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RXC

Hallux abducto valgus – what it is and how it is treated.

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Objectives

- Understand the hallux valgus deformity
- Know pertinent findings on preoperative radiographs
- Be familiar with types of surgical corrections
- Know pertinent findings on the postoperative radiographs

Hallux abducto valgus

- Abduction and valgus rotation of the great toe combined with a medially prominent first metatarsal head

Biomechanics

- “hallux valgus complex” – progressive disorder
  - calluses under the forefoot
  - metatarsalgia
  - splayfoot
  - flatfoot
  - hammer toes
  - plantar fascitis

Etiology

- Associated with wearing enclosed shoes
- At least 2x women > men
- First mentioned in literature in the 18th century
  - Not in early Greeks or Romans
  - Often in European farmers, but not islanders or African tribes
  - Not with sandals that separate 1st and 2nd toes

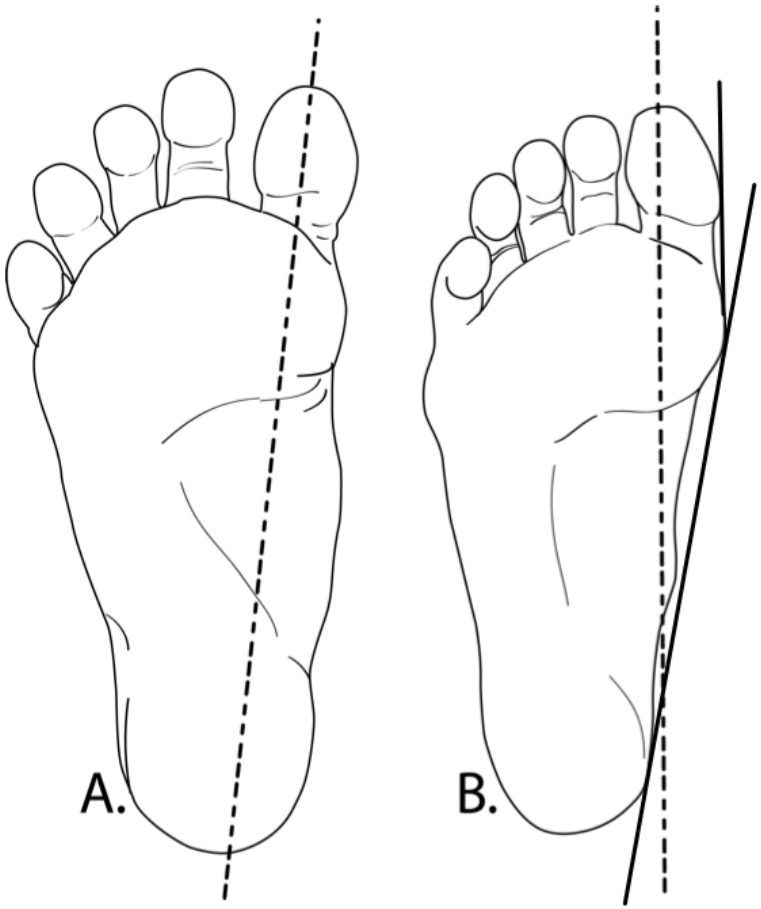


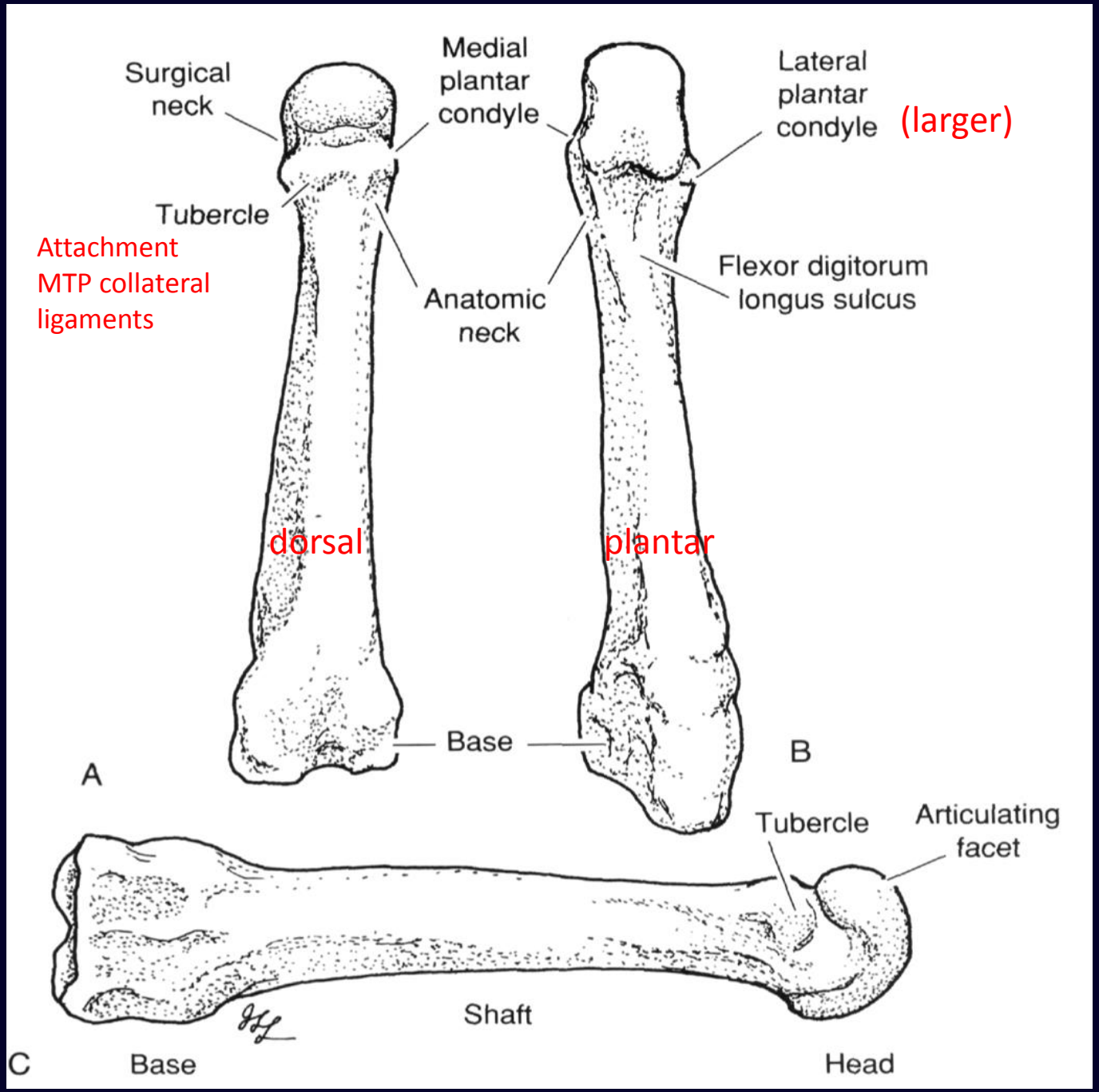
Fig. 3-1. (A) A foot that has never worn shoes. (B) A normal foot that has worn shoes. Feet that have never worn shoes are commonly found to have the digits in alignment with their respective metatarsals, giving the foot a fan shape. Normal feet that wear shoes are commonly found to have the digits in alignment with the longitudinal axis of the rearfoot, thus giving the foot a sarcophagus shape. (From Hoffman,[164]).

Etiology

- But wearing shoes does not explain hallux valgus on its own
- Other factors
  - Abnormal pronation
  - Ligamentous laxity
  - Shape of the metatarsal head

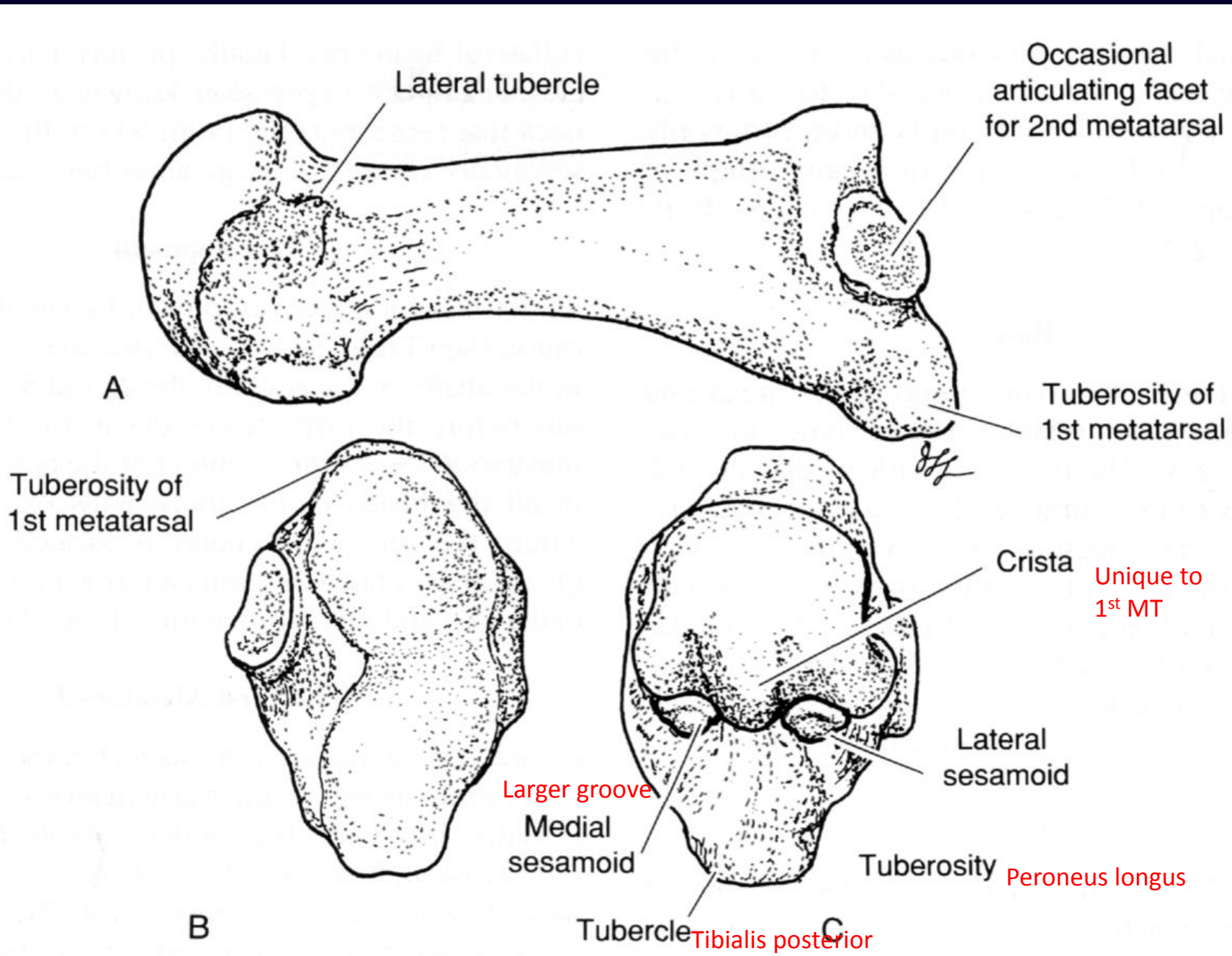
Foot anatomy:

- Midline of the foot is through 2nd metatarsal
- Metatarsals are nearly parallel to each other (0-8 degrees)
- 1st metatarsal is the shortest
- 2nd metatarsal is the longest


Surgical neck
Medial plantar condyle
Lateral plantar condyle
(larger)
Tubercle
Attachment
MTP collateral ligaments
Anatomic neck
Flexor digitorum longus sulcus
dorsal
plantar
Base
A
B
Tubercle
Articulating facet
Shaft
C
Base
Head

1st metatarsal

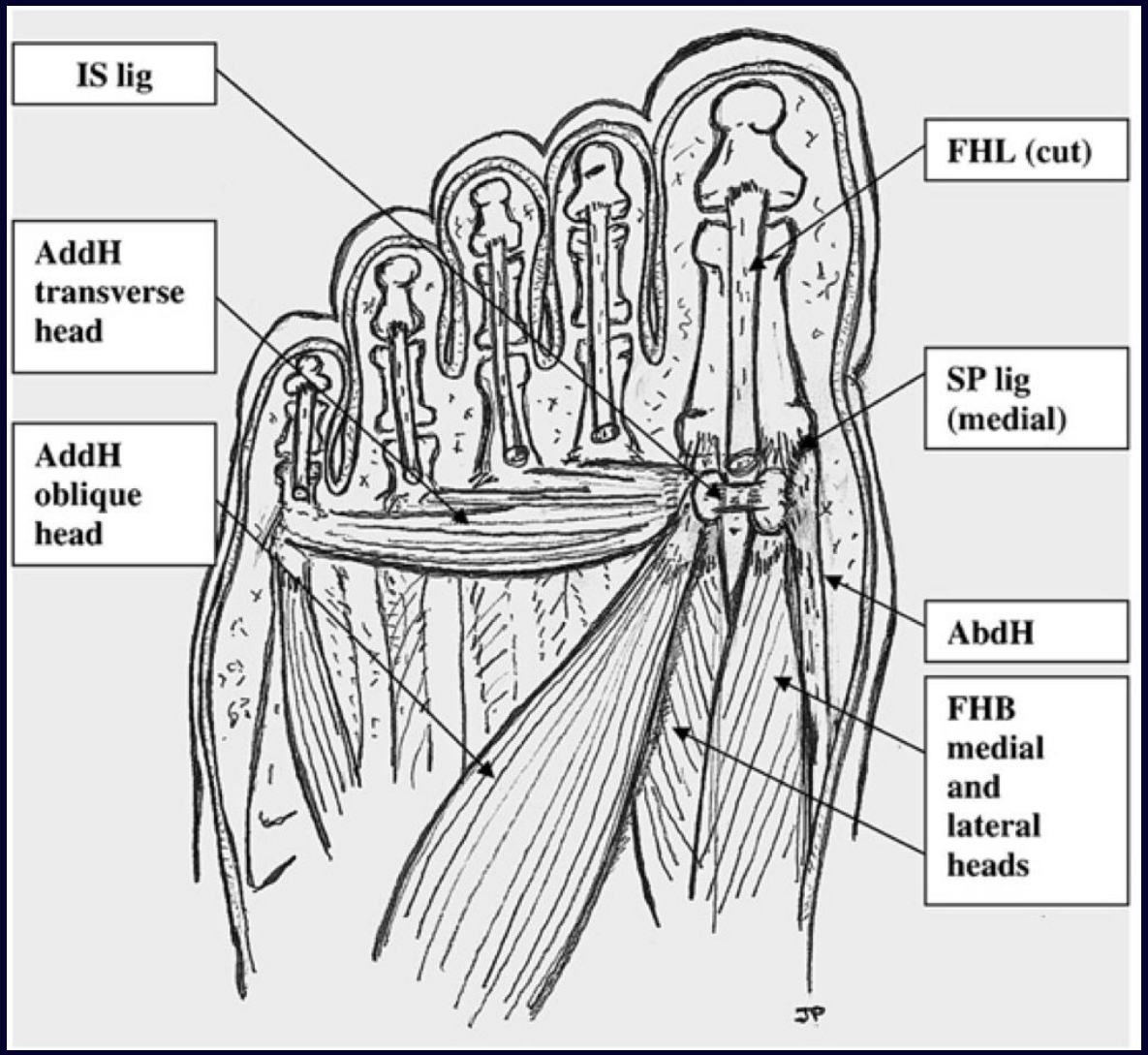
- Shortest, broadest
- Most mobile
- Occasional articulation b/w 1st and 2nd metatarsal bases


Lateral tubercle
Occasional articulating facet for 2nd metatarsal
A
Tuberosity of 1st metatarsal
Tuberosity of 1st metatarsal
Crista
Unique to 1st MT
Lateral sesamoid
Larger groove
Medial sesamoid
Tuberosity
Peroneus longus
B
Tubercle
Tibialis posterior
C

Crista:

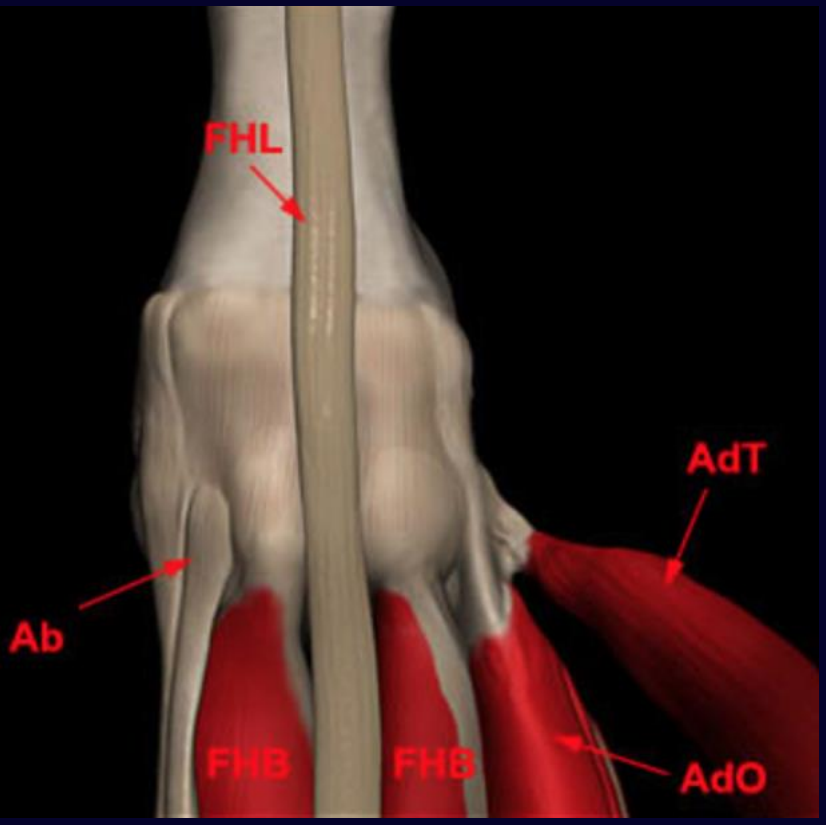
- Is slightly lateral to the midline
- 78 degrees angle during stance (sligtly everted)
- Perpendicular during loading to distribute weight b/w sesamoids

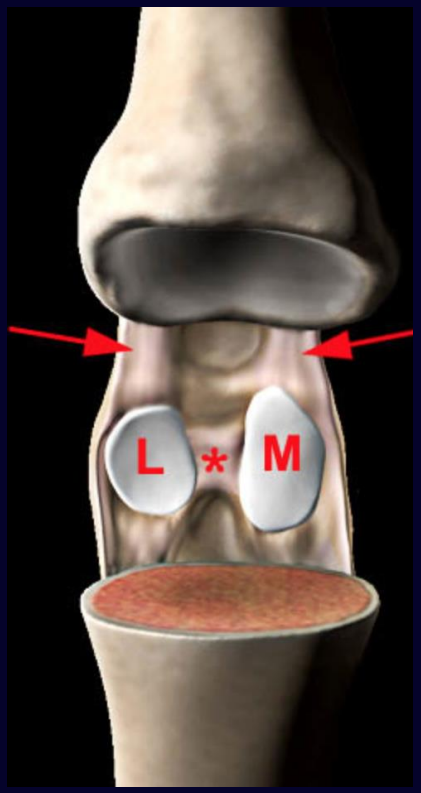
1st MTP joint anatomy

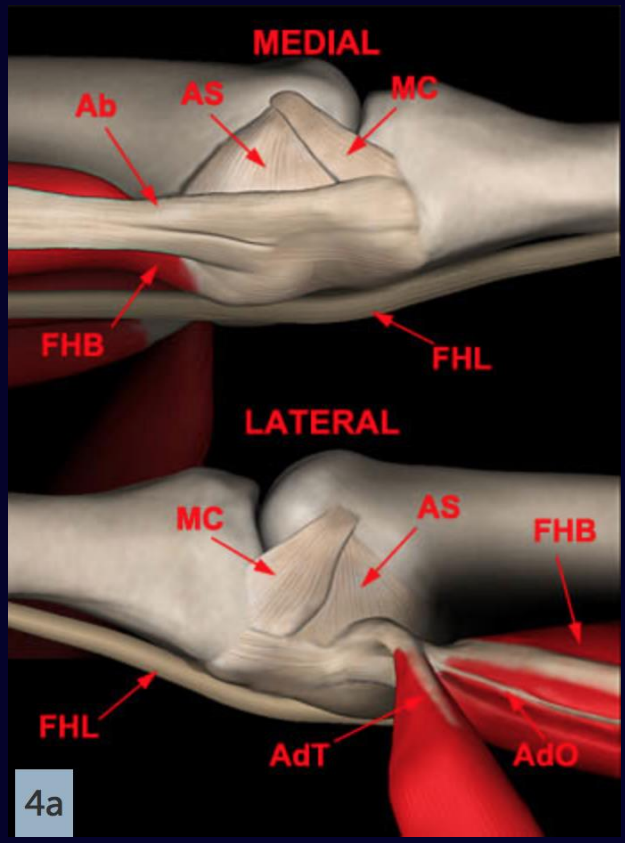


Crain J.M., Phancao, Stidham K. *MR Imaging of Turf Toe.* Magn Reson Imaging Clin N Am 16 (2008) 93–103

1st MTP joint anatomy







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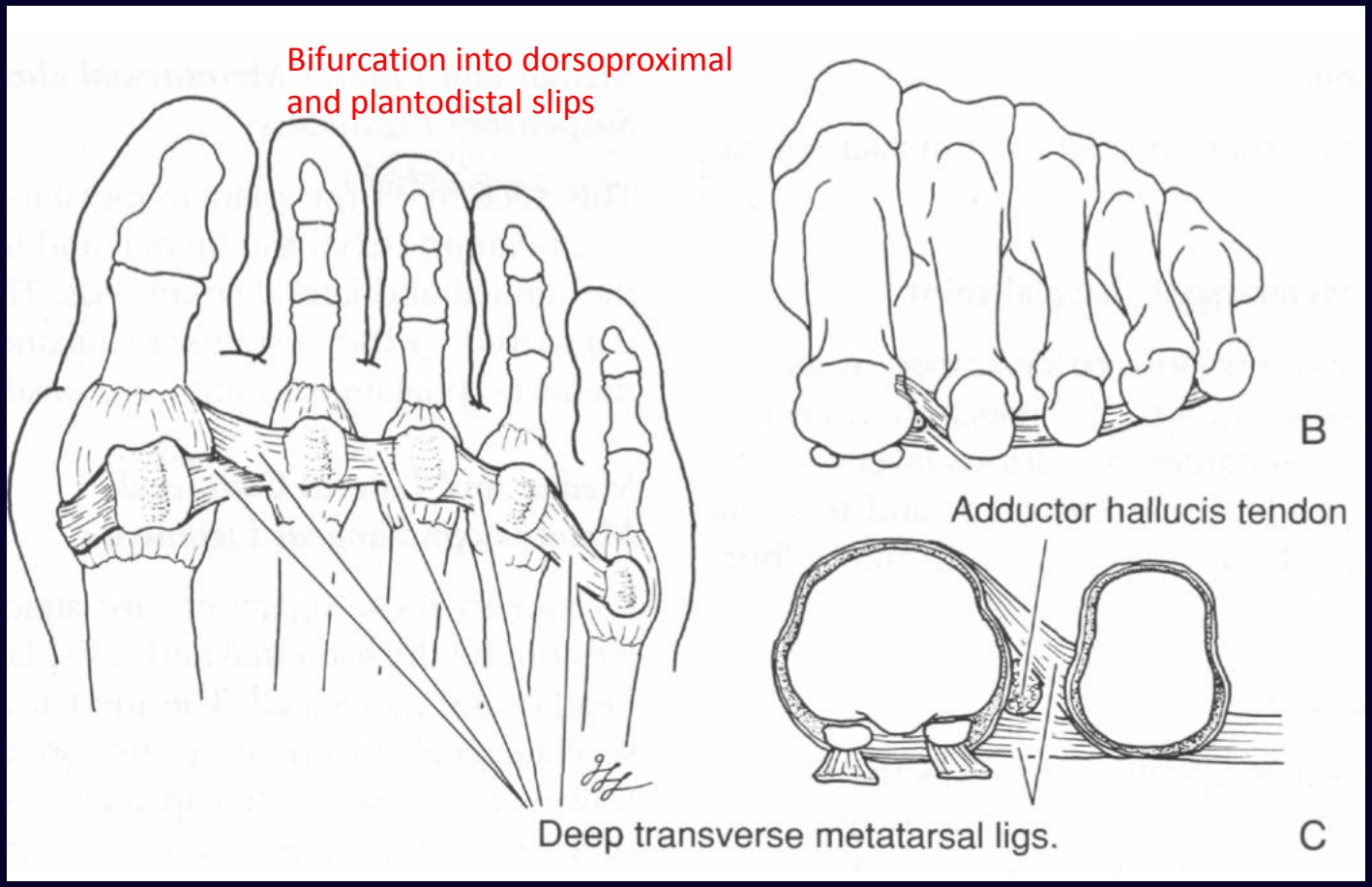
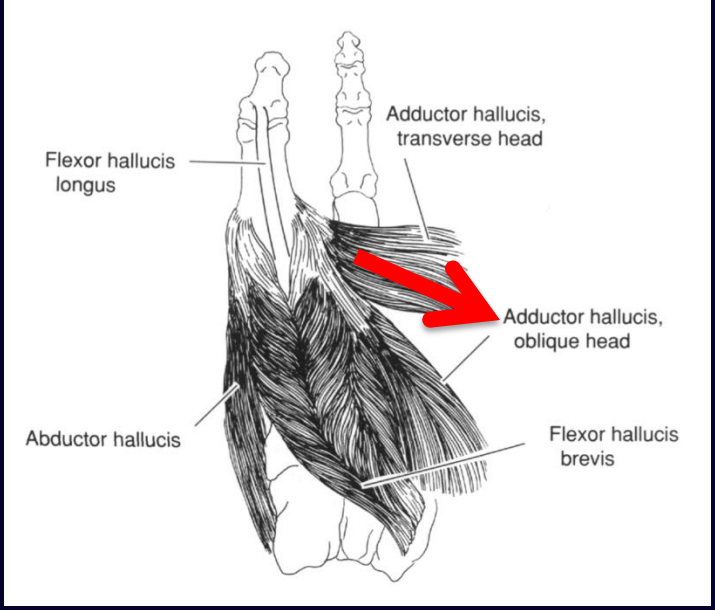
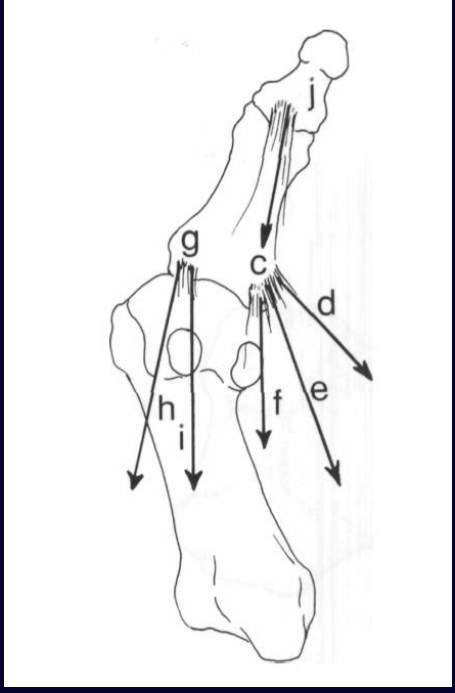

Bifurcation into dorsoproximal and plantodistal slips
B
Adductor hallucis tendon
Deep transverse metatarsal ligs.
C

Biomechanics

- Abnormal pull of the adductor hallucis muscle in the pronated foot
- Lateral pull on sesamoids
- Stretching and tearing of medial collateral ligaments
- Erosions in the medial sesamoid





In all cases of hallux valgus the sesamoid apparatus moves laterally

Fig. 3-13. (A) Radiograph of normal foot that is supinated. (B) Radiograph of the same foot when the foot is pronated. Note the appearance of "lateral displacement" of the sesamoids and the hallux, which is actually caused by the first metatarsal dorsiflexing and inverting.

Fig. 3-14. As the hallux becomes displaced laterally, the tibial sesamoid encroaches and compresses the plantar crista of the first metatarsal head.

And the lateral sesamoid is more lateral

Biomechanics

- Median eminence of the 1st metatarsal head
  - Is not a hypertrophied bone
  - But an original medial epicondyle that has lost cartilage as phalanx shifted laterally

Development of metatarsus primus adductus

- Metatarsus primus adductus = metatarsus primus adducto varus = metatarsus primus varus
- Normal intermetatarsal angle 5-9 degrees (12)
- Relationship between degree of the hallux valgus and intermetatarsal angle
- This deformity has to be corrected along with hallux valgus deformity!

Radiographic evaluation - AP

- First intermetatarsal angle
  - between the line bisecting the longitudinal axis of the first metatarsal and the line bisecting the longitudinal axis of the second metatarsal
  - Metatarsal osteotomy
    - More proximal as angle increases
    - Segmental osteotomy in severe cases


B
C
D

Radiographic evaluation - AP

- Hallux valgus angle
  - Normal < 15
  - principle determinant of severity of hallux valgus deformity
  - corrective soft-tissue procedure consisting of medial capsulorrhaphy and tightening of the abductor hallucis tendon together with release of the adductor hallucis tendon laterally is performed in most cases

Radiographic evaluation - AP

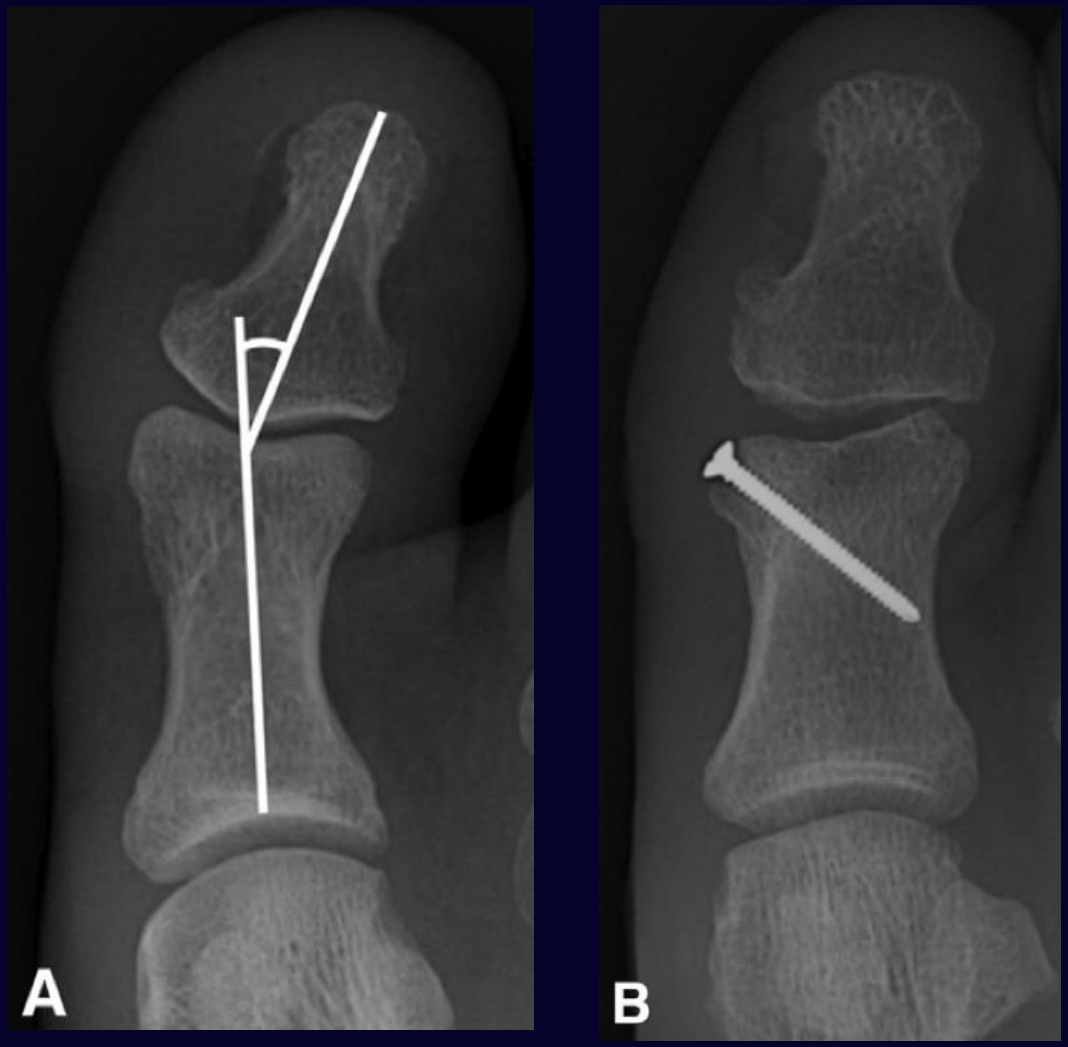
- Proximal articular set angle (PASA)
  - Measures the lateral offset of the articular surface of the first metatarsal head
  - between a perpendicular to the line bisecting the longitudinal axis of the first metatarsal and a line delineating the orientation of the metatarsal head articular surface
  - Normal < 10
  - realigning metatarsal osteotomy is indicated

Radiographic evaluation - AP

- distal articular set angle (DASA)
  - measures the orientation of the articular surface of the proximal phalangeal base
  - between a perpendicular to the line bisecting the longitudinal axis of the proximal phalanx and a line delineating the orientation of the proximal phalangeal base articular surface
  - Normal < 10
  - realigning phalangeal osteotomy is indicated
  - If not appreciated, it can lead to overcorrection of the hallux valgus deformity

Radiographic evaluation - AP

- Hallux interphalangeus angle
  - bisection of the longitudinal axes of the proximal phalanx and the distal phalanx of the hallux
  - Normal < 10
  - Corrective phalangeal osteotomy is indicated
  - Failure to recognize this deformity can, therefore, lead to surgical overcorrection of hallux valgus


