

# The Subtle Cavus Foot

by  
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UT Health

San Antonio

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Orthopaedics

# CME Accreditation

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Mayo J. Galindo Jr., MD has no relevant financial disclosures.



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# Irrelevant Disclosures

“History is brutal; only future peril lies in omitting or obscuring man’s continuing brutalities. Generations that have been sheltered from the brutalities of the past are poorly equipped to cope with those of their own times.”

T. R. Fehrenbach

Comanches: The Destruction of a People

*Scalped buffalo hunter, Ralph Morrison, near Fort Dodge, 1868.  
Photograph by William S. Soule.*



# Objectives

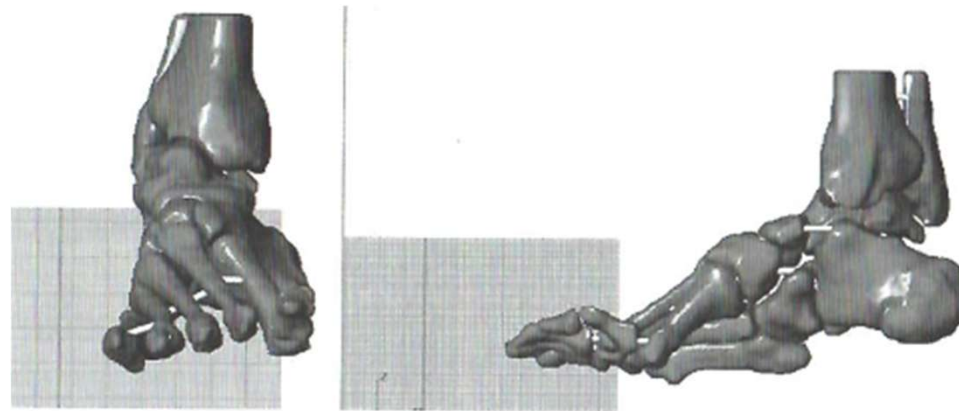
Recognize the subtle cavus foot as a non-neurological variation of normal foot structure.

Understand the anatomy and biomechanics that may cause overuse or injