Management of the Adult flatfoot

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What’s flatfoot?

A static tridimensional deformity of the foot

Introduction

Classifications:
- clinical examination
- imaging
- aetiologies

Treatments:
- Stage 1: medical
- Stage 2: conservative
- Stage 3: fusion
- Stage 4: the ankle

Specific treatments

Conclusion

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What’s flatfoot?

A dynamic default of the lock mechanism of the midfoot with an apropulsive gait

(Meehan – Foot ankle clinics sept 2005)

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For the management =

Clinical and radiographic examination to know:
- the stage
- the type of deformity
- all the pathologic joints & tendons
- the aetiology

Indication and drawbacks of the different medical and surgical treatments

The combined surgical procedures
1 - Location of the pain

Medial:
* posterior tibialis t. dysfunction
* ankle medial ligament lesion
* coalition
* arthritis (subtalar, talonavicular, cuneonavicular, Lisfranc)

Lateral:
- calcaneofibular conflict
- calcaneocuboid overpressure (abduction)
- lateral malleolar stress fracture
- peroneal muscle spasms
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2 - The deformities: different types & stages

- Valgus: too many toes sign (Johnson)
  - abduction
  - flattening

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2 - The deformities

Dynamic pedobarography classification


Flatfoot abductus

Flatfoot valgus
2 - The deformities

Axis of the lower limb & flatfoot

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2 - The deformities

Hallux valgus & flatfoot

17.3% PPV if HV / 1-3 % normal population

Relationship between M1P1 angle and Calcaneus valgus on X ray ( V Staquet)

Why ? : - overload on the medial side
- passive great toe valgus on heel rise
- 1srt ray hypermobility ( Mueller )
- FHL desaxation

Recurrency in HV surgery if flatfoot : 1/3 of cases by overload above the first ray (Groulier )
3 - The reductibility of the deformity

Valgus of the hindfoot

Heel rise tests = dynamic reductibility by PTT

1. Double heel rise test: no HF inversion
   = fixed

2. Double heel rise normal + single single: no inversion
   = supple with PTT elongation or rupture

3. Painful PTT or no inversion only after repetitive monopodal test = PTT weakness
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3 - The reductibility of the deformity

Valgus reductibility when passive correction

ankle medial laxity

or sometimes subtalar laxity
The laxity of the joint

Chopart hypermobility = unstable flatfoot

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3 - The reductibility of the deformity

Sometimes, valgus fixed by achille tendon contracture

Dorsal flexion of the ankle after correction of the valgus of the hindfoot knee flexed and in extension (Silverskiold test) gastrocnemius or achille retraction
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3 - The reductibility of the deformity

The posterior tibialis tendon (PTT) strength

Inversion against resistance from plantar flexed & everted position
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3 - The reductibility of the deformity

Chopart joint stiffness

Passive inversion impossible:
tendon (peroneus tendon contracture) or joint (arthritis)?
3 - The reductibility of the deformity

Valgus of hindfoot in stand position sometimes due to forefoot supination

- Partial reductibility
- No reductibility

Reductibility when forefoot not in charge (Caroll test)
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3 - The reductibility of the deformity

Supination (varus) of forefoot:

First metatarsal rise sign (Hinterman)

Supination of the forefoot after correcting the valgus of the hindfoot

Rising of the 1rst ray head if varus fixed
The laxity of the joint

TMT1 hypermobility (often multiplanar)

Elevation of the 1srt metatarsal

- reductible forefoot varus
- X ray TMT1 collapse (plantar gap)

Reductible metatarsus varus

- Hallux valgus
- radiographic squeeze test

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Imaging

X ray = 3 views in weightbearing

- Forefoot abduction
  - Dorso-plantar view

- Flattenning medial arch
  - Lateral view

- Hindfoot valgus
  - Meary view

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X ray = 3 views in weightbearing

1 – dorso-plantar view

1. Talo1srt metatarsal angle
   Mann and Thompson:
   N= 0, mild<15°, severe >15°

2. Talocalcaneal angle
   N= 25-35°

3. Talonavicular uncoverage
   N=0%

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**X ray = 3 views in weightbearing**

**2 – lateral view**

- **Talocalcaneal angle**: N = 25-35°
- **Calcaneal pitch**: N = 15-20°
- **Talo1srt metatarsal (Méary) ++**: N = 0°
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X-ray = 3 views in weightbearing

2 – lateral view

- Break of the medial arch
- Gap above the TMT1, NC joint with sometimes arthritis
X ray = 3 views in weightbearing

3 – Meary view

Axis of hindfoot : N= 4-8°

Measure of the valgus
localisation of the valgus
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X ray = 3 views in weightbearing

3 – Meary view

- Tibiotarsal joint shape
- Lateral malleolar stress fracture
- Medial laxity: talar tilt
- Arthritis in tibiotalar or subtalar joint
Instructional course lecture

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X ray = 3 views in weightbearing

X ray in stress if laxity

- Stress in valgus
- Stress in varus
- Stress in abduction
- Stress in adduction
Ultrasound

