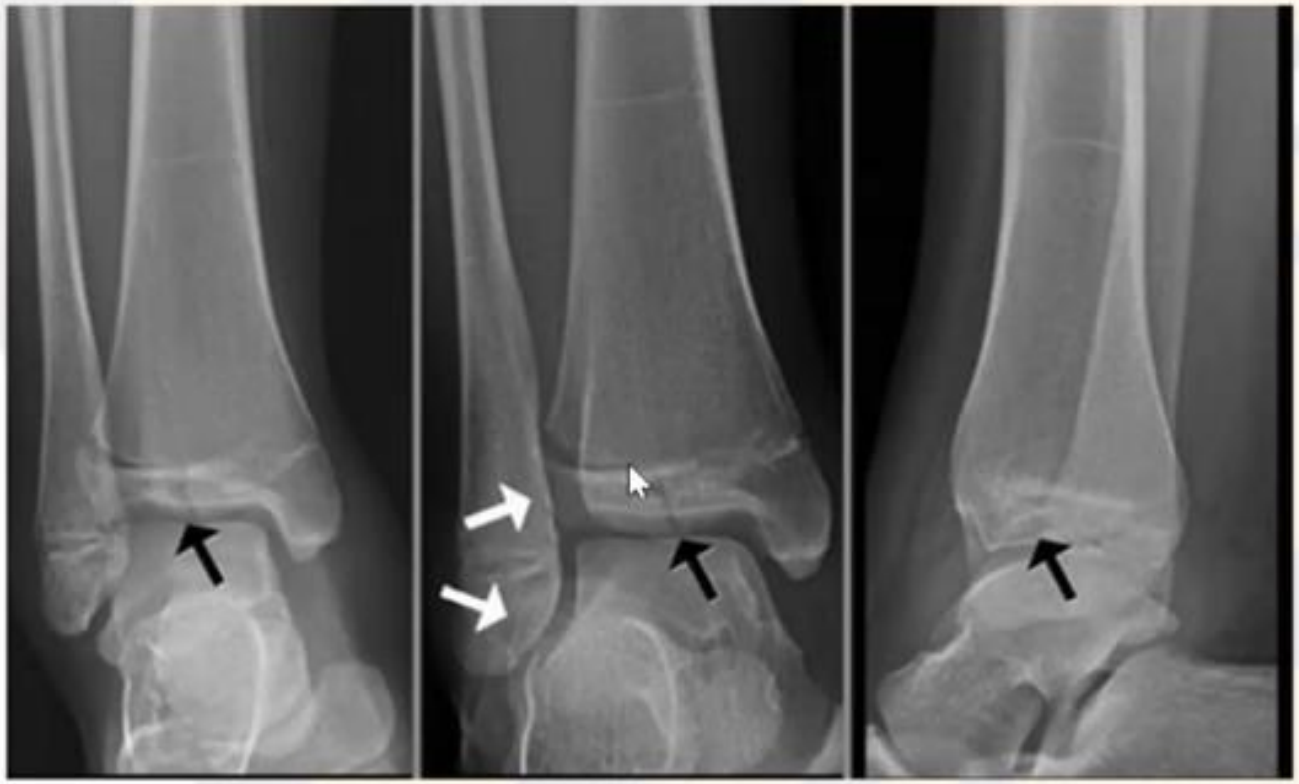
TILLAUX FRACTURE

Introduction

- Paul Jule Tillaux, 1876
- 3% to 5% of pediatric ankle fractures
- Avulsion of anterior tibiofibular ligament
- Anterolateral fracture of the distal tibia physis
- SH III
- Intraarticular fracture
- Mechanism of injury : SER

Investigations

- X-Ray : Best seen on mortise view



- CT scan

CT is warranted in cases in which displacement >2 mm is suspected (Figure 6). CT better defines fracture displacement and can aid in surgical planning.

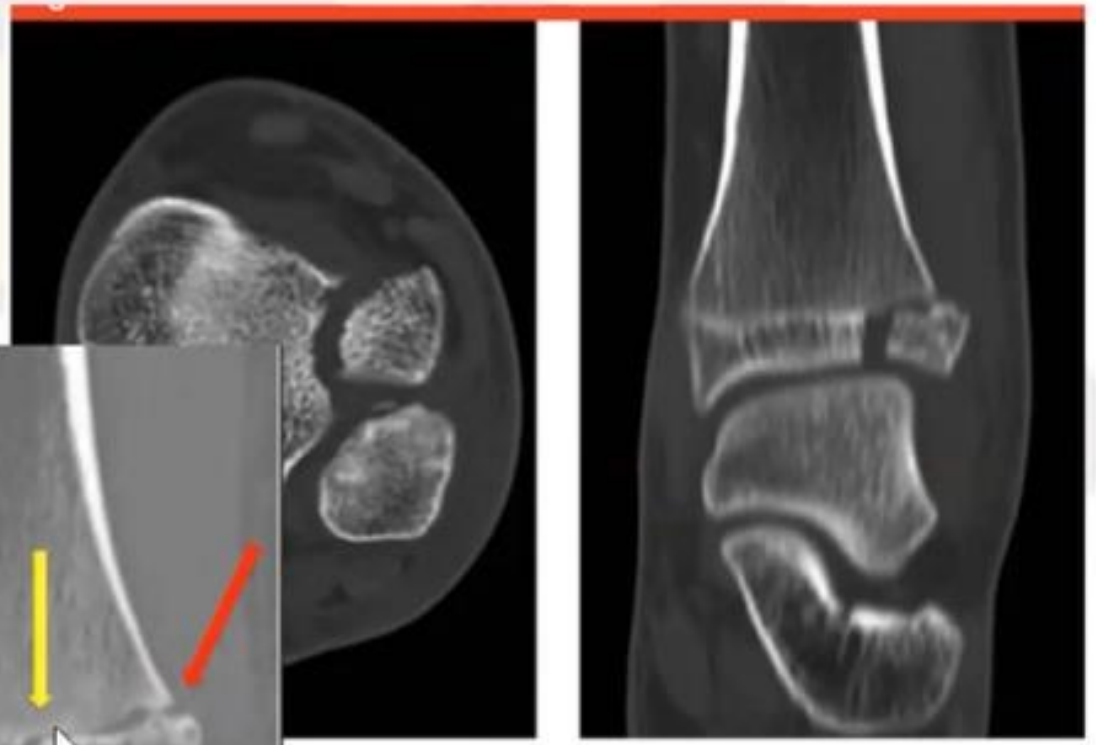
Review Article

Pediatric Physeal Ankle Fracture

Thomas H. Wuerz, MD, MSc
David P. Gurd, MD

J Am Acad Orthop Surg 2013;21: 234-244

http://dx.doi.org/10.5435/JAAOS-21-04-234



...nal (**B**) CT scans of a Tillaux fracture. Note the Salter-...ure with displacement.

Management

- AIM : for anatomic reduction
- **Non displaced**
  - NWB immobilization in a long leg cast x 6 weeks
  - 4 weeks in NWB long leg casts applied in internal rotation → NWB in boot for 2 weeks with ROM exercise → FWB in the boot x 2 weeks
  - Patients must be followed closely initially, with radiologic imaging performed to verify adequate alignment during cast treatment

Pediatric Ankle Fractures

Concepts and Treatment Principles

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1083-7515/15/$ – see front matter

If the reduction is satisfactory, weekly radiographs should be obtained to ensure maintenance of alignment for 3 weeks, at which point the child can be transitioned to a short-leg, non-weight-bearing cast for an additional 3 weeks. If the articular alignment is not anatomic, ORIF is recommended.

- Displaced fracture :

All five of these studies had patients with 2 mm or more of fracture displacement as an indication for surgery. Anatomic reduction without persistent articular incongruity in Tillaux fractures appears to be associated with favourable outcomes. Whilst an initial attempt at closed reduction is warranted, it may not always be possible to obtain the reduction; periosteal interposition at the fracture site may prevent reduction and necessitate definitive open reduction.

Cureus

Open Access Review Article

DOI: 10.7759/cureus.12860

Adolescent Tillaux Fractures: A Systematic Review of the Literature

Tak S, Qureshi M K, Ackland J A, et al. (January 22, 2021) Adolescent Tillaux Fractures: A Systematic Review of the Literature. Cureus 13(1): e12860. DOI 10.7759/cureus.12860

- Close reduction
  - Method of CMR
    - Dorsiflexion and internal rotation, maintain reduction in long leg cast
  - joystick technique may be helpful

- OR : anterolateral approach
- Implants :
  - K-wire, Screw (AL to PM), alternative : bioabsorbable screw

AP (**A**), mortise (**B**), and lateral (**C**) radiographs demonstrating metallic screw fixation of a Tillaux fracture.

Complications

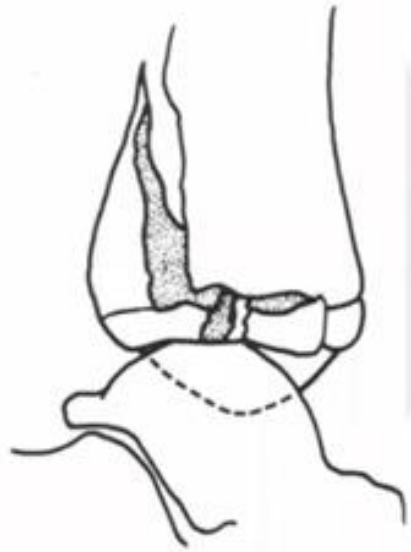
- These patients are near the end of growth and physeal function, and thus, the risk of physeal damage with resultant deformity is low
- Poor radiographic sequelae reported includes poor joint congruity, angular deformity and shortening, but no report on premature physeal closure, likely due to near maturity injury.

Figure 1. Case 26. A 13-year-old girl with a Tillaux fracture, treated by closed reduction.
A. Fractured right ankle, showing that the medial part of the physis is still open.
B. Follow-up at 12 years revealed 17 mm of shortening and 5 degrees of valgus. Although the remaining growth potential must have been small, there was no other apparent cause for differences between the two sides.

TRIPLANE FRACTURE

Introduction

- Triplane fractures are a subgroup of Salter-Harris type IV injuries.
- 3 planes involvement, fracture line is :
  - sagittal orientation within the epiphysis,
  - axial through the physis,
  - and coronal within the metaphysis



- **6.3%** of all paediatrics ankle fracture
- **12 to 15 years** (girls, 12 to 14 years; boys, 13 to 15 years) who is transitioning to skeletal maturity
- not occur in patients younger than age 10 years or older than age 16.7 years
- Slightly earlier than tillaux

- Mechanism of injury :
  - Twisting ankle injury – SER lateral triplane, Adduction medial triplane
- 50% has concomitant fibula fracture
- Other associated injury : ipsilateral tibia shaft fracture, Maisonnauve fracture

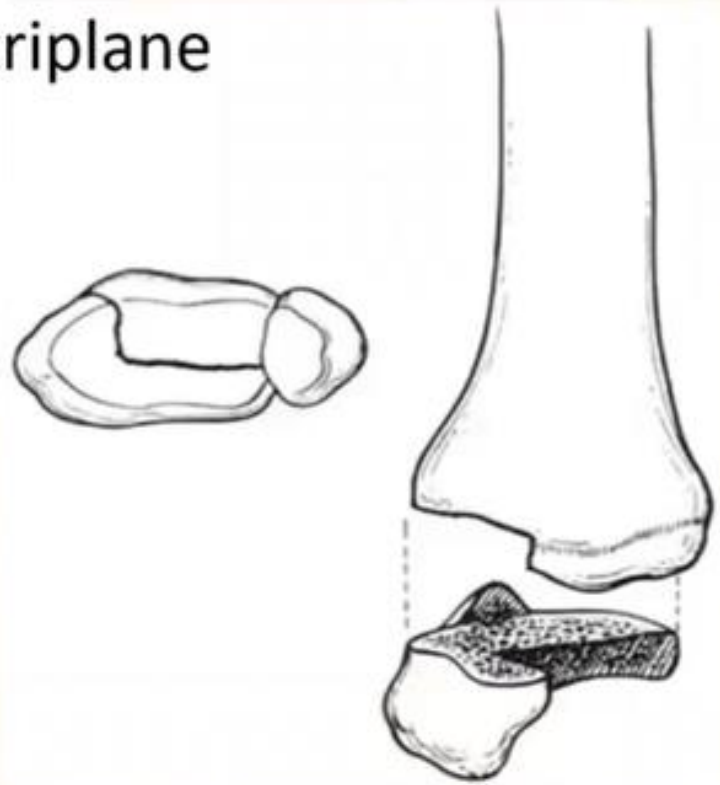
Types

- 2parts : medial/lateral
- 3parts : present of episphyseal separation
- 4parts (rare)