A
B

Radiographic evaluation - AP

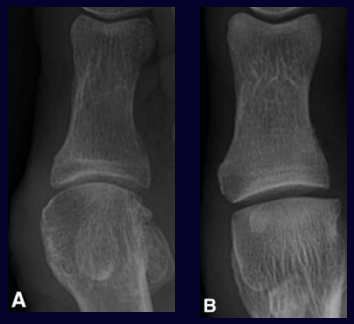
- MTP joint congruence
  - The joint is congruent when the articular surfaces of the metatarsal head and proximal phalangeal base are parallel
  - If congruent – osteotomy along or osteotomy + soft tissue procedure
  - If not congruent - a soft-tissue procedure is necessary and is sometimes accompanied by an osteotomy

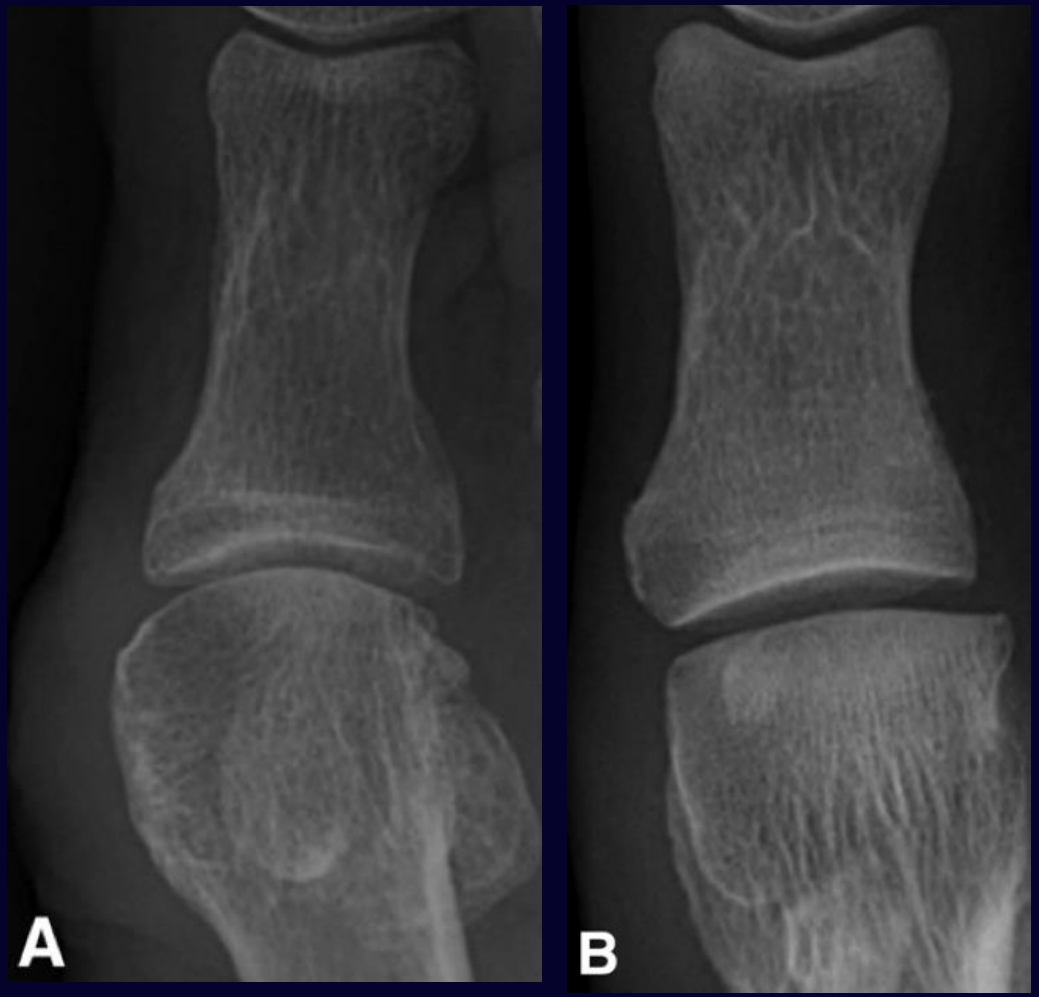
An osteotomy alone may be sufficient for surgical correction

A soft-tissue surgical procedure is required to realign the articulation and an osteotomy may also be required, especially in longstanding cases where exposed metatarsal head articular cartilage has become eroded

Radiographic evaluation - AP

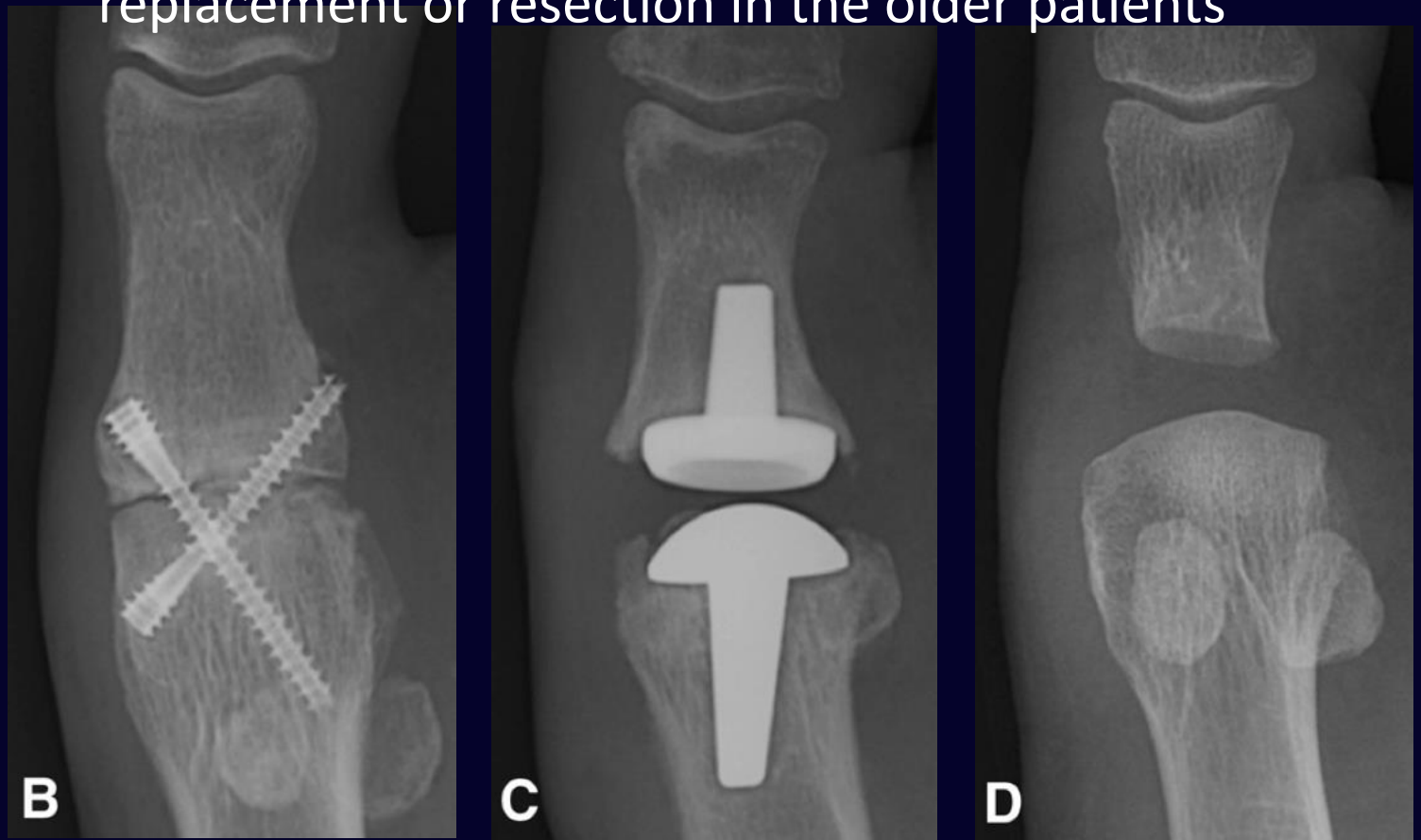
- 1st metatarsal head shape
  - Convex – prone for hallux valgus
  - Flat – more stable - but predisposes to degenerative changes and the development of hallux limitus and hallux rigidus
  - While the shape of the articular surface has no direct bearing on the surgical procedure performed, a flatter head will more often require resection arthroplasty or arthrodesis




A
B

Radiographic evaluation - AP

- 1st MTP joint arthrosis
  - If severe – arthrodeses in younger patients (more loading), replacement or resection in the older patients



Radiographic evaluation - AP

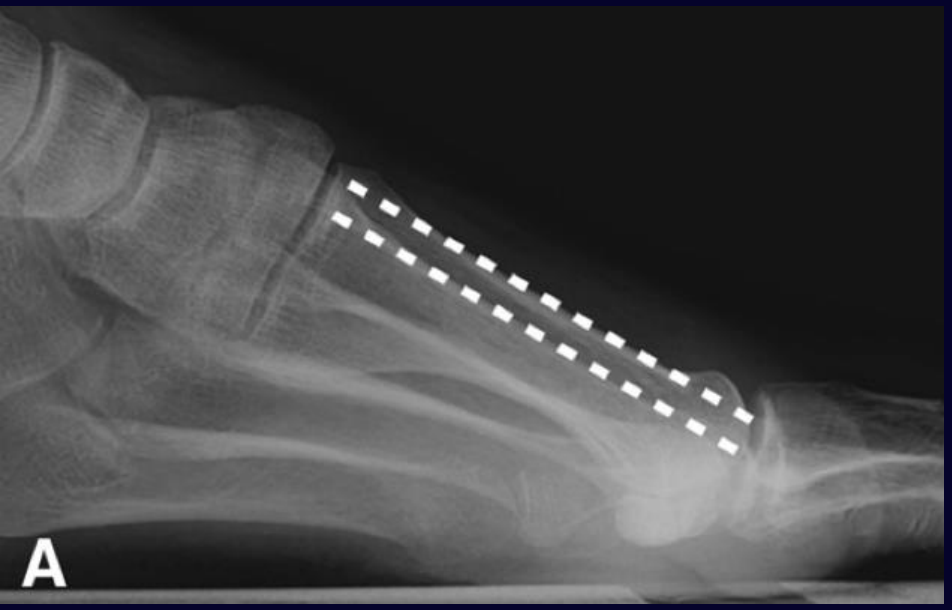
- 1st TMT joint orientation
  - Increased medial inclination – progressive joint instability
  - Flat
  - Curved
  - No consistent normal values
  - With severe medial inclination, a curved articulation, advanced arthrosis, or hypermobility, first tarsometatarsal joint arthrodesis is considered

Increased medial inclination

Curved articulation

Arthrodesis – for pain, arthrosis, or hypermobility

Hypermobility may result in elevation of the first metatarsal relative to the second metatarsal with loss of their normal parallel relationship on the weight- bearing lateral view



Normal

Elevated 1st metatarsal 2/2 hypermobility at the 1st TMT

Radiographic evaluation - AP

- Medial eminence
  - Usually proportional to the degree of hallux valgus deformity
  - Excessive resection is complicated by hallux varus due to the lack of a medial bony restraint

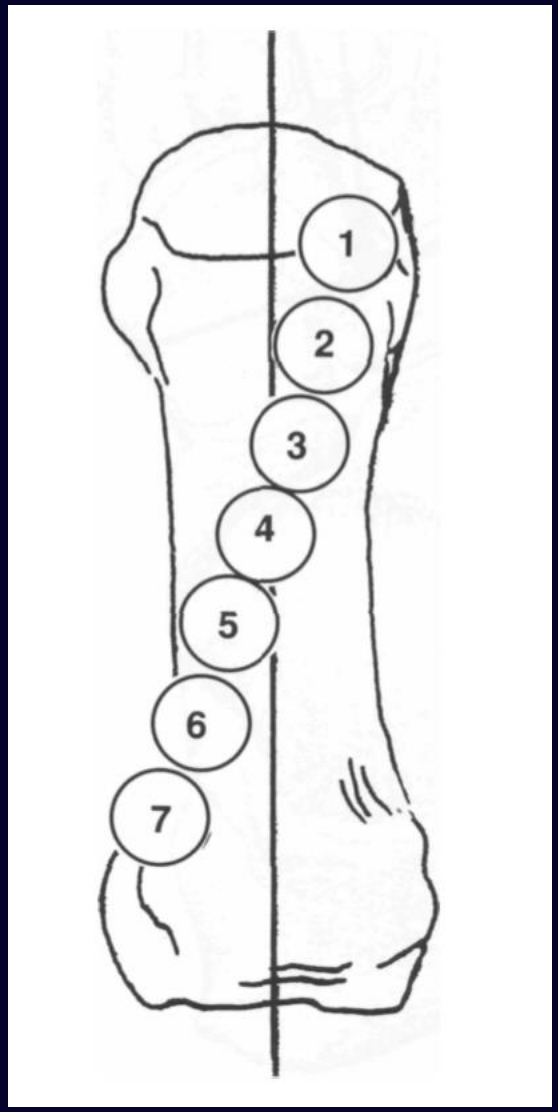
Following resection, there should be no residual bony projection with a resection margin parallel to the medial bone cortex.

Radiographic evaluation – sesamoid view

- Sesamoid position
  - Degree of lateral subluxation
  - Quality of the articular surface between the sesamoids and the first metatarsal bone
  - Difficult to distinguish between sesamoid sublaxation and 1st metatarsal pronation on the AP – do sesamoid view

Degree of pronation and sesamoid sublaxation, erosion of a crista

Cannot distinguish between degree of sesamoid sublaxation and 1st MT pronation, bowstringing of the flexor apparatus (dashed line) exacerbates the deformity



Position 4 or greater – significant contraction of ligaments

Valgus rotation of the hallux

- Evaluated clinically

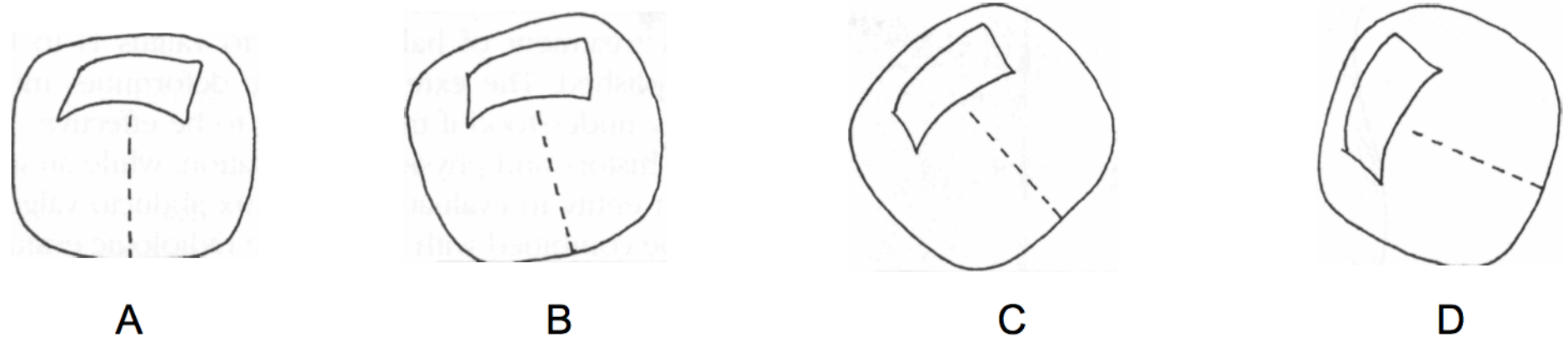


Fig. 5-2. Valgus rotation of the hallux. **(A)** Grade 0, no rotation. **(B)** Grade 1, rotation less than 25°. **(C)** Grade 2, rotation greater than 25°. **(D)** Grade 3, rotation greater than 45°.