Cost effective

posterior tibialis tendon (tenosynovitis, splits, ..)
Interest in stage 1 dysfunction

dynamic tests: laxity

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CT scan → Specific aetiologies

Subtalar arthritis

coalition

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Aetiologies

Coalition

Acquired flatfoot (PTT dysfunction)

Medial TN & TT laxity

Congenital flatfoot

Lisfranc injury

Rheumatoid arthritis

Poliomyelitis

Tumor

Coalition

Rheumatoid arthritis
Rheumatoid foot

- severe deformity
- Joint arthritis
- Knee often impaired
- Tendon weakness or rupture
- osteoporosis

Introduction

Classifications:
clinical examination imaging aetiologies

Treatments:
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Charcot disease

Diabetes or peripheral neuropathy

Major risk of infection

Bone necrosis at different levels
Hyperlaxity (Marfan syndrome, Ehlers-Danlos)

- Global hyperlaxity
- Congenital

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Tumor of the foot or the leg

Man 21 years old - Anterolateral leg tumor (peroneus muscles compression) since 5 years old
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**Neurologic flatfoot**

**Neuromuscular imbalance**
( closed head injury, cerebral palsy, poliomyelitis, nerve injury)

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**Poliomyelitis with equinovalgus**

**PTT and ATT insufficiency**

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Traumatic flatfoot

PTT tendon, spring ligament injury

Woman 70 years old: flatfoot 1 year after ankle sprain with rotation on the foot in charge (Chopart laxity)
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Traumatic flatfoot

Ankle collateral medial ligament injury

Chronic medial laxity of the ankle after ankle injury

Subtalar fusion = a bad solution
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Traumatic flatfoot

Bone & joint injuries

After Lisfranc’s fracture

After calcaneus fracture
Abduction/ lateral compression
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Coalition = Rigid flatfoot in young adult

- Talar beak
- C sign

- Accessory navicular bone
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The most frequent

Congenital flatfoot

Achilles retraction

Acquired flatfoot

Subtalar dislocation

PTT dysfunction
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Classification of the posterior tibialis tendon dysfunction:


Stage 1: TP tenosynovitis, no or a few deformity
Stage 2: flexible flatfoot, tendinous strengthening or prerupture
Stage 3: severe deformity with rigid hindfoot


Stage 4: medial laxity with lateral ankle arthritis

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Stage I (Bluman)

Tenosynovitis without deformity

IA: normal anatomy, tenderness along PTT
X ray: normal
PTT inflammatory

IB: normal anatomy, tenderness along PTT
X ray normal
Partial PTT tear

IC: slight hindfoot valgus, tenderness PTT
X ray: slight valgus (< 5°)
Partial PTT tear

Tests:
Normal inversion strength
Single heel rise test normal
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Medical treatment

The means:
- Specific shoes (semirigid, extradepth)
- Insoles
- Brace, walking boot, cast
- physiotherapy (cryotherapy)
- NSAIDs

The indications:
- stage 1
- surgery contraindication

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Medical treatment

In acute PTT tenosynovitis:

below knee cast or boot
6 to 8 weeks

Removable stirrup brace
non sufficient
Stage 1: sometimes surgery

- Tenosynovectomy
- PTT suture (splint)
- Medial calcaneal osteotomy (I-C)
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Stage 2 (Bluman)

Ruptured PTT, flexible flatfoot

- Inversion weakness
- Inhability to single or multiple single heel rise test

3 categories
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Stage 2 (Bluman): Ruptured PTT, flexible flatfoot

II A supple hindfoot valgus

X ray: hindfoot valgus
Meary’s line disruption
loss of calcaneal pitch

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Stage 2 (Bluman): Ruptured PTT, flexible flatfoot

II A supple hindfoot valgus

A1 flexible forefoot supination
A2 fixed forefoot supination

First metatarsal rise sign (Hinterman)
II A = Medial calcaneal osteotomy

Translation of achilles tendon

The medial translation protect the medial collateral ligament

Oblique osteotomy 45° & translation of 1cm
II A = Medial calcaneal osteotomy

Increase the forefoot abduction
( Toullec – EFAS Seville march 2003)

Pulling procedure

Always associated with PTT repairing or transfert + spring ligament suture

FDL transfert
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If fixed forefoot varus (IIA2)

1st ray lowering by osteotomy or fusion

- Navicular plantar soustraction
- 1st metatarsal dorsal addition
- 1st cuneiform plantar soustraction or dorsal addition (Cotton)
- Lowering scarf ost.
- TMT1 & CN fusion
- TMT1 fusion
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Stage 2 (Bluman): Ruptured PTT, flexible flatfoot

II B forefoot abduction

X ray: forefoot abduction
talonavicular uncovering
hindfoot valgus
Instructional course lecture

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**Stage 2 (Bluman):** Ruptured PTT, flexible flatfoot

II B supple hindfoot valgus & forefoot abduction

But different kind of abduction

Transverse tarsal joint

1srt tarsometatarsal

Abduction location in dynamic pedobarography
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Stage IIB: lateral column lengthening

To push = Evans

1 to 1.5 cm/ CC joint

The best situation for the osteotomy

direction of the center of the talus head
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Stage IIB: lateral column lengthening

No deformity of the head to turn

Failure because no possibility of rotation (congenital flatfoot)

Interest of peroperative X ray with correction

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Stage IIB: lateral column lengthening

The weak point = the graft:
- tricortical iliac crest
- size from 8 to 10 mm
- stable fixation

Drawbacks:

overcorrection = clubfoot

Undercorrection / Compressed graft

migration

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Stage IIB: lateral column lengthening

Increase peroneus tendon contracture

CC joint overpressure

(65% for Philipps, Mosier LaClair 14%)
but without peroneus tendon lengthening

Fusion = a solution?