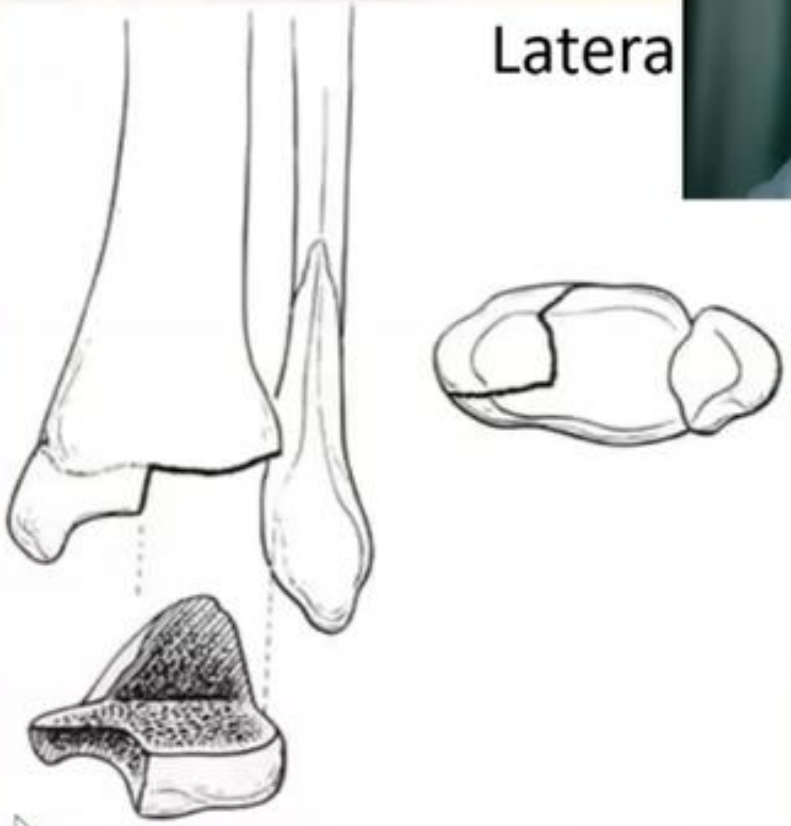
Fig. 4

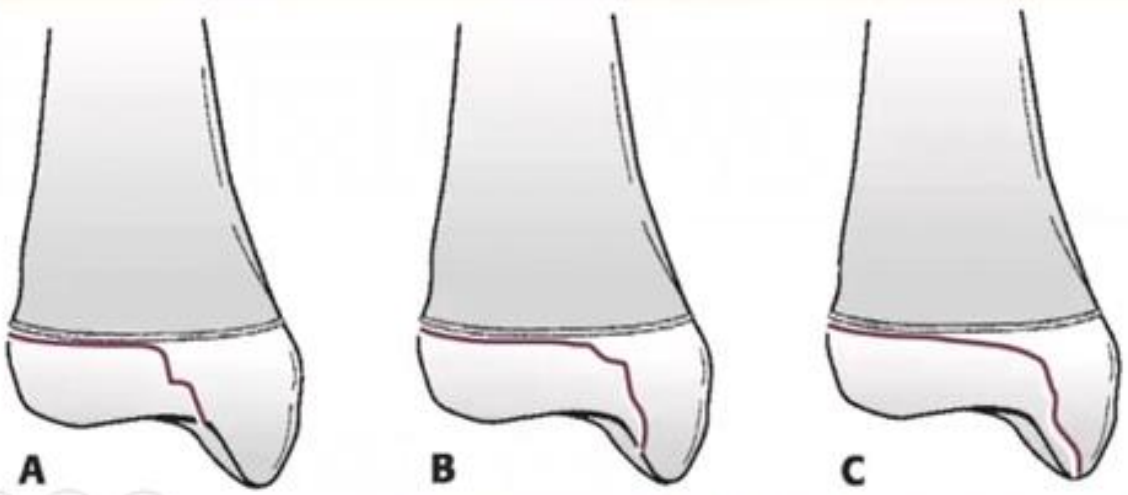
Figs. 4-A through 4-G Triplane fractures. **Fig. 4-A** Two-part fracture with the medial malleolus attached to a large metaphyseal spike. **Fig. 4-B** Two-part fracture with the medial malleolus attached to the shaft fragment. **Fig. 4-C** Three-part fracture with the epiphysis completely detached from the shaft, and the medial malleolus on the large metaphyseal spike. **Fig. 4-D** Three-part fracture with a completely detached medial malleolus. **Fig. 4-E** Three-part fracture with the medial malleolus attached to the shaft fragment, and a separate anterolateral epiphyseal free fragment. **Fig. 4-F** Rare four-part so-called quadriplane variant with a double metaphyseal spike as described by van Laarhoven and van der Werken[32]. **Fig. 4-G** Four-part fracture with free medial malleolus and anterolateral epiphyseal fragments.

Medial triplane



Latera





Intermaleolar triplane

Investigation : X-ray

- Salter Harris type III fracture on anteroposterior radiographs and a Salter Harris type II fracture on lateral radiographs
- Mortise view : best characterize the fracture displacement

