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 2\textsuperscript{nd} metatarsal
- Metatarsals are nearly parallel to each other (0-8 degrees)
- 1\textsuperscript{st} metatarsal is the shortest
- 2\textsuperscript{nd} metatarsal is the longest
Attachment
MTP collateral ligaments
1\textsuperscript{st} metatarsal

- Shortest, broadest
- Most mobile
- Occasional articulation b/w 1\textsuperscript{st} and 2\textsuperscript{nd} metatarsal bases
Crista:

- Is slightly lateral to the midline
- 78 degrees angle during stance (slightly everted)
- Perpendicular during loading to distribute weight b/w sesamoids
1st MTP joint anatomy

1st MTP joint anatomy

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Bifurcation into dorsoproximal and plantodistal slips
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.
And the lateral sesamoid is more lateral.
Biomechanics

- Median eminence of the 1\textsuperscript{st} 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
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
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
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. An osteotomy alone may be sufficient for surgical correction.
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
Radiographic evaluation - AP

- $1^{st}$ 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 subluxation, erosion of a crista

Cannot distinguish between degree of sesamoid subluxation 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 **
- Family History
- Painful Bunion
  - Aggravated by shoe wear
  - Progressive Deformity

** Associated Findings **
- 2nd Digit Hammertoe
- Plantar Callos
- Central Metatarsalgia
- Pronated Foot
- Ankle Equinus
- Ingrown Toenail

** Significant Findings **
- Medial Prominence - "Bunion"
- Lateral Deviation of Great Toe
- +/- Abnormal ROM 1st MTP Joint, 1st Ray
- Painful Medial Bursts
- Neuriletic Bunion Pain
- Widening of Forefoot

** Radiographic Findings **
- 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
- HA Angle
- +/- Presence of DJD

** INITIAL TREATMENT OPTIONS **
- ** 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

** ASSESS DEGREE & LOCATION OF DEFORMITY or ARTHROSIS **
Choose Surgical Procedure(s), all include Capsule Tendon Balance (CTB), Refer to Table 1

** STAGE 1 **
- HA Angle < 25°
- IM Angle < 12°
- Joint Deviated or Congruent
- +/- Hallux Deformity
  1. CTB
  2. EXOSTECTOMY
  3. OSTEOTOMY

** STAGE 2 **
- HA Angle ≥ 25°
- IM Angle ≥ 16°
- Joint Deviated, Congruent or Subluxed
- +/- Hallux Deformity
  1. CTB
  2. EXOSTECTOMY
  3. OSTEOTOMY
  4. MC ARTHRODESI

** STAGE 3 **
- HA Angle > 35°
- IM Angle > 10°
- Joint Deviated or Subluxed
- +/- Hallux Deformity
- Joint Arthrodesis
  1. CTB
  2. EXOSTECTOMY
  3. OSTEOTOMY
  4. Resection Arthroplasty
  5. MTP or MC ARTHRODESI
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**
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 1\textsuperscript{st} metatarsal osteotomies

- Reverdin
- Roux
- Peadbody
- Distal L
- Hohmann
- DRATO
- Mitchell
- Miller
- Wilson
- Lindbren and Turan
- Mygind
- Austin
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
  – Peabody osteotomy – nearly identical but slightly more proximal
  – Reverdin-Green osteotomy – the distal L
Riverdin osteotomy
Riverdin-Green osteotomy

Plantar transverse
Green osteotomy step
Hohmann osteotomy

- Corrects both hallux valgus and intermetatarsal angle
- For more severe deformities
Axis of the osteotomy

A

Shorten metatarsal  Lengthen metatarsal
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

Normal postop
Middiaphyseal metatarsal osteotomies

Scarf

Ludloff

Mau
Ludloff osteotomy
Mau osteotomy
Scarf or Z osteotomy

A

B

PASA correction
1\textsuperscript{st} metatarsal BASE osteotomies

- Indicated if intermetatarsal angle > 12 in adductus foot, or > 15 in a rectus foot
- If 1\textsuperscript{st} MT length within 2 mm of the 2\textsuperscript{nd} - closing base osteotomy (Juvara, Loison and Balasescu)
- If 1\textsuperscript{st} 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 1\textsuperscript{st} MT osteotomy = Logroscino
V-type base osteotomies

Kotzenberg osteotomy - rare

Lenox-Baker osteotomy - rare
Complications of base osteotomies

• Shortening of the 1\textsuperscript{st} metatarsal
• Hallux varus
  – Stress Fx lesser metatarsals
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


5. [www.bonepit.com](http://www.bonepit.com)

6. [www.radsoure.us](http://www.radsoure.us)