Not around the center of the talus head

CC fusion with lengthening
but sometimes non healing (47% for Conti)
Combined osteotomies = a solution?

Evans + MCO

Mosier LaClair (2001), Catanzariti (2005)

Arthrose CC 14% à 5 ans

Z osteotomy or calcaneal scarf ost. (Malerba –Weil)

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Stage 2 (Bluman): Ruptured PTT, flexible flatfoot

Il C
supple hindfoot valgus
fixed forefoot varus
medial column instability

X-ray: hindfoot valgus
medial plantar gaping
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Stage II C

Medial arch arthrodesis

Medial cuneiform opening wedge osteotomy (Cotton)

Cotton FJ. Foot statics and surgery. N Engl J Med 1936;214

From Myerson
Man 71 years old – PTT dysfunction & Lisfranc abduction
Evans + achilles & peroneus length. + TMT1 fusion

1 year later
Sono validi gli interventi tipo Evans?

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Introduction
Indications
The procedure
osteotomy & graft
achille tendon
peroneus tendon
tibialis posterior
forefoot supination

Conclusion

Torino, 30 novembre 2007
Lateromedial force index in dynamic pedobarography

Force on the medial side during all the step

Force on the lateral side

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The place of arthroereisis

In stage II, to correct the collapse of the talus head

In conjunction with FDL transfert (minimal deformity)
or MCO & FDL transfert (moderate deformity)
& if necessary, achille tendon lengthening and
opening wedge medial cuneiform osteotomy (Cotton)

(Schon L: Foot Ankle Clinics –2007:329-339)

! Sinus tarsi pain → implant removal
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Tendons imbalance

Peroneus contracture

PTT stretching

- Tenosynovectomy
- PTT tightening = Kidner
- Tendon transfert:
  - FDL or FHL

Achille contracture

Tendon lengthening:
- Evans

Cobb (half TA)
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Stage III (Bluman)

Rigid hindfoot valgus

Pain in sinus tarsi

X-ray: Hindfoot valgus
- Subtalar joint space loss
- Angle of Gissane sclerosis

III A

III B: Forefoot abduction

Tests: Inability to perform double heel rise test
Instructional course lecture

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Stage III (Bluman): rigid hindfoot valgus

The gold standard = Triple arthrodesis

Sagittal view: correction of the medial arch flattening

Meary view:
Valgus corrected in subtalar fusion

Dorsoplantar view:
Fixed varus corrected in Chopard fusion
Stage III (Bluman): rigid hindfoot valgus

Triple arthrodesis: procedure

The approach:
- classical: lateral (ST & CC) and medial (TN)
- only medial approach (wound healing)

Associated procedures if necessary:
- Achilles lengthening
- Medial displacement osteotomy
- Lateral column lengthening
- Plantar flexion osteotomy 1st ray (Cotton)
Stage III (Bluman): rigid hindfoot valgus

Is partial arthrodesis sometimes useful?

Arthrodesis with lengthening of the lateral side of the foot if abduction + arthritis
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Stage IV (Bluman): ankle valgus

4A = flexible ankle valgus

Surgery for hinfoot valgus + deltoide reconstruction

4B = rigid ankle valgus

Tibiotalocalcaneal fusion or pantalar fusion or triple arthrodesis + ankle prosthesis

X ray stress in varus

Stage 1: medical
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Stage IV (Bluman): ankle valgus

Stage 4B without instability: Pantalar fusion?
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Specific treatment = often fusion

Traumatic ankle arthritis with valgus tibiotalar & syndesmosis fusion

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- Stage 2: conservative
- Stage 3: fusion
- Stage 4: the ankle

Specific treatments

Conclusion

Nice, 30 May 2008

But not always...

Medial collateral instability + sometimes lateral instability

No fusion but Medial col. Ligt suture + MCO

FU 1 year: excellent but what prognosis?
Management of adult flatfoot

1. What kind of flatfoot is it?
   Joints, tendons, aetiologies
   - clinical tests
   - X-ray in weightbearing
   - dynamic pedobarography

2. How to correct all these deformities?
   A box of surgery tools
   - ankle and foot axis
   - muscle imbalance
   - arthritic joints

Nice, 30 may 2008
woman 65 years old – PTT rupture (left foot):
Evans ost. & scarf ost.
Achille & peroneus length.
without repairing the tibial. post

2 years later

6 years later
Dynamic pedobarography

before  8 months  2 years  4 years  6 years

Thank you