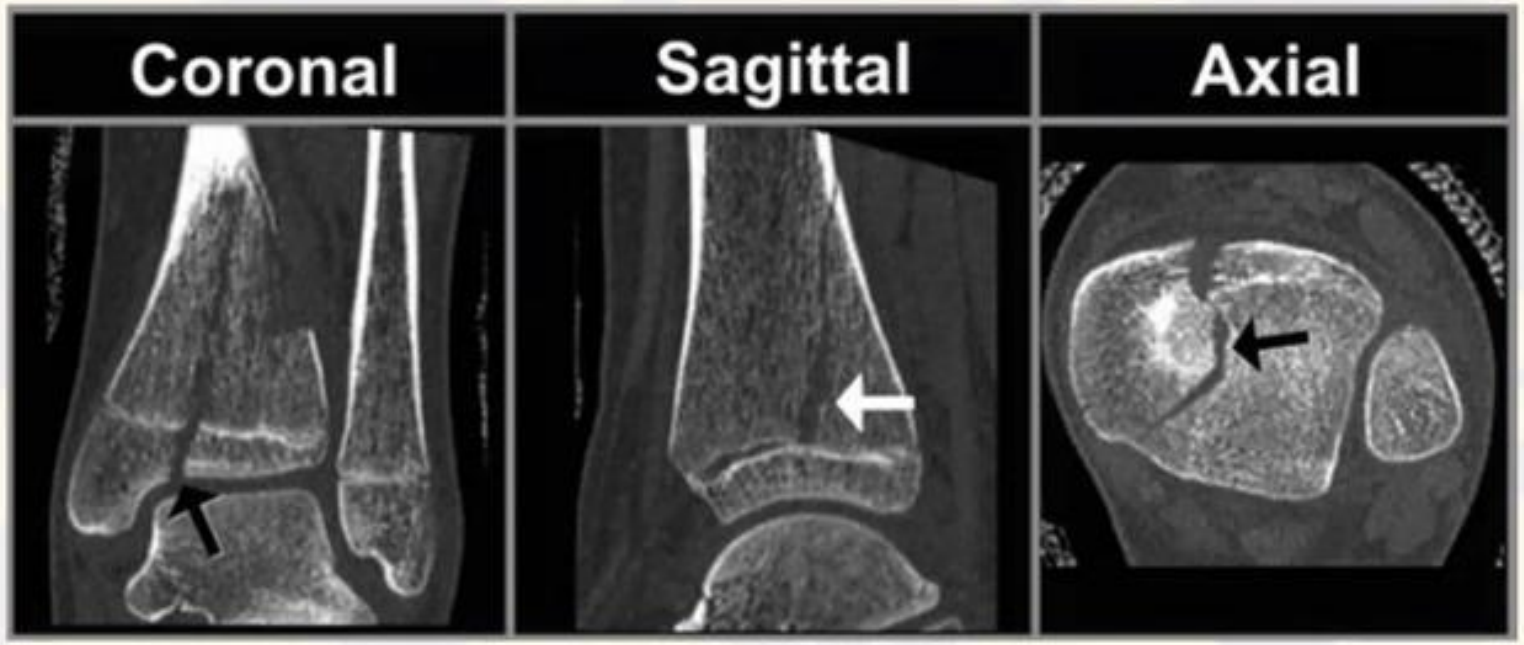
CT Scan

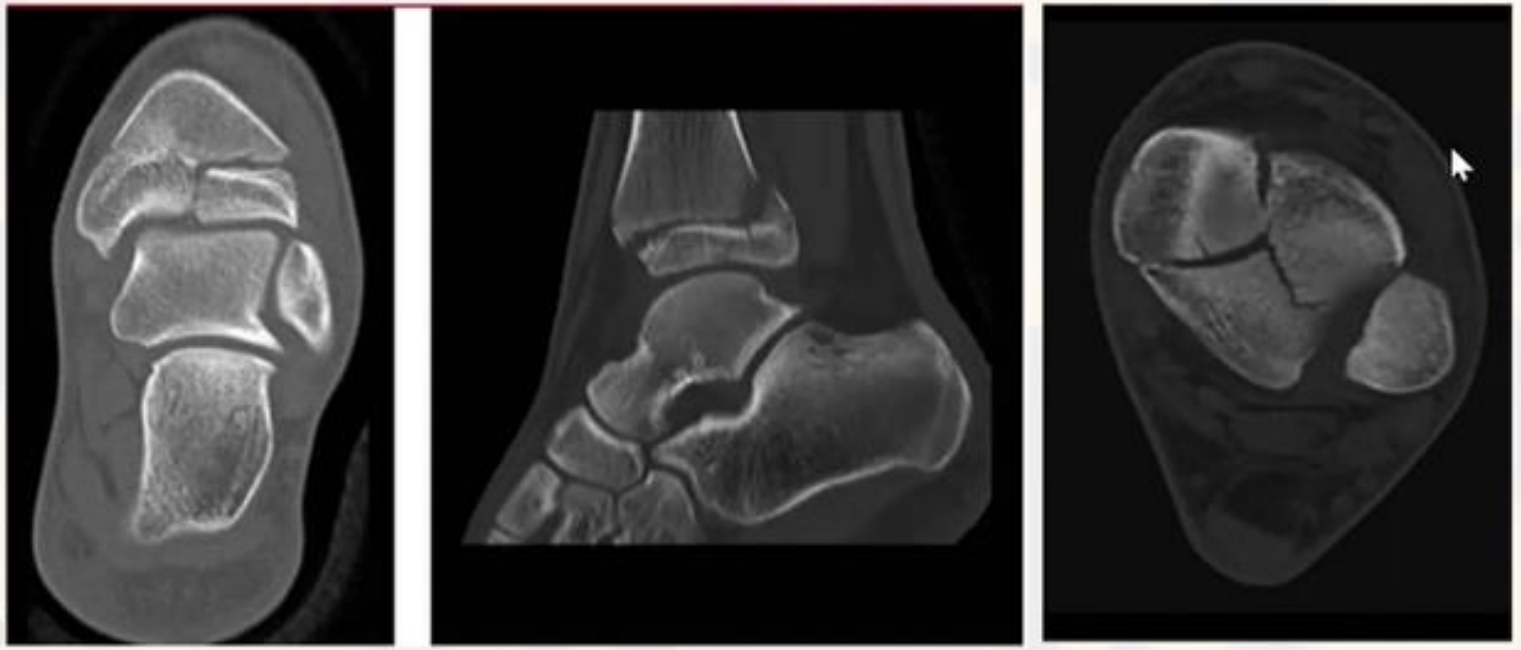
- Fracture configuration
- Fracture displacement
- Pre op planning

