Pes Planovalgus
Tibialis Posterior Tendon Dysfunction
*stadium II*

**Therapeutic choices**

**Medializing Calcaneal osteotomy**

**Versus**

**Lengthening Calcaneal Osteotomy**

*Dr de Halleux Jacques*  
*GENOA, december 2th 2015*
# Tibialis Posterior Insufficiency

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcaneum</td>
<td>Valgus</td>
</tr>
<tr>
<td>Subtalar joint</td>
<td>Tilted medially</td>
</tr>
<tr>
<td>Talus</td>
<td>Medially and down</td>
</tr>
<tr>
<td>T-N and N-C</td>
<td>Subluxation</td>
</tr>
<tr>
<td>Midtarsal joints</td>
<td>Abduct + supination</td>
</tr>
</tbody>
</table>

- Valgus hindfoot
- Achilles T = Evertor
STAGES
tibialis posterior dysfunction

- **Stage 1**
  - **A**: inflammation, no deformation
  - **B**: partial PTT tear, no deformation
  - **C**: partial PTT tear, little hindfoot valgus

- **Stage 2 = SUPPLE**
  - **A**: valgus hindfoot; (<50% uncovering TN)
  - **B**: forefoot supination flexible; (>50% uncovering TN)
  - **C**: A or B with forefoot supination fixed
  - **D**: Forefoot abduction
  - **E**: medial column (TN, NC, CMT) stability

- **Stage 3 = RIGID**
  - **A**: Hindfoot valgus
  - **B**: Forefoot abduction

- **Stage 4**
  - **A**: reducible ankle valgus
  - **B**: rigid ankle valgus (more common presentation)

**PLANUS VALGUS ABDUCTUS SUPINATION MEDIAL COLUMN**

**complex problem that has multiple treatment options**

*Myerson, JBJS Am, 1996*

*Hill K, Foot Ankle Clin. 2003. 8(1):91-104*
BONE PROCEDURES

MEDIALIZATION CALCANEAL OSTEOTOMY (KOUTSOGIANNIS, MYERSON)
MALERBA CALCANEAL OSTEOTOMY
SILVER CALCANEAL OSTEOTOMY

LATERAL LENGHTENING OSTEOTOMY
LATERAL LENGHTENING CALCANEAL-CUBOIDAL ARTHRODESIS

SUBTALAR ARTHRODESIS
SUBTALAR ARTHROERESIS
TALO-NAVICULAR ARTHRODESIS

MEDIAL COLUMN RESTORATION
COTTON CUNEIFORM 1 OSTEOTOMY
PLANTAR FLEXION MT1 OSTEOTOMY
ARTHRODESIS NAVICULO-CUNEIFORM 123
ARTHRODESIS TARSO-MT1

SOFT TISSUE PROCEDURES

TIBIALIS POSTERIOR RECONSTRUCTION
SUTURE
TRANSFER (TFDL OR FDC; COB TECHNIQUE)
SPRING LIGAMENT RECONSTRUCTION
ACHILLES TENDON LENGHTENING
MEDIALIZING CALCANEAL OSTEOTOMY
MCO
(valgus correction)

Koutsogiannis. JBJS. Febr 1971
MEDIALIZING CALCANEAL OSTEOTOMY
MCO
(valgus correction)

Line of weight-bearing transmitted through the talus medial to the calcaneus
SURGICAL TECHNIQUE MCO

Lateral incision (parallel and behind peroneal tendon) sural n!

Osteotomy // skin incision

**MEDIAl TRANSLATION POSTERIOR PART**
**CALCANEUM**
(1/3 to ½ of the width of the calcaneus)
1- TREATMENT of AQUIRED FLATFOOT

   = Association of different procedures that impact hindfoot alignment
      (MCO, LCL, TMT fusion, reconstruction PTT + spring ligament …)

   Main Predictor of hindfoot valgus alignment correction = MCO
      (others: much lesser effect)

2- LINEAR RELATIONSHIP between:

   - amount of MCO displacement
   - correction hindfoot alignment
3- HINDFOOT MOMENT ARM

- Help surgeon to titrate the amount of correction

- 0 - 5 mm varus = greatest clinical improvement *

Comparison of Three Different Fixation Methods of Calcaneal Osteotomies

Ali Abbasi, FRCS(Tr&Orth), Razi Zaidi, MRCS, Abhijit Guha, FRCS(Tr&Orth), Andrew Goldberg, FRCS(Tr&Orth), Nicholas Cullen, FRCS(Tr&Orth), and Dishan Singh FRCS(Tr&Orth)

MCO FIXATION = 1 headless screw

- 2 headless screws: no better result
- Headed screw: 30-50% removal
- Lateral plate: more non-union
Medial Displacement Calcaneal Osteotomy Using Minimally Invasive Technique

Ehab Kheir, FRCS Tr&Orth¹, Vishal Borse, MRCS¹, Jon Sharpe, FRCR²,
David Lavalette, FRCS Tr&Orth¹, and Mark Farndon, FRCS Tr&Orth¹

- Good results
- No non-union
- N = 30
MCO Correction of:

- Valgus
- Eversion force of the Achilles tendon
- Medial arch + Forefoot abduction
  = only if no severe flatfoot

MCO alone not enough!
Suture / Z lengthening

Transfert
FDL-FHL
Tib ant (Cobb)

RECONSTRUCTION PTT

RECONSTRUCTION SPRING LIGAMENT

OSTEOTOMY - ARTHRODESIS

LCL, Cotton, MT1

N-C, T-MT
# RESULTS

**MCO + FDL transfert**

<table>
<thead>
<tr>
<th><strong>Myerson M S</strong> *</th>
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<tbody>
<tr>
<td>n: 32</td>
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<tr>
<td>mean age : 58 y</td>
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<tr>
<td>FU : 20 months (14 to 48)</td>
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<td>results : AOFAS score 48 to 84</td>
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<td><strong>94%</strong> pain relief, improvement arch of the foot</td>
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<table>
<thead>
<tr>
<th><strong>Wacker J T</strong> **</th>
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<tbody>
<tr>
<td>n : 44</td>
</tr>
<tr>
<td>mean age 61 y</td>
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<tr>
<td>FU : 51 months (38 to 62)</td>
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<tr>
<td>results : AOFAS score 48 to 88,5</td>
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<tr>
<td><strong>95%</strong> pain relief</td>
</tr>
<tr>
<td>80% improvement arch of the foot</td>
</tr>
</tbody>
</table>

* Myerson MS, Orthopedics. 19:383-8,1996
** Wacker JT, JBJS. 84-B : 54-8, 2002
CALCANEAL OSTEOTOMY:
Lateral column lengthening

St IID : forefoot abduction
Correction of:

- **Medial arch height** *
  
  not because F Pl tightness ***

- **Forefoot abduction** *
  
  improve coverage Talar head by Navicular

- **Hindfoot valgus** *

Side effect:

- **Lateral forefoot plantar pressure ↑** *
  
  simultaneous procedure medially

---

* Evans D, Calcaneo-valgus deformity. JBJSBr. 1975;57-B(3):270-278

** Benthien et al, Foot Ankle International.2007;28(1):70-77

calcaneo-cuboidal osteoarthritis

Evans : 65% at 13 years follow-up
Mosier-Laclair : 14% at 5 years follow-up *

Alternative = calcaneocuboïd distraction arthrodesis

- less motion hindfoot,
  (loss subtalar motion of 18 to 30% and loss TN of 40%**)
- increasing arthritis hind and midfoot

•Mosier-Laclair, Foot Ankle Clinic (6):95-119, 2001 Mar
** Deland J et al, Foot Ankle.16(11) , 1995
**Table 1.** The Calcaneocuboid Joint Peak Pressures Under 7 Conditions With Vertical Loads of 350 N (kg/cm², x ± s, n= 6)

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Peak Pressure Across the CC Joint</th>
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<tbody>
<tr>
<td>Intact foot</td>
<td>9.21 ± 1.60</td>
</tr>
<tr>
<td>Flatfoot</td>
<td>24.90 ± 2.45</td>
</tr>
<tr>
<td>Corrected with 4 mm LCL</td>
<td>21.68 ± 2.21</td>
</tr>
<tr>
<td>Corrected with 6 mm LCL</td>
<td>15.95 ± 2.59</td>
</tr>
<tr>
<td><strong>Corrected with 8 mm LCL</strong></td>
<td><strong>11.04 ± 1.15</strong></td>
</tr>
<tr>
<td>Corrected with 10 mm LCL</td>
<td>15.20 ± 2.35</td>
</tr>
<tr>
<td>Corrected with 12 mm LCL</td>
<td>21.55 ± 2.03</td>
</tr>
</tbody>
</table>

CC, calcaneocuboid; LCL, lateral column lengthening.