Radiographic evaluation - AP

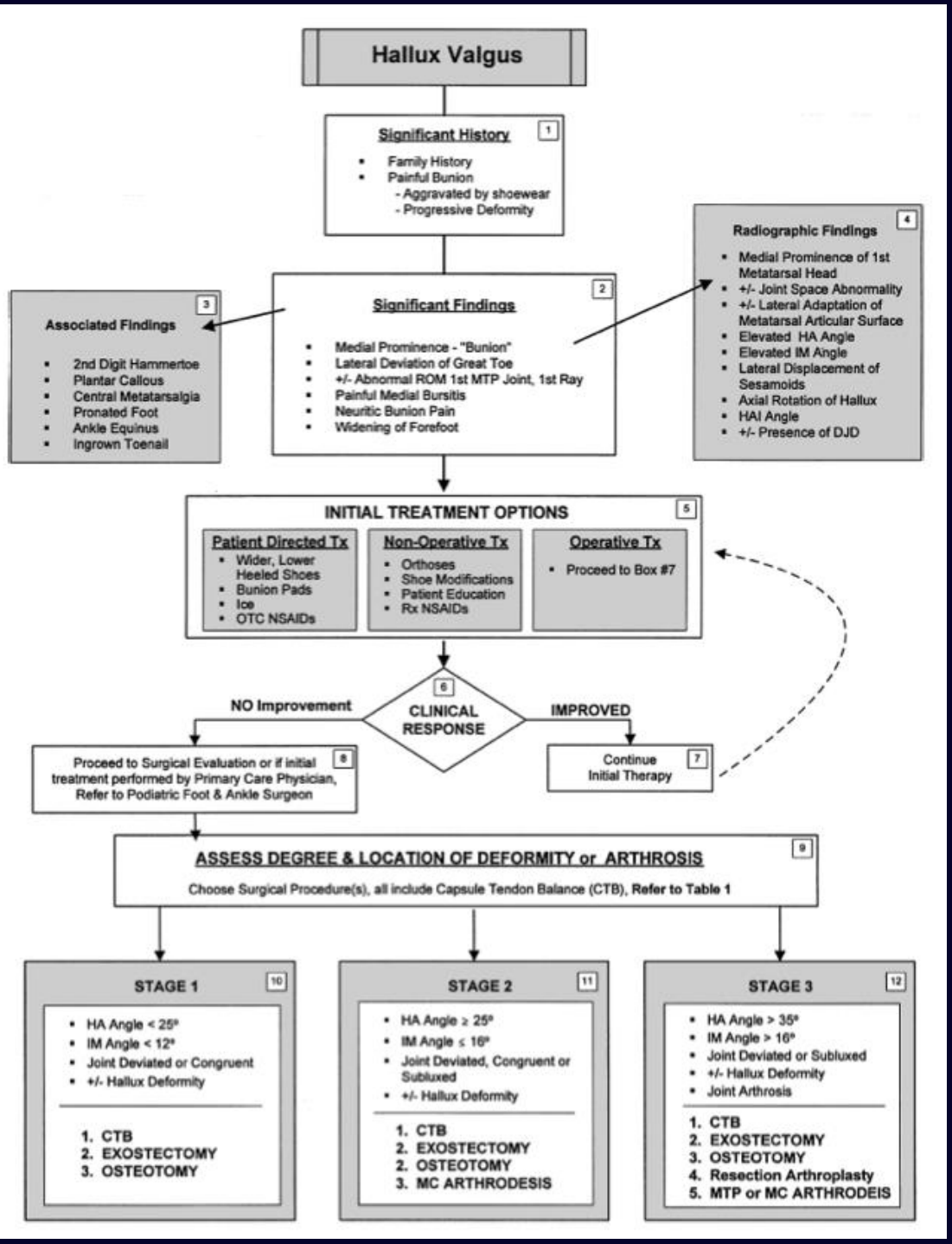
- Quality of bone stock
  - Osteopenia or cystic change – wire fixation instead of screw fixation
  - Cystic metatarsal head – may require more proximal osteotomy

Radiographic evaluation - AP

- Metatarsus adductus angle
  - Usual upper limit – 14-17
  - Normal adult range – 5-17
  - Pathologic > 20

Treatment

- Structural deformity: Proximal articular set angle (PASA) + distal articular set angle (DASA) = hallux abductus angle (HAA)
- Positional deformity: PASA + DASA < HAA

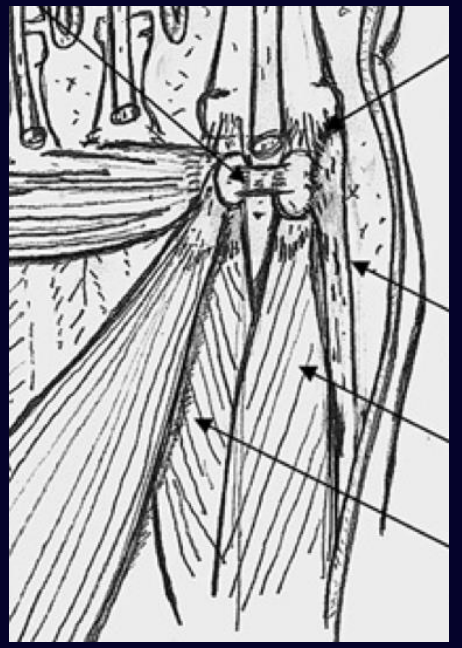

Hallux Valgus
Significant History
1
Family History
Painful Bunion
- Aggravated by shoewear
- Progressive Deformity
Significant Findings
2
Medial Prominence - "Bunion"
Lateral Deviation of Great Toe
+/- Abnormal ROM 1st MTP Joint, 1st Ray
Painful Medial Bursitis
Neuritic Bunion Pain
Widening of Forefoot
Associated Findings
3
2nd Digit Hammertoe
Plantar Callous
Central Metatarsalgia
Pronated Foot
Ankle Equinus
Ingrown Toenail
Radiographic Findings
4
Medial Prominence of 1st Metatarsal Head
+/- Joint Space Abnormality
+/- Lateral Adaptation of Metatarsal Articular Surface
Elevated HA Angle
Elevated IM Angle
Lateral Displacement of Sesamoids
Axial Rotation of Hallux
HAI Angle
+/- Presence of DJD
INITIAL TREATMENT OPTIONS
5
Patient Directed Tx
Wider, Lower Heeled Shoes
Bunion Pads
Ice
OTC NSAIDs
Non-Operative Tx
Orthoses
Shoe Modifications
Patient Education
Rx NSAIDs
Operative Tx
Proceed to Box #7
6
CLINICAL RESPONSE
NO Improvement
IMPROVED
Proceed to Surgical Evaluation or if initial treatment performed by Primary Care Physician, Refer to Podiatric Foot & Ankle Surgeon
8
Continue Initial Therapy
7
ASSESS DEGREE & LOCATION OF DEFORMITY or ARTHROSIS
9
Choose Surgical Procedure(s), all include Capsule Tendon Balance (CTB), Refer to Table 1
STAGE 1
10
HA Angle < 25°
IM Angle < 12°
Joint Deviated or Congruent
+/- Hallux Deformity
1. CTB
2. EXOSTECTOMY
3. OSTEOTOMY
STAGE 2
11
HA Angle ≥ 25°
IM Angle ≤ 16°
Joint Deviated, Congruent or Subluxed
+/- Hallux Deformity
1. CTB
2. EXOSTECTOMY
2. OSTEOTOMY
3. MC ARTHRODESIS
STAGE 3
12
HA Angle > 35°
IM Angle > 16°
Joint Deviated or Subluxed
+/- Hallux Deformity
Joint Arthrosis
1. CTB
2. EXOSTECTOMY
3. OSTEOTOMY
4. Resection Arthroplasty
5. MTP or MC ARTHRODEIS

Treatment

- > 130 surgical approaches
  - 75 % of them are variations

Treatment

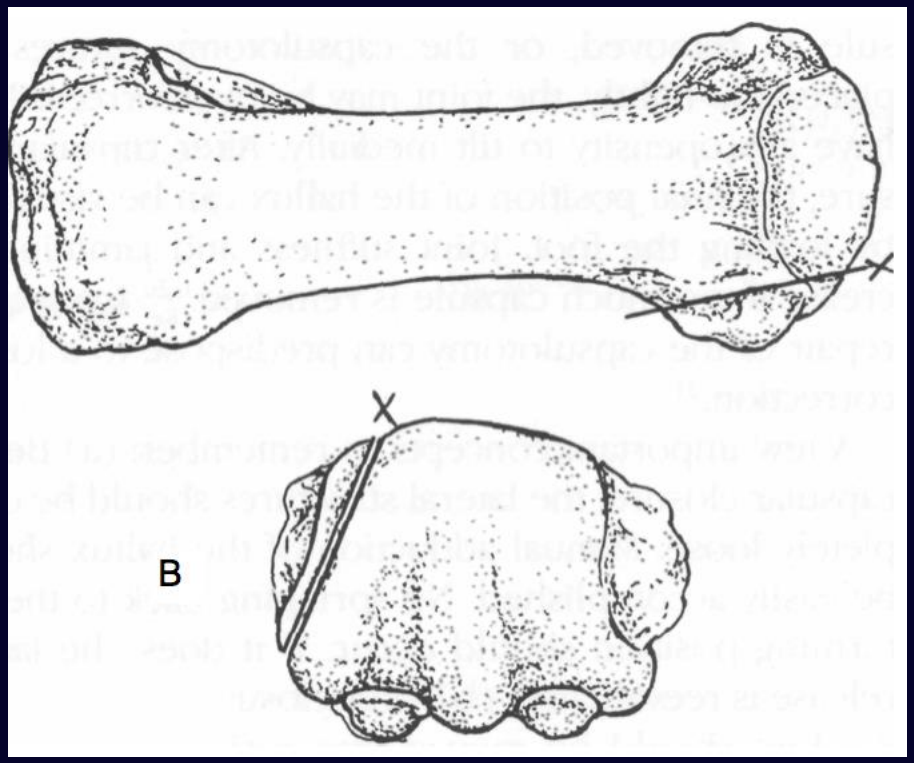
- Soft tissue procedures –
  - Performed alone only for positional deformities
  - Are never performed on congruent joints
  - Silver and McBride procedures



  - Capsule tendon balance
    - resection of the medial eminence
    - medial elliptical capsulotomy
    - adductor hallucis tenotomy
    - repositioning of the abductor hallucis more dorsally via sutures into the medial periosteum and capsule of the first metatarsal

Soft tissue procedures

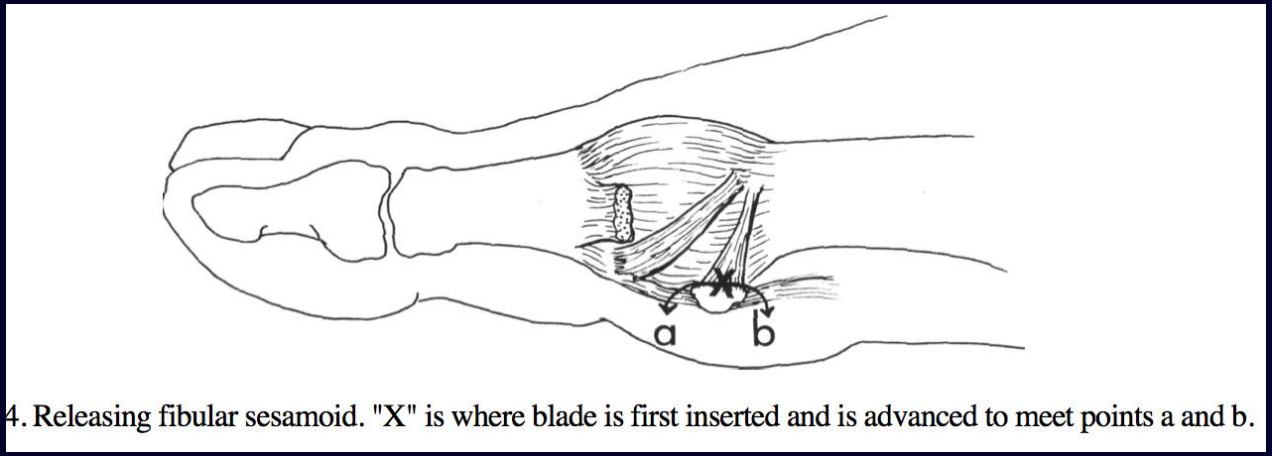
- Silver bunionectomy – only the medial eminence is removed



To preserve plantar articular tibial sesamoid surface, cut under the angle – to prevent hallux varus especially in patients who get deformity correction

Soft tissue procedures

- Modified McBride bunionectomy - medial eminence resection and extensive lateral release with the fibular sesamoid remaining in vivo
  - "true" McBride bunionectomy - the fibular sesamoid is removed
  - Lateral release - conjoined tendons tenotomy (oblique and transverse) of the adductor hallucis, severing the deep transverse metatarsal ligament, and lateral vertical capsulotomy



4. Releasing fibular sesamoid. "X" is where blade is first inserted and is advanced to meet points a and b.

Soft tissue procedures

- Failure
  - Undercorrection
  - Recurrence – in juvenile cases always have to correct for underlying deformity
  - Overcorrection = hallux varus (intermetatarsal angle is 0° or a negative value)

- Postoperative – faster recovery; adhesions, stiff joints - PT

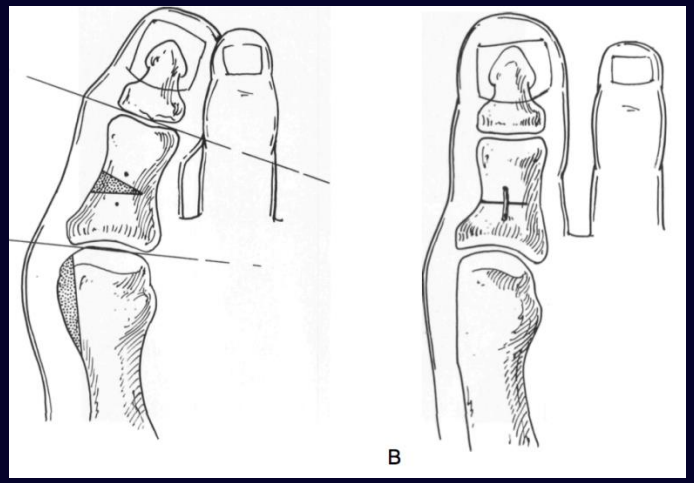
Hallux varus - tibial sesamoid "peaking"
from excessive resection of the medial eminence

Corrective bony procedures

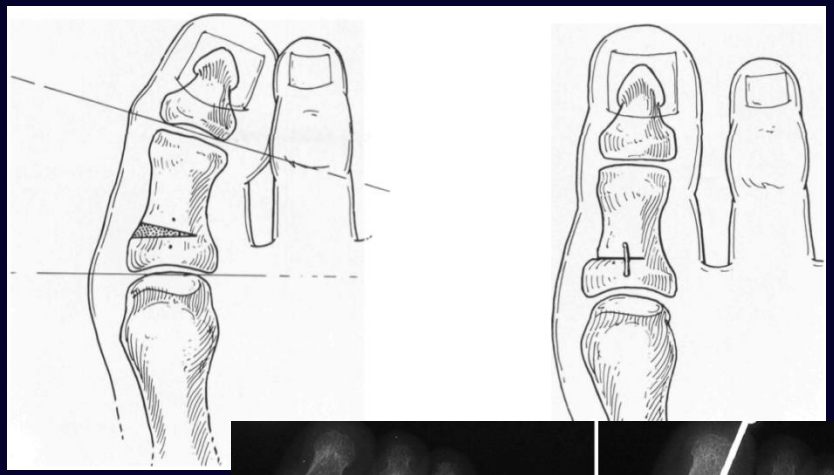
- Also involve soft tissue balancing to some extent

Akin procedure

- Proximal phalangeal osteotomy



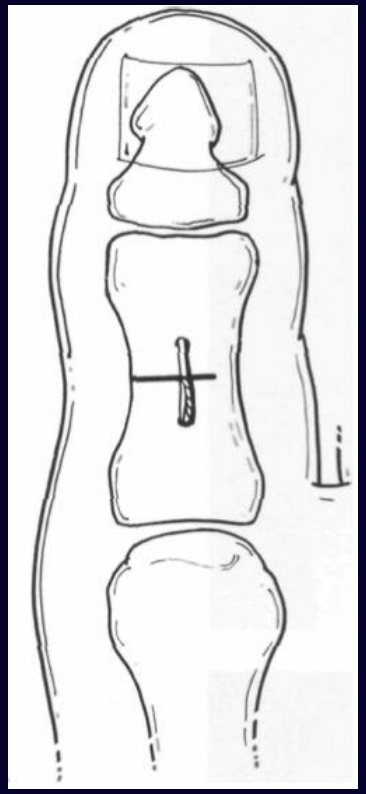
distal - the apex of the deformity lies in the distal aspect of the proximal phalanx