The Pediatric Triplane Ankle Fracture

Kent A. Schnetzler, MD, MS
Daniel Hoernschemeyer, MD

Preoperative plans based on CT demonstrated a significant ($P < 0.0001$) improvement in accuracy for both the point of insertion and the direction of the screw compared with plans made using plain radiographs alone.[48]


Coronal
Sagittal
Axial



Treatment – conservative

- Nondisplaced triplane (<2mm displacement)
- Immobilization in a long leg cast
- CMR :
  - with axial traction on the ankle then ;
    - foot is positioned in external rotation in medial fractures,
    - for lateral fractures, in internal rotation

- Displacement >3 mm bodes poorly for successful closed reduction secondary to the energy of the injury, soft-tissue interposition at the fracture and swelling

Treatment : Open reduction

- May attempt CR then fixed
- If fails : Open reduction
- Approach : Anterolateral approach (lateral fractures) or an anteromedial approach (medial fractures)
- Implants : K-wire/Screw
- Post operative immobilization : non–weight-bearing, long leg cast for 3 to 4 weeks, followed by a short leg walking cast/boot

- Anterolateral fragment : screw from AL towards PM (entirely in epiphysis)
- Posterior metaphyseal spike fragment : screw from anterior to posterior

A B

A, Postoperative lateral plain radiograph demonstrating placement of an anteroposterior screw affixing the posterior fragment in a classic triplane fracture. **B,** Postoperative AP plain radiograph demonstrating placement of a screw affixing the anterolateral fragment in a classic triplane fracture.

Complications

- Degenerative
- Premature physeal closure
  - May leads to angular deformity
  - 7-21%[1] 21%[4]
  - Residual fracture displacement after reduction was the most important determinant[4]

The Pediatric Triplane Ankle Fractu

Kent A. Schnetzler, MD, MS
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their outcomes. In a study with long-term follow-up of 35 patients with triplane fractures, degenerative changes were seen at >5 years when good reduction (<2 mm) could not be achieved.[39] In another study with long-term follow-up (38 months to 13 years), residual displacement >2 mm was associated with poorer results unless the fracture was outside the weight-bearing articular surface.[24] Residual gaps in the physis (>3 mm) attributed to trapped periosteum after closed reduction may result in premature physeal closure, which attests to the need for accurate reduction.[56]

References

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2

CURRENT CONCEPTS REVIEW

Ankle Fractures in Children

Ethan W. Blackburn, MD, David D. Aronsson, MD, James H. Rubright, MD, and Jennifer W. Lisle, MD

Investigation performed at the Department of Orthopaedics and Rehabilitation, McClure Musculoskeletal Research Center, University of Vermont, Burlington, Vermont

3

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Thank you