**LCL with 8 mm trapezoidal grafts**

Cadaveric study
Linear relationship:
- Graft size (Lengthening LCL)
- Correction forefoot abduction

(measured by the RX lateral incongruency angle)

**helpfull for surgeon to titrate the proper amount of correction**

**Figure 5.** A linear regression model for the amount of LCL performed in relation to the change in lateral incongruency angle is shown. The model demonstrates a significant positive correlation between LCL and the correction in forefoot abduction ($P = .001$). Each additional millimeter of lengthening performed corresponded to a 6.8 degree change in lateral incongruency angle.
Majority of publications = trapezoidal graft

Rectangular graft

Better bony realignment = Better flatfoot deformity correction
(more graft volume medially)
(Intraarticular TN pressure: trapezoidal = rectangular)

Article

Effect of Graft Shape in Lateral Column Lengthening on Tarsal Bone Position and Subtalar and Talonavicular Contact Pressure in a Cadaveric Flatfoot Model

Sean T. Campbell, MD, Keri A. Reese, MD, Steven D. Ross, MD, Michelle H. McGarry, MS, Thu-Ba Leba, MD, and Thay Q. Lee, PhD
If double osteotomy performed: Prior MCO or Prior LCL?

- Performing MCO prior to the LCL osteotomy

  Risk of overcorrection (cfr additional hindfoot inversion)

- Performing LCL osteotomy prior to MCO

  Reduce risk of overcorrection
- **LCL osteotomy**  
  *(autologous tricortical bone block, T-plate)*  
- Reinsertion Post. tib.  
- FDL transfer to navicular  
- Reconstruction Spring ligament  
- Gastroc-slide/lengthening
N=112 feet
FU 2 years n101 feet
58,2y

Talo-MT1 normalized
Post Tib insufficiency improved
VAS FA improved
Pedography normalized

9% wound healing delay

**Association**
- LCL
- reconstructionTib Post + Spr
Lig
- Ach T lengthening

safe and predictable technique
Flatfoot correction
(Abducto-Plano-Valgus)
CONCLUSION

- Posterior Tibialis Tendon Dysfunction St II
  =
  Complex problem
  multiple therapeutic options

- MCO or LCL = not to be used alone
  Need for Additional procedures
  depending on the deformations
Thanks
TIBIALIS POSTERIOR TENDON

- Inversion of the heel
- Adduction forefoot
- Plantar flexion of the Ankle
Inversion of the heel
Adduction forefoot
Plantar flexion of the Ankle

Tibialis posterior tendon
DIAGNOSIS

- tibialis posterior dysfunction

- flattening longitudinal arch
DIAGNOSIS

*tibialis posterior dysfunction*

- valgus of the hindfoot
DIAGNOSIS
tibialis posterior dysfunction

- abduction of the mid and forefoot
- „too-many-toes sign“
DIAGNOSIS

tibialis posterior dysfunction

single-heel rise test

Normal Tib Post
DIAGNOSIS

tibialis posterior dysfunction

„single-heel-rise test“
## STAGES

**tibialis posterior dysfunction**

<table>
<thead>
<tr>
<th></th>
<th>stage 1</th>
<th>stage 2</th>
<th>stage 3</th>
<th>stage 4</th>
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</thead>
<tbody>
<tr>
<td>retromalleolar pain</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>hindfoot valgus</td>
<td>(+/-)</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>arch flattening</td>
<td>(+/-)</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>forefoot supination</td>
<td>(+/-)</td>
<td>(+)</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>forefoot abduction</td>
<td>(+/-)</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>deformity</td>
<td>supple</td>
<td>supple</td>
<td><strong>rigid</strong></td>
<td>rigid</td>
</tr>
<tr>
<td>Ankle pain</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td><strong>++</strong></td>
</tr>
</tbody>
</table>

*Stages 1, 2, 3 = Johnson and Strom, Clin Orthop, 1989*

*Stage 4 = Myerson, JBJS Am, 1996*
Posterior Tibial Tendon Dysfunction St II
TREATMENT

*complex problem that has multiple treatment* options *
- Valgus hindfoot?
- Forefoot abduction?
- Forefoot supination?
- Medial column instability?
- Spring ligament?
- Tibialis posterior?
- Achilles tendon?

* Hill K, Foot Ankle Clin. 8(1):91-104, 2003 Mar
Posterior Tibial Tendon Dysfunction
Stage 1

- retromalleolar pain
- X Ray Normal
- Stages A: inflammation, no deformation
  - B: partial PTT tear, no deformation
  - C: partial PTT tear, little hindfoot valgus

Tenosynovitis or partial rupture

Haddad St, Myerson MS and al, Foot and Ankle Int, 2011, Jan.
Supple pes plano valgus

- A: valgus hindfoot (<50% uncovering TN)
- B: forefoot supination flexible (>50% uncovering TN)
- C: A or B with forefoot supination fixed
- D: Forefoot abduction
- E: medial column (TN, NC, CMT) instability

Posterior Tibial Tendon Dysfunction

Stage 2

Elongation, tendinosis

(partial) rupture

Haddad St, Myerson MS and al, Foot and Ankle Int, 2011, Jan.
Posterior Tibial Tendon Dysfunction

Stage 3

- Rigid pes plano valgus
  - A: Hindfoot valgus
  - B: Forefoot abduction

More advanced course of tendon rupture

Haddad St, Myerson MS and al, Foot and Ankle Int, 2011, jan
1893: medial closing wedge (Gleich)

1967: lateral opening wedge (Silver)

MEDIAlIZING CALCANEAL OSTEOTOMY
MCO (Koutsogiannis. JBJS. Febr 1971)
(valgus correction)
CALCANEAL OSTEOTOMY
(valgus correction)

MEDIAL TRANSLATION POSTERIOR PART CALCANEUM

(1/3 to ½ of the width of the calcaneus; 1 cm)
CALCANEAL OSTEOTOMY
(valgus correction)
LATERAL OPENING WEDGE OSTEOTOMY

2005 : Z osteotomy (Malerba)

pictures from: Th Leemrijse, B Valtin, Pathologie du Pied et de la cheville, 2009
MALERBA OSTEOTOMY
Lateral *opening* wedge osteotomy

*picture from: Th Leemrijse, B Valtin, Pathologie du Pied et de la cheville, 2009*
TIBIALIS POSTERIOR RECONSTRUCTION: suture
TENDON RECONSTRUCTION: Z-lengthening
TENDON RECONSTRUCTION:
FHL or FDC transfert

Tibialis posterior

FDC
TENDON RECONSTRUCTION
WITH TIBIALIS ANTERIOR
COBB TECHNIQUE

restore plantar flexion power of the 1st ray
( more distal insertion of the Tib Ant)
supple forefoot supination St IIB

COBB TECHNIQUE

Knupp M, Hintermann B

- n = 22 PTT dysfunction st IIB
- FU : 24 months
- results : AOFAS score 53.2 to 88.5
  excellent / good results : 95 %
  no decreasing Force of TA

- Cobb technique = apropriate alternative to arthrodesis
  in st II B PTT dysfunction ( in addition with other technique)
LIGAMENT RECONSTRUCTION
spring ligament suture
RESULTS
MCO + LCL + FDL transfert (Mosier-Laclair**)

- Satisfaction rate high
- No medial arch restauration in all patients
- Cc arthritis 14%

** Mosier-Laclair, Foot and Ankle Clinic, Mar 2001: (6):95-119;
Posterior Tibial Tendon Dysfunction

Stage 4

- Rigid pes plano valgus
- Lateral ankle pain

- A: reductible ankle valgus
- B: rigid ankle valgus (more common presentation)

rupture

ankle arthrosis

Myerson MS and al, Foot and Ankle Int, 2011, Jan
Posterior Tibial Tendon Dysfunction

TREATMENT

Stage 1

- conservative
  - physiotherapy
  - shoe corrections
  - medial support

Surgery?

Ténosynovectomy?
LCL osteotomy correct
- Majority of the hindfoot valgus deformity
- While also correct the midfoot deformity
Posterior Tibial Tendon Dysfunction Stage II

Treatment

SURGICAL

- Calcaneal osteotomy
  ( => valgus : MCO and others (Silver, Malherba...))
  ( => abd midfoot : LCL lateral column lengthening)
- Arthrodesis
  ( => abd forefoot : lateral column lengthening)
  ( => supp forefoot : medial column)
- Tendon reconstruction
  ( suture, plasty, transfert FHL or FDC, Cobb)
- Ligament reconstruction
  ( spring ligament)
- Others
  ( Achilles tendon lengthening, TN arthrodesis,
    subtalar arthrodesis, subtalar arthroereisis, medial
    cuneiform osteotomy, 1st MT osteotomy)
RESULTS
CC arthrodesis + PTT repair + Achilles tendon lengthening (Lauwerens, 2006)

- N = 20; FU = 24 months
- 85% complete relief of pain
- 10% nonunion
- 15% sural nerve damage

RIGID FOREFOOT SUPINATION?
STADIUM II C

• Arthrodesis naviculo-cuneiform 123 *
• Arthrodesis 1st tarso-metatarsal
• Cotton osteotomy (plantar flexion opening wedge cun 1)**
• Plantar flexion osteotomy MT1

• Alastair Younger, Foot Ankle Int. 32 (1) : 101-3, 2011
** Hirose CB, Foot Ankle Int. 25 : 568-74, 2004
Stephen J Pinney, Foot Ankle Int, 27 (1) : 66-75, 2006 jan
Posterior Tibial Tendon Dysfunction

Treatment

- Stage 3
  - A: + Medial transl calc ost
  - B: + lenght lat column

- surgical
  - triple arthrodeses
Posterior Tibial Tendon Dysfunction Treatment

- Stage 4

Surgical*

A: ankle soft tissue repair + Triple Arthrodesis
B: Panarthrodesis / TTC arthrodesis

*Bluman EM, Myerson MS, Foot Ankle Clinic, 12(2): 341-62, 2007
# Posterior Tibial Tendon Dysfunction TREATMENT

## CONCLUSION

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>II / III</th>
<th>III / IV</th>
<th>IV</th>
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<tbody>
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<td></td>
<td>conservative</td>
<td>MTCO</td>
<td>PTT repair</td>
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<td>TTC desis</td>
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<tr>
<td>I</td>
<td>pain</td>
<td>PTT inflam; no deform</td>
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<td></td>
<td>A</td>
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<td>B</td>
<td>part PTT tear; no deform</td>
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<td>C</td>
<td>part PTT tear; little valgus</td>
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<td>II</td>
<td>supple PPV</td>
<td>calc valgus</td>
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Posterior Tibial Tendon Dysfunction

CONCLUSION

• Good physical examination
• Good treatment indication
• Good results
Linear relationship:
- LCL graft size
- Correction forefoot abduction

(measured by the RX lateral incongruency angle)

helpfull for surgeon to titrate the proper amount of correction
What kind of graft shape?

Rectangular graft (no trapezoidal)

- better bony realignment = better flatfoot deformity correction (more graft volume medially)
- Intraarticular TN pressure: trapezoidal = rectangular

Article

Effect of Graft Shape in Lateral Column Lengthening on Tarsal Bone Position and Subtalar and Talonavicular Contact Pressure in a Cadaveric Flatfoot Model

Sean T. Campbell, MD, Keri A. Reese, MD, Steven D. Ross, MD, Michelle H. McGarry, MS, Thu-Ba Leba, MD, and Thay Q. Lee, PhD
- Tibialis Posterior Dysfunction St II
  =
  Complex problem
  multiple therapeutic options

- MCO or LCL = not to be used alone
  Additional procedures mandatory
  depending on the deformations

- Displacement :
  - MCO = Hindfoot moment arm = 0-5 mm varus
  - LCL = 0,8 cm

- Double Osteotomy: LCL prior to the MCO
  avoid overcorrection