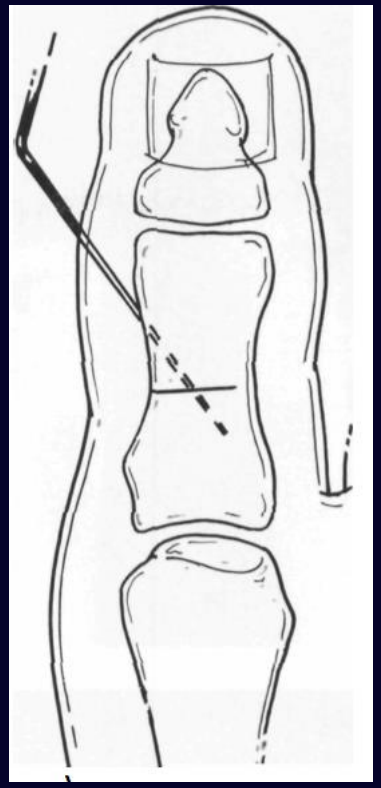


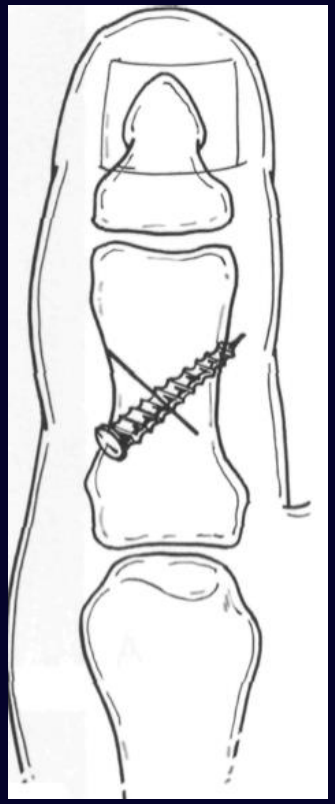
proximal

distal

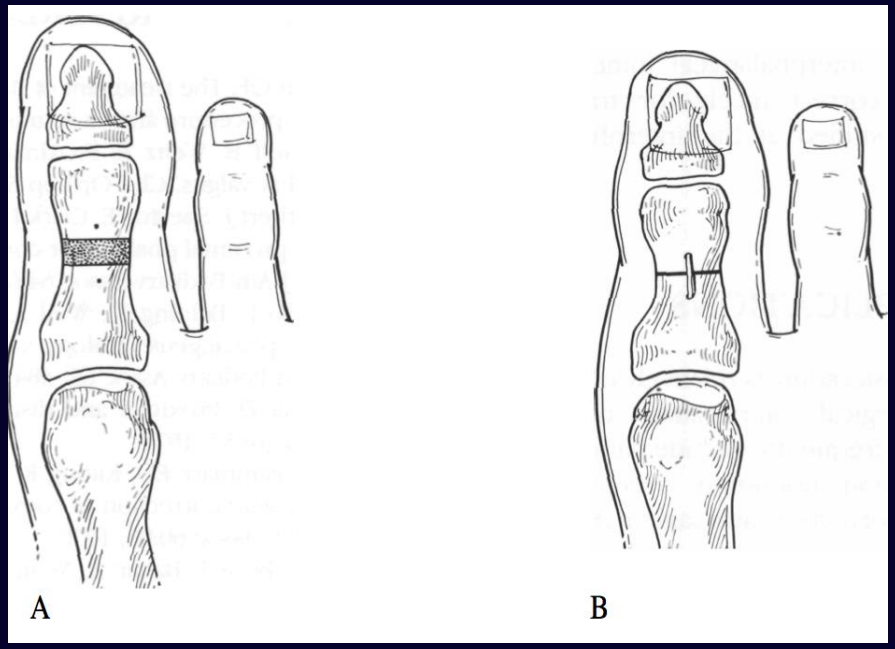
Akin procedure – types of fixation







Distal with wire fixation



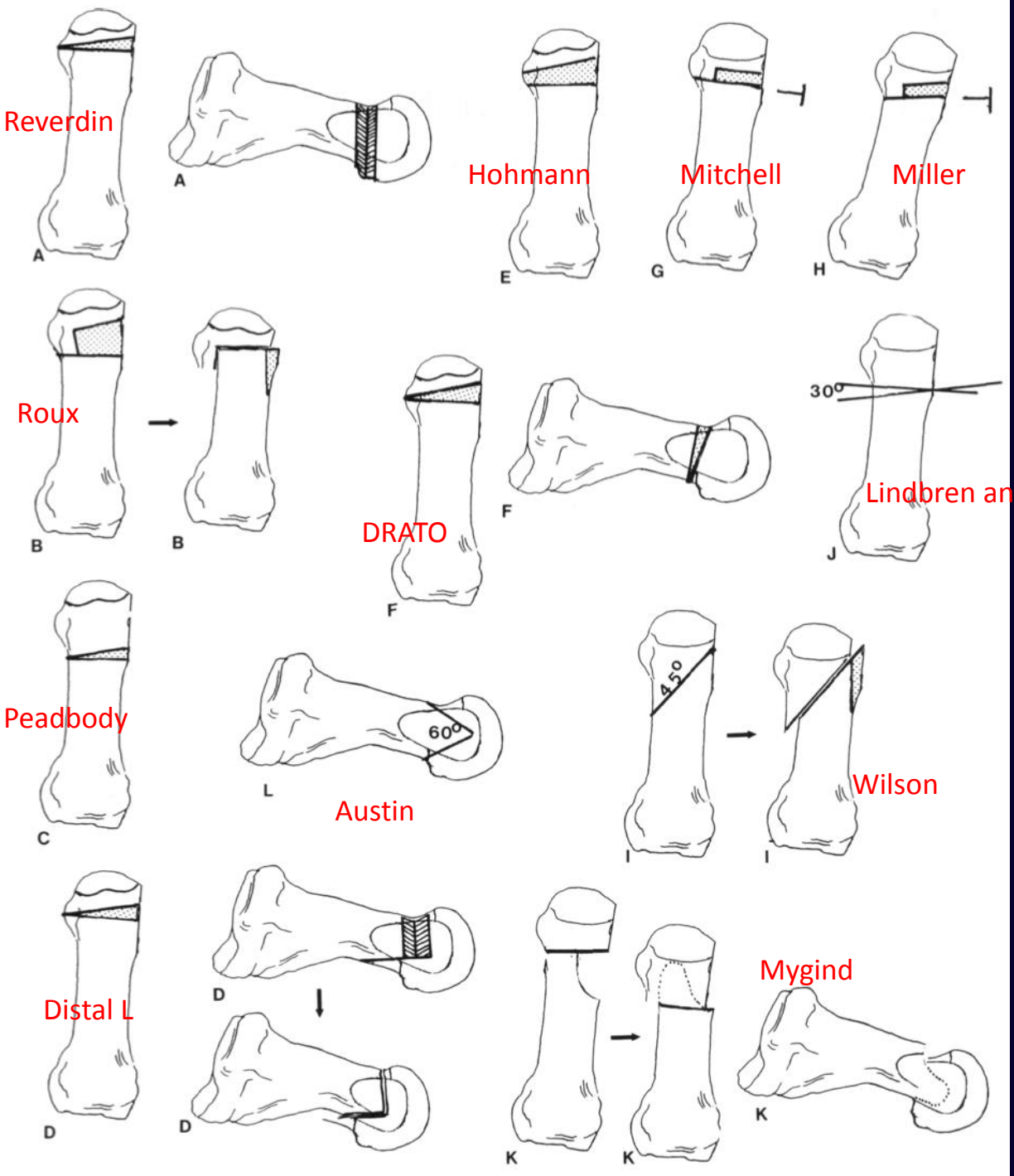
Cylindrical Akin procedure

Akin procedure

- Complications:
  - pain
  - edema
  - infection
  - delayed union
  - nonunion
  - overcorrection (hallux varus)
  - undercorrection
  - sagittal plane hallucal deformities (e.g., hallux extensus, hallux malleus)

Distal 1st metatarsal osteotomies

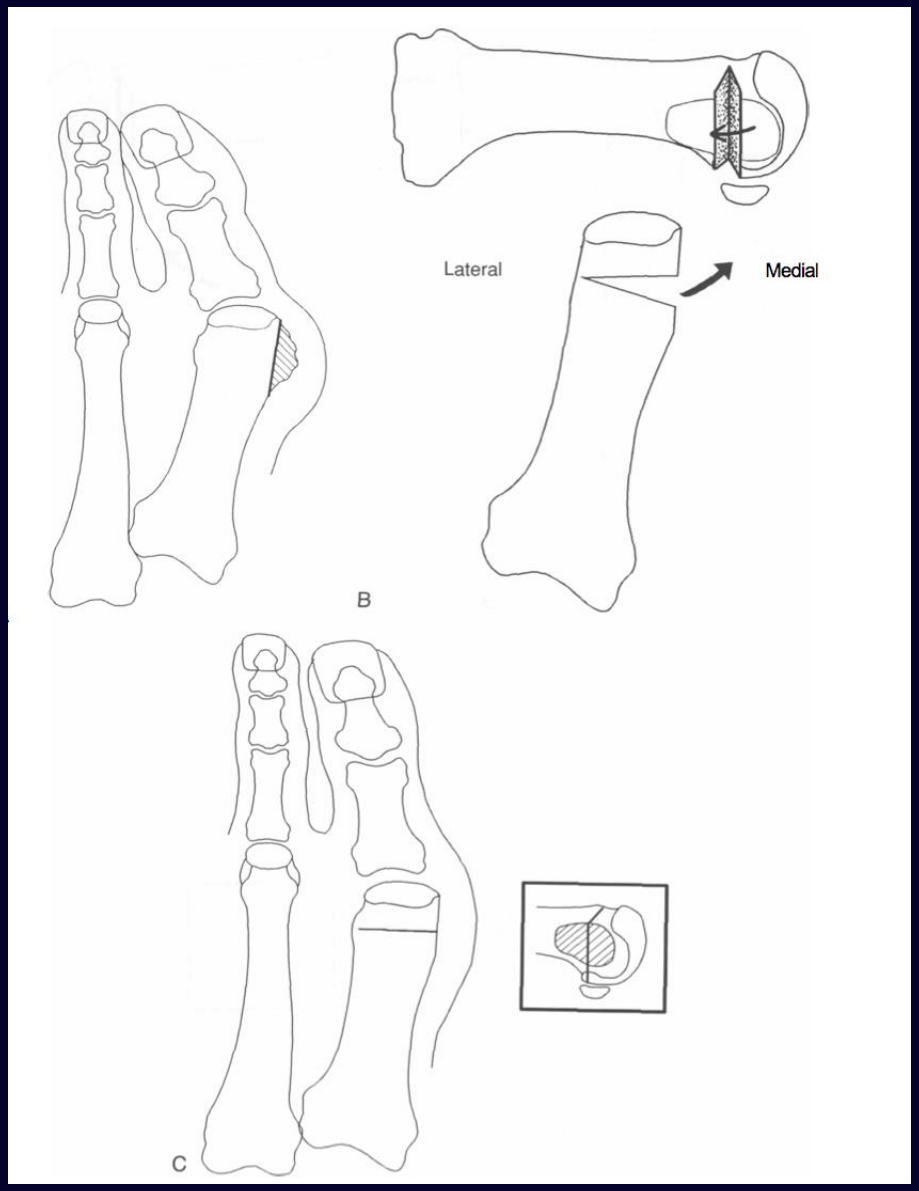
- Reverdin
- Roux
- Peadbody
- Distal L
- Hohmann
- DRATO
- Mitchell
- Miller
- Wilson
- Lindbren and Turan
- Mygind
- Austin


Reverdin
A
A
Hohmann
Mitchell
Miller
E
G
H
Roux
B
B
DRATO
F
F
30°
Lindbren and Turan
J
Peadbody
C
60°
L
Austin
45°
I
I
Wilson
Distal L
D
D
D
Mygind
K
K
K

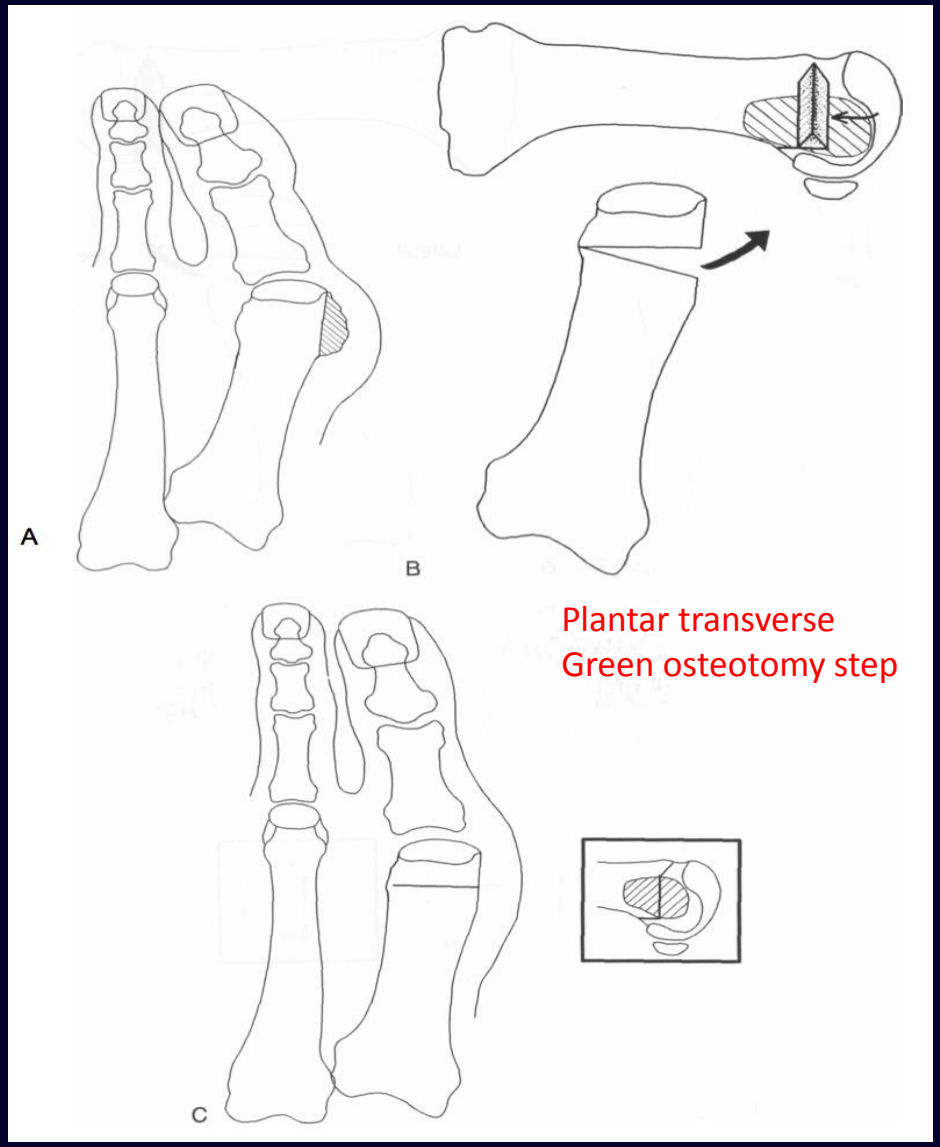
Reverdin osteotomy

- realign the abducted hallux and remove the prominent bump
- effectively reduces an abnormal proximal articular set angle but does not directly address the intermetatarsal angle
- Modifications – address intermetatarsal angle:
  - Roux – long lateral beak
  - Peadbody osteotomy – nearly identical but slightly more proximal
  - Reverdin-Green osteotomy – the distal L

Riverdin osteotomy

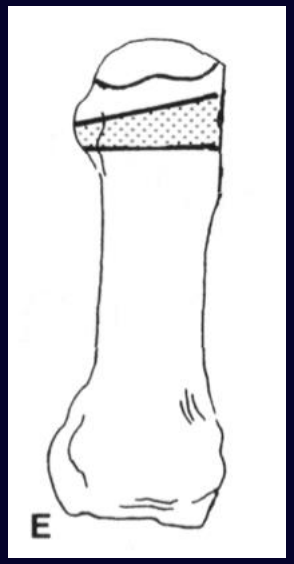


Riverdin-Green osteotomy

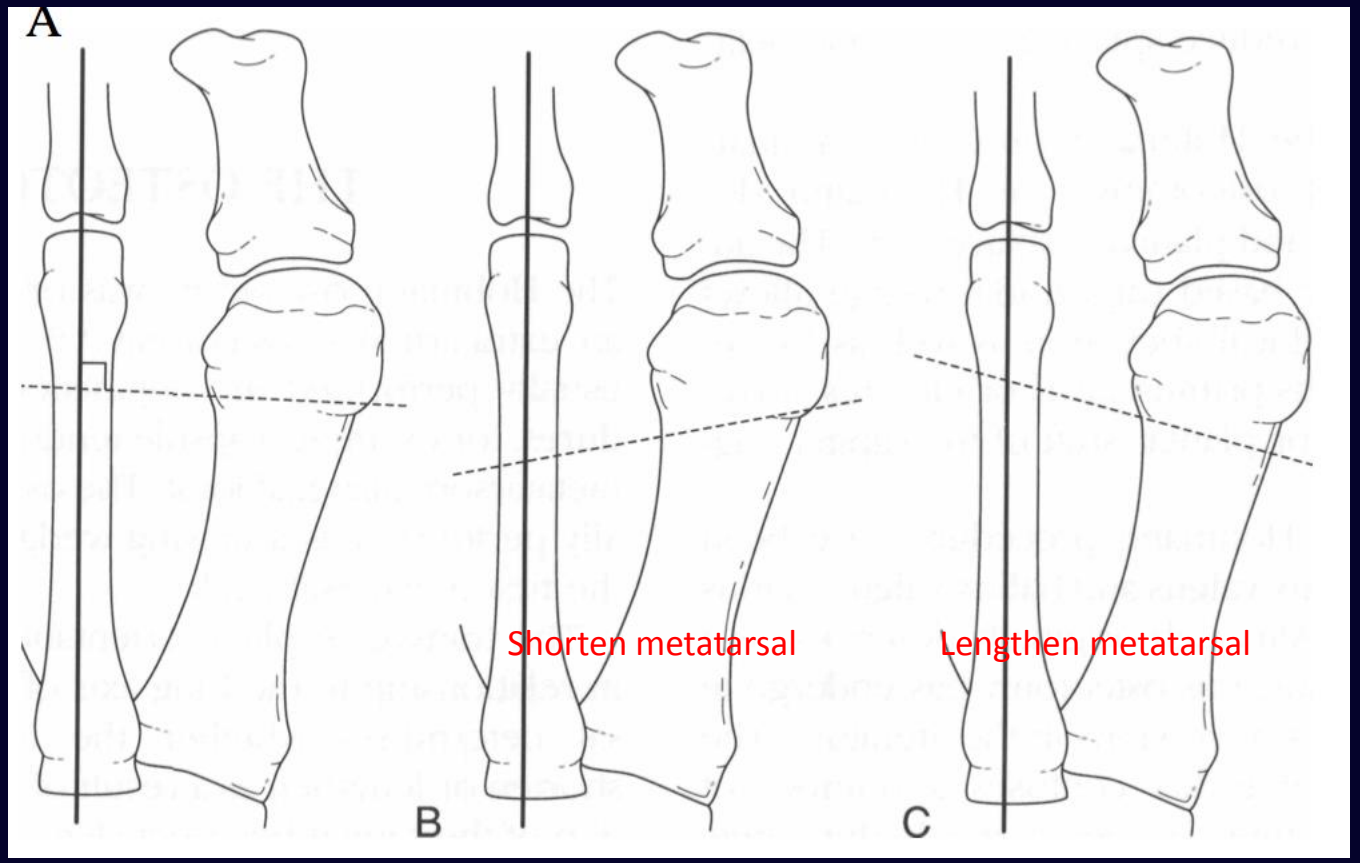


Hohmann osteotomy

- Corrects both hallux valgus and intermetatarsal angle
- For more severe deformities

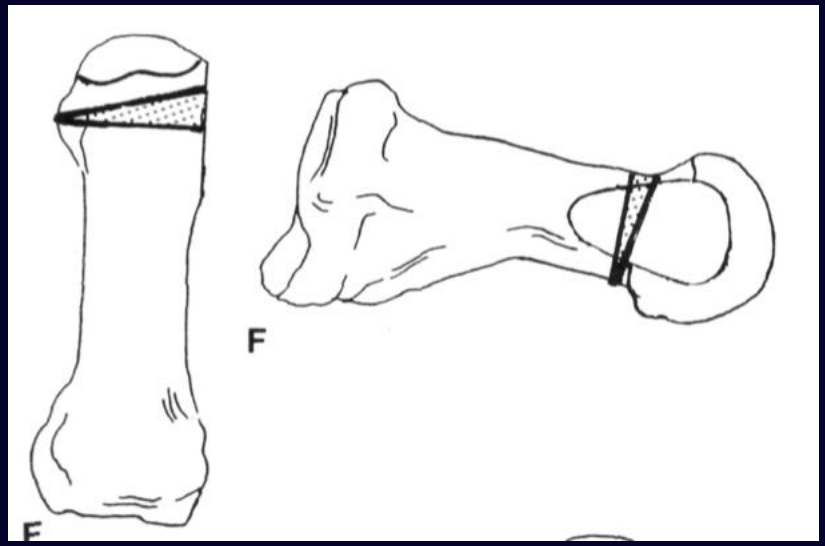


Axis of the osteotomy



DRATO osteotomy

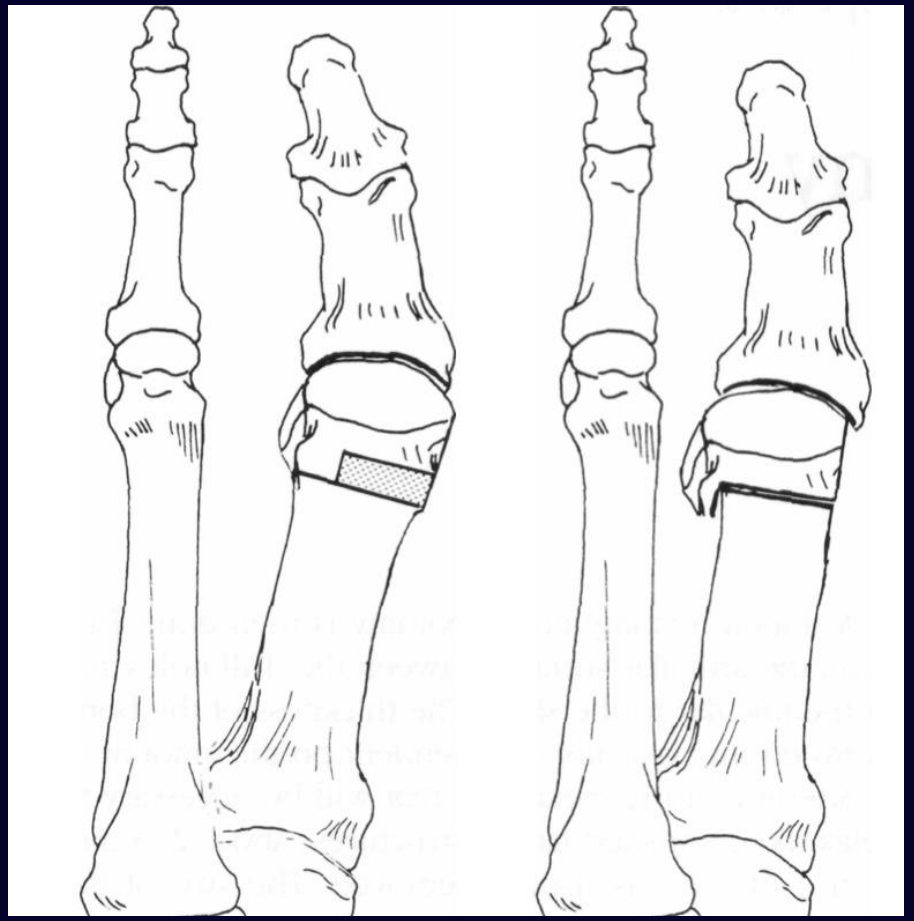
- Derotational angulational transpositional osteotomy
- Resection of the medial exostosis, transverse osteotomy at the neck of the metatarsal perpendicular to its shaft, additional distal osteotomy, lateral displacement of the head by 1/3 shaft width



Mitchell osteotomy

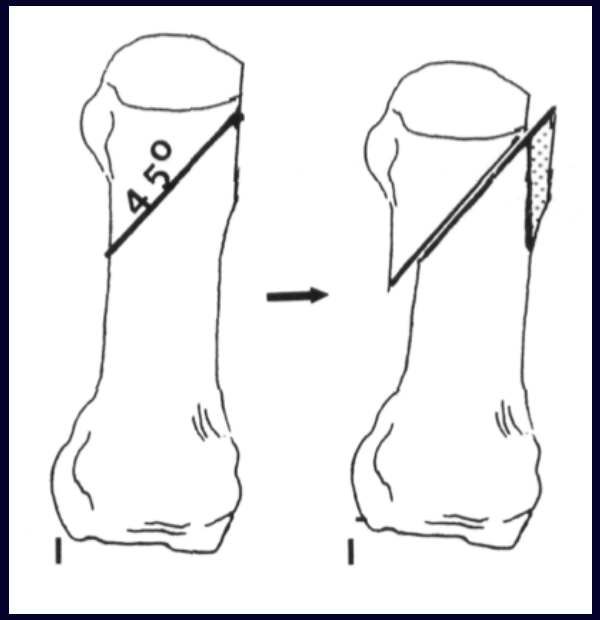
- Corrects metatarsus primus varus and hallux valgus
- For the correction of the moderate hallux valgus deformity
- Long first metatarsal bone

  – Variation – Miller osteotomy



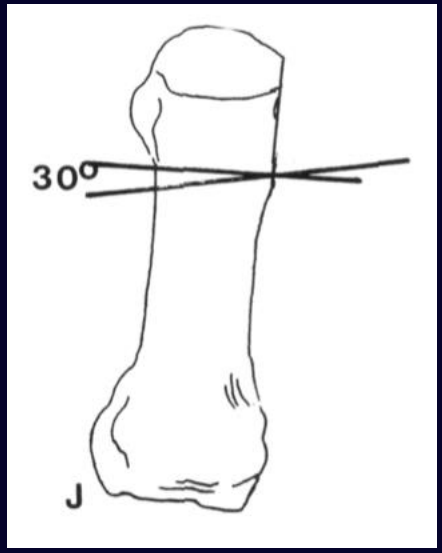
Wilson osteotomy

- Oblique osteotomy of the distal third of the first metatarsal, combined with remodeling of the medial exostosis
- No need for internal fixation
- Reduces risk of nonunion and AVN



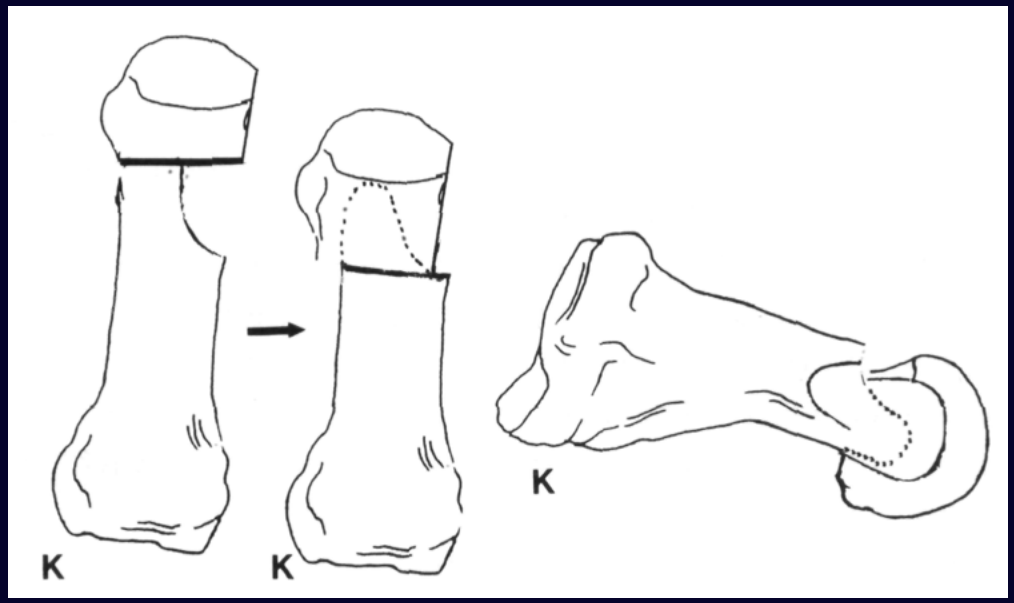
Lindgren and Turan osteotomy

- Transverse at approximately 30° to a line that transverses the metatarsal head
- osteotomy is displaced laterally and fixated



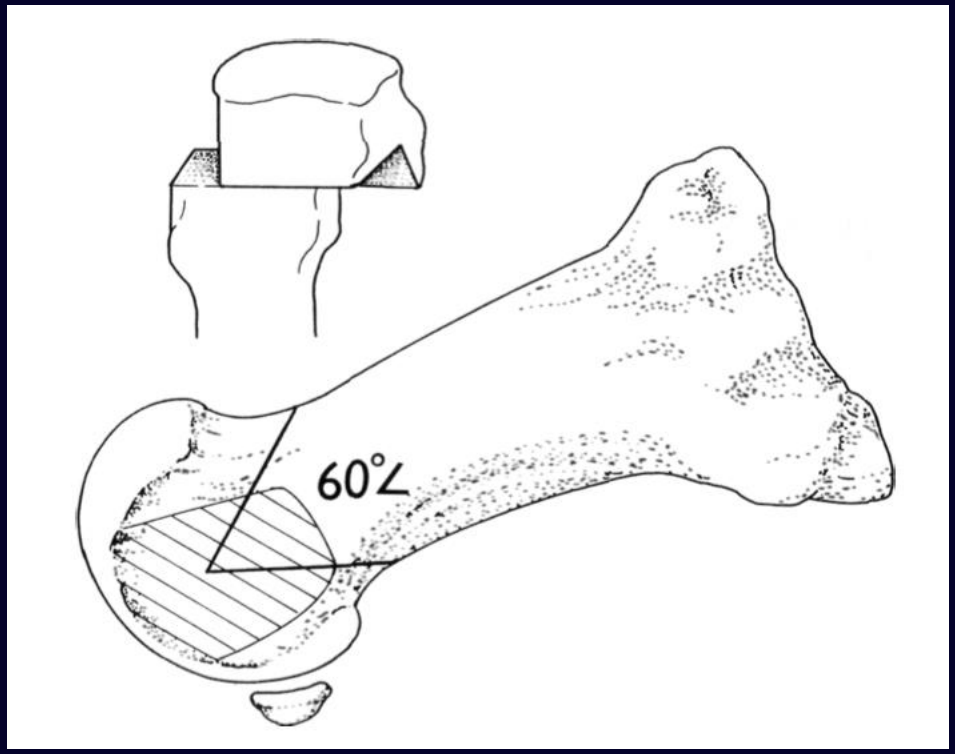
Mygind osteotomy

- Peg-in-hole osteotomy
- Adolescents and young adults with hallux valgus and metatarsus primus varus



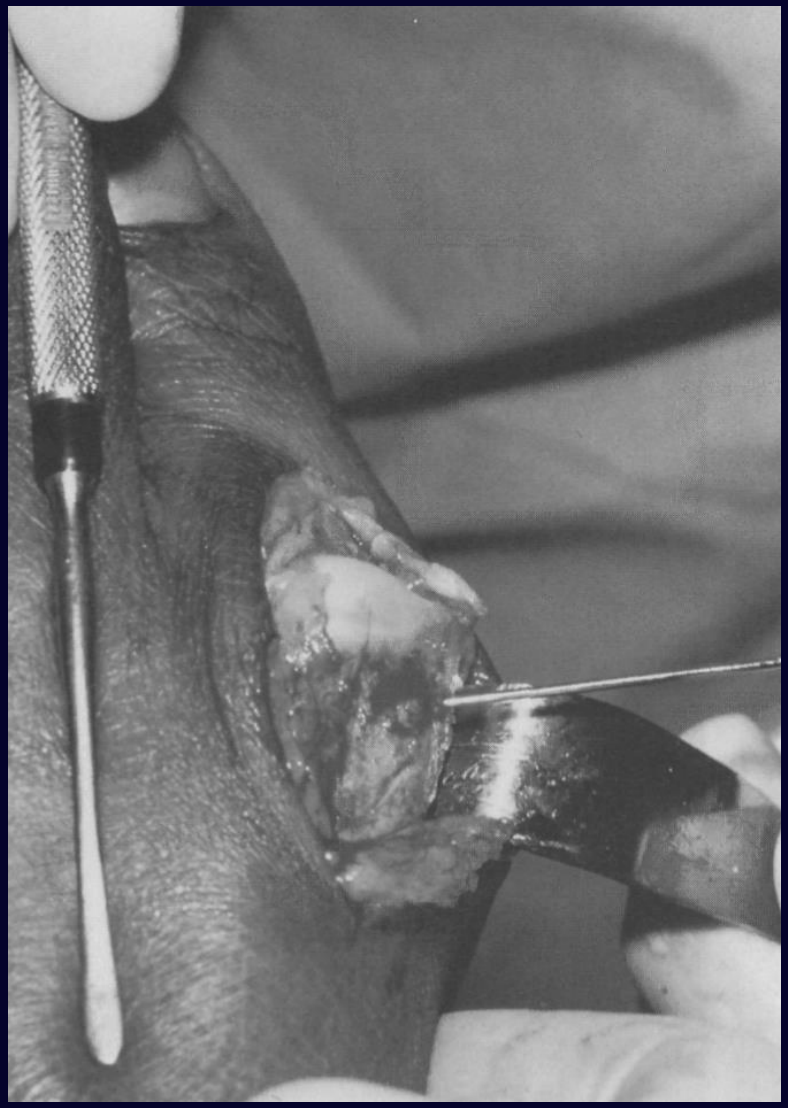
Austin (Chevron) osteotomy

- The V osteotomy is horizontally directed, and the cuts are made at a 60°
- Excellent stability



Austin (Chevron) osteotomy

Austin (Chevron) osteotomy



Complications:

- Nonunion
- AVN
- Overcorrection/undercorrection

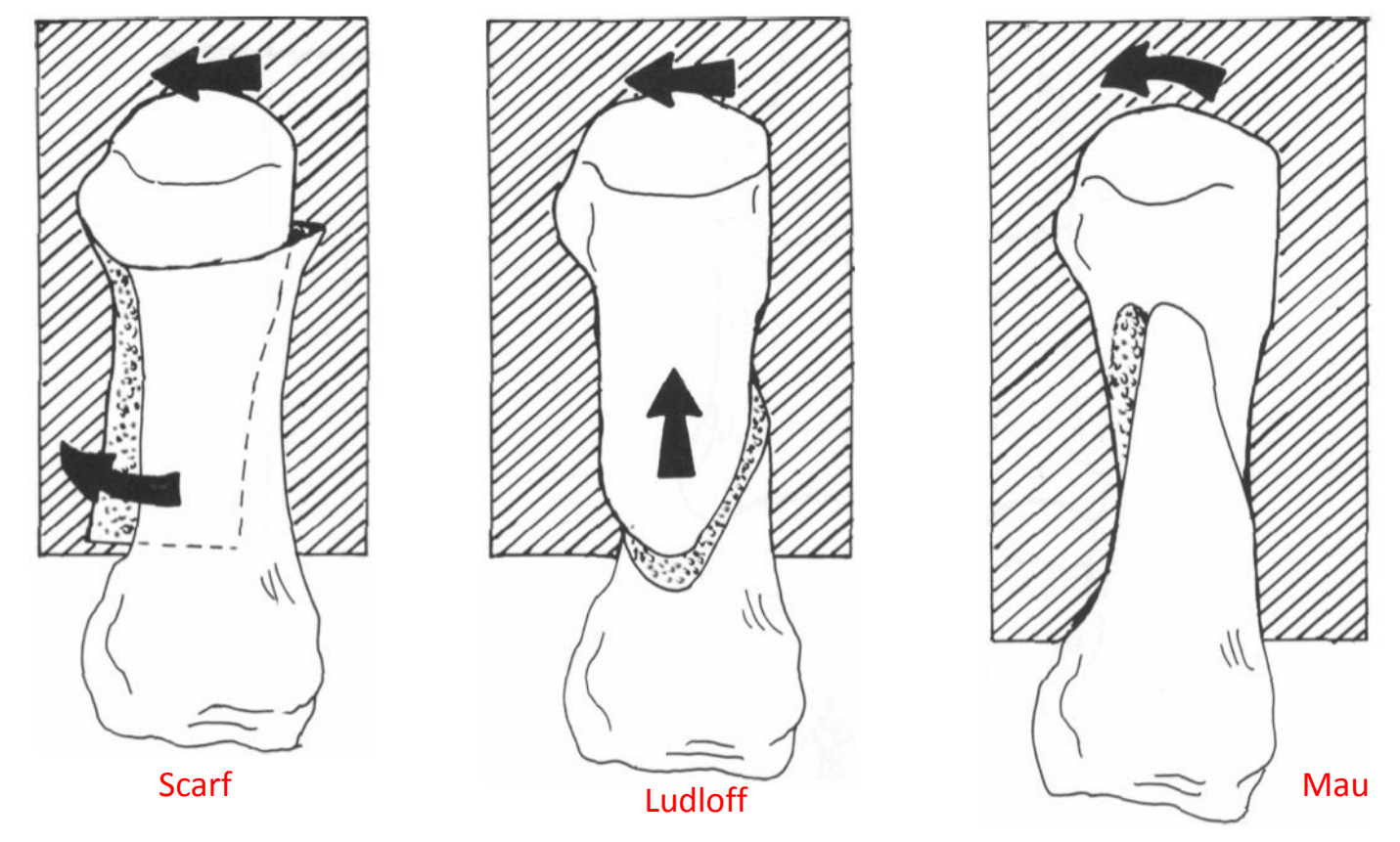
AVN metatarsal head following Austin procedure

Hallux varus following Austin procedure

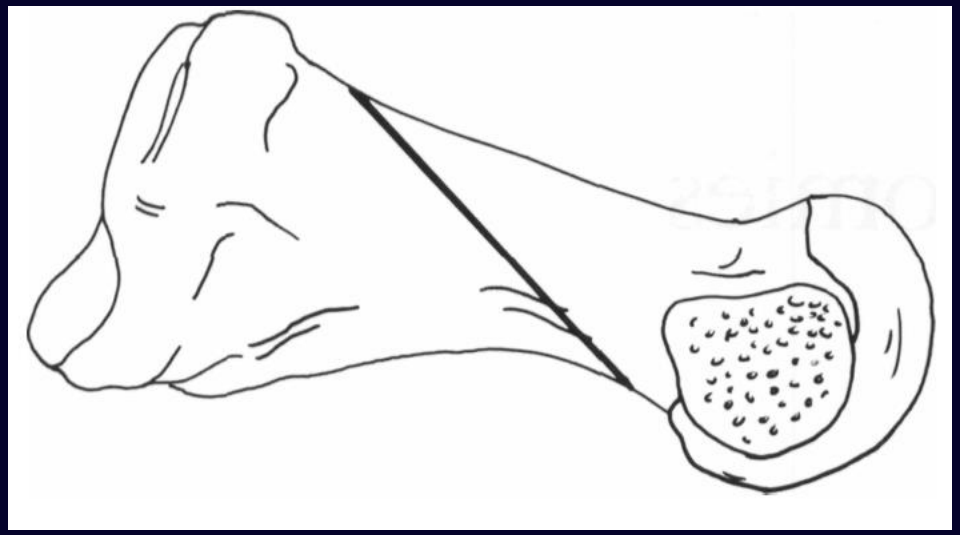
Dislocation of capital fragment following Austin procedure

Rotation rather than transposition following Austin procedure

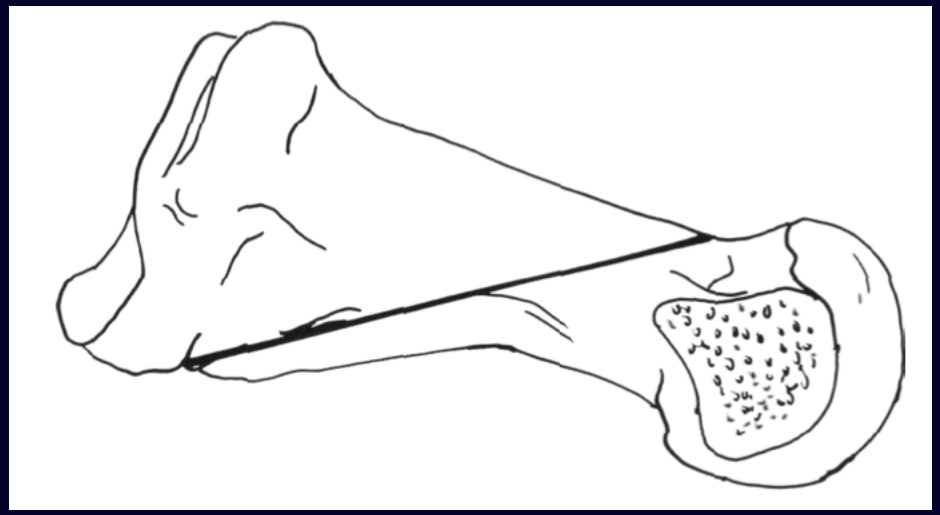
Middiaphyseal metatarsal osteotomies



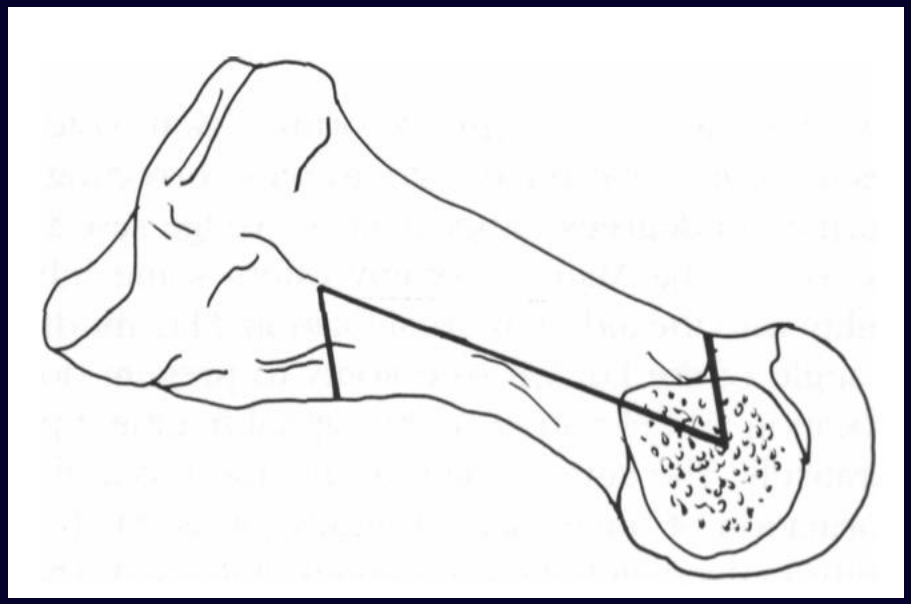
Ludloff osteotomy

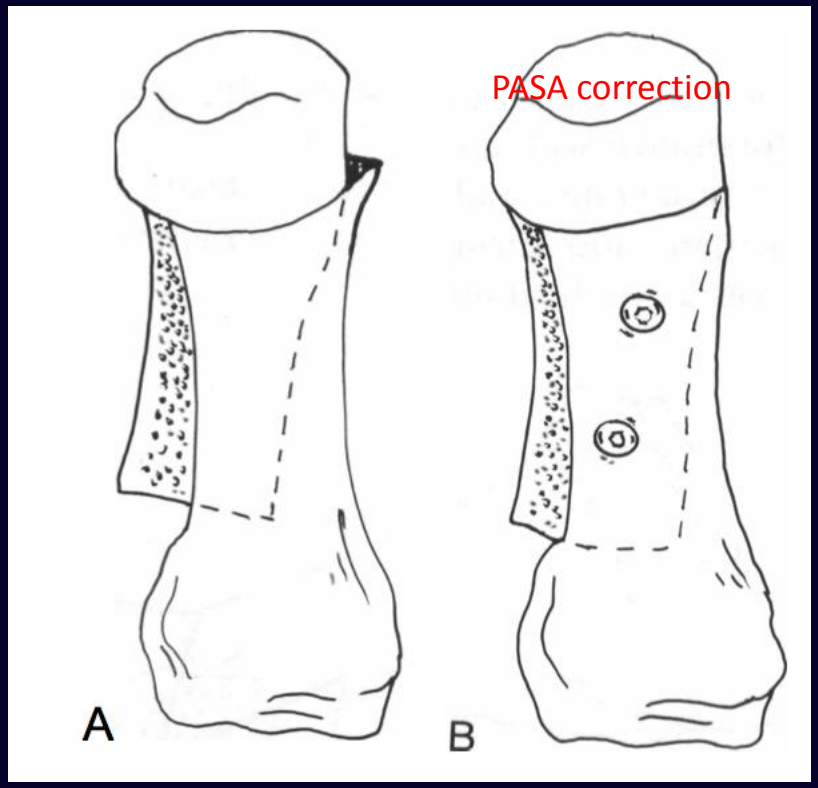


Mau osteotomy



Scarf or Z osteotomy

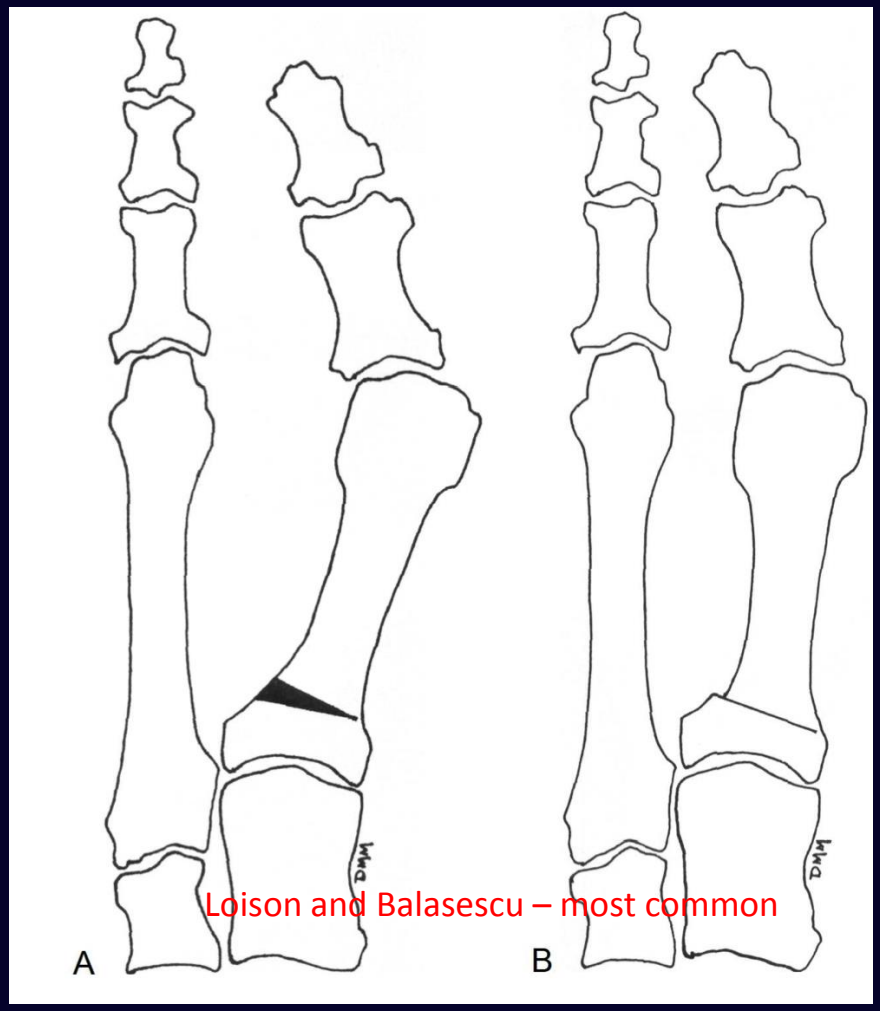




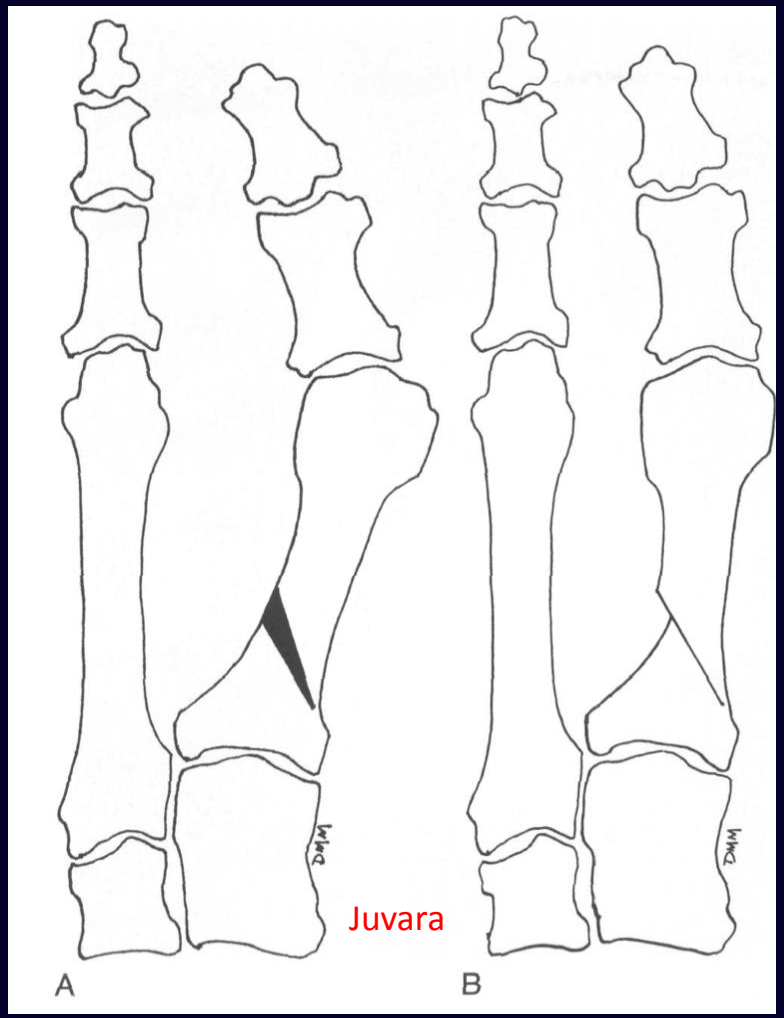
1st metatarsal BASE osteotomies

- Indicated if intermetatarsal angle > 12 in adductus foot, or > 15 in a rectus foot
- If 1st MT length witin 2 mm of the 2nd - - closing base osteotomy (Juvara, Loison and Balasescu)
- If 1st MT is shorter - opening base wedge osteotomy (Trethowan, Stamm), crescenteric, or V-type

Closing base osteotomy

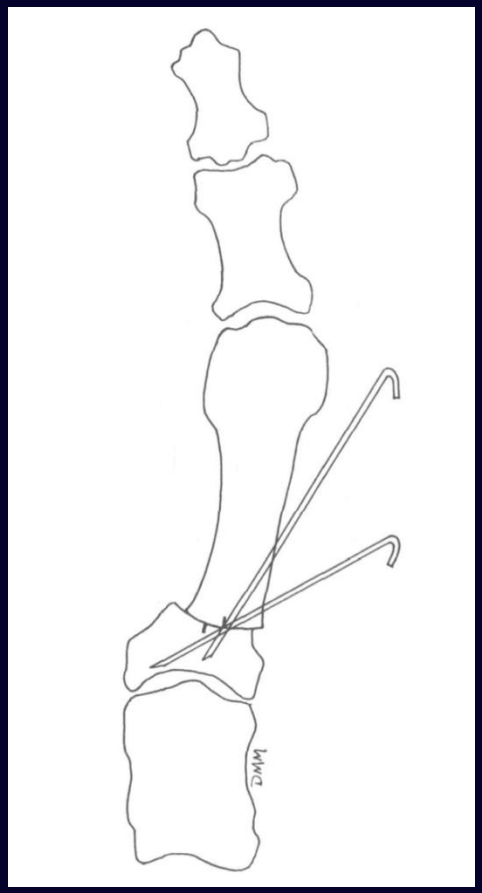


Loison and Balasescu – most common

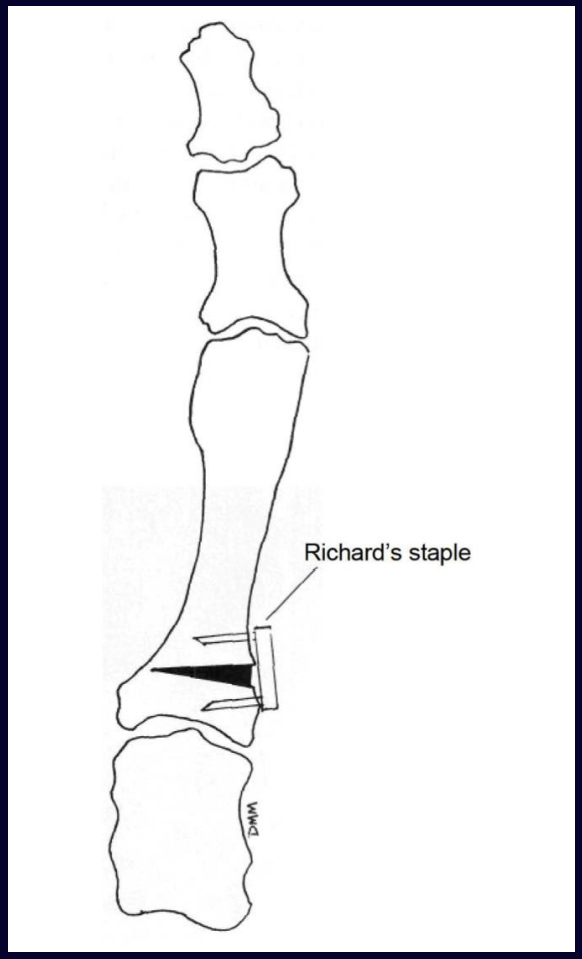


Juvara

Crescenteric osteotomy

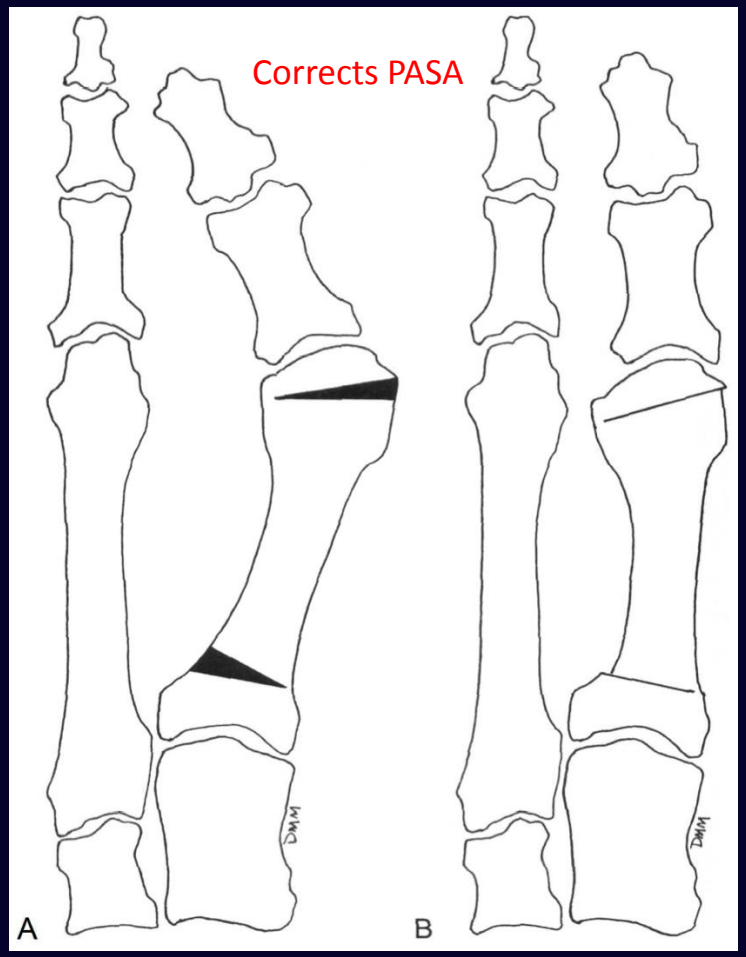


Opening wedge osteotomy

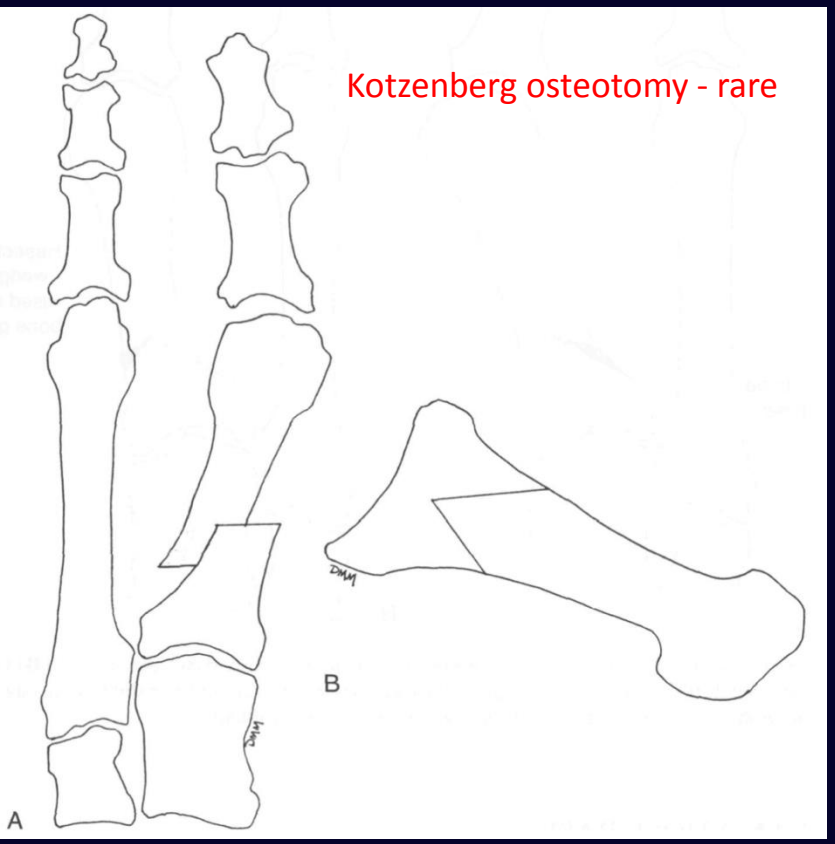


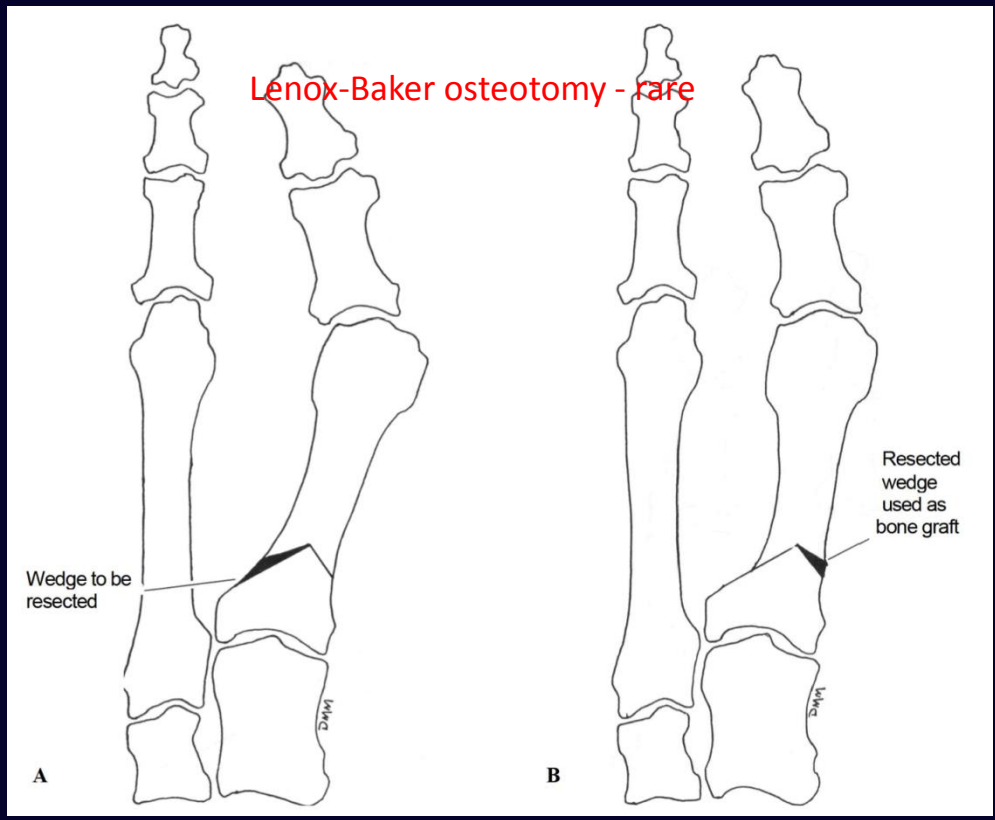
Opening wedge osteotomy

Double 1st MT osteotomy = Logroscino



V-type base osteotomies

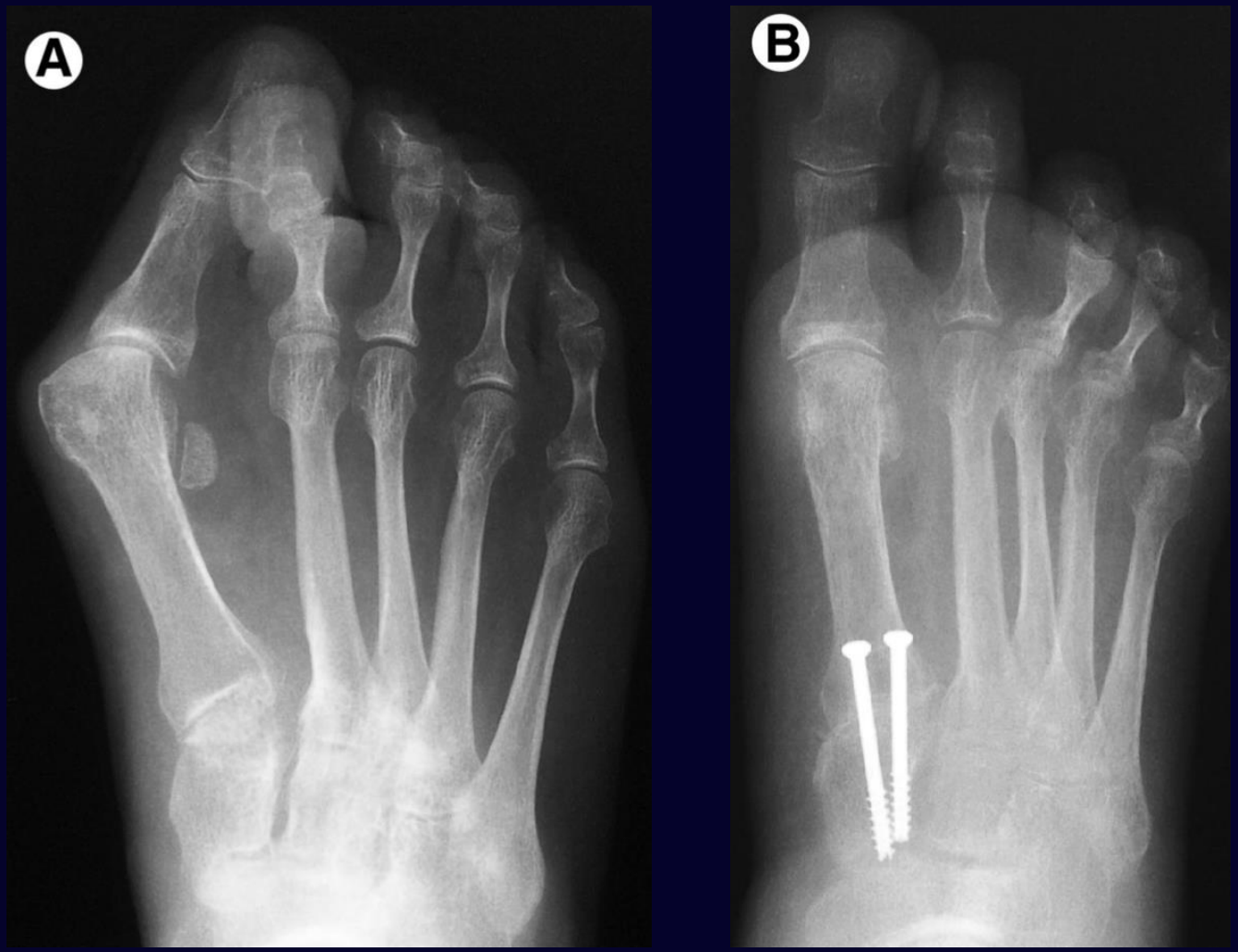




Complications of base osteotomies

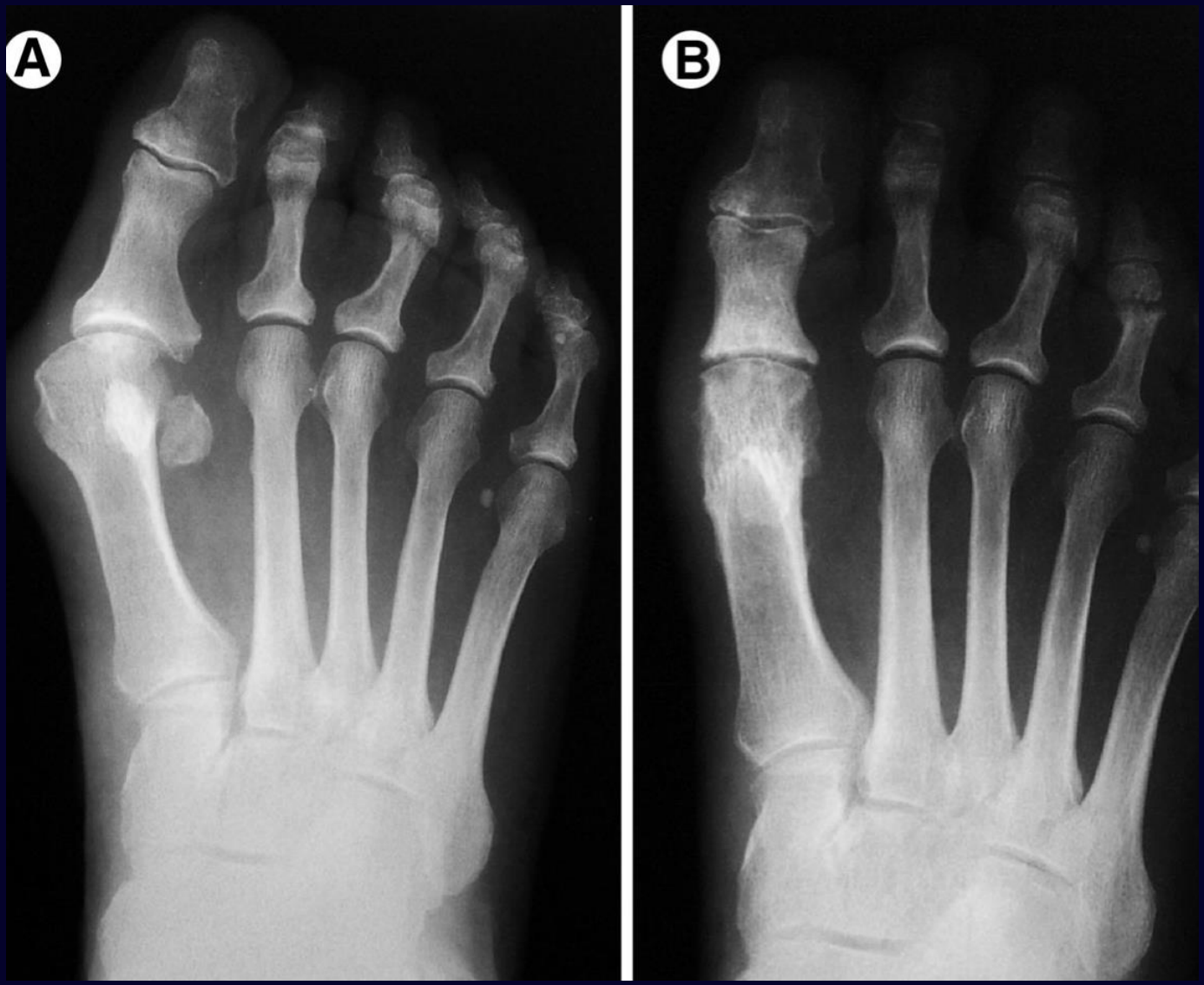
- Shortening of the 1st metatarsal
- Hallux varus
  - Stress Fx lesser metatarsals

Lapidus = 1st MCJ fusion



Lapidus – do you see any complications?

Keller bunionectomy = resection of the proximal phalangeal base



Conclusions

- Understanding hallux valgus
- Foot alignment evaluation on the preoperative radiographs
- Major surgical treatment options
- Postsurgical complications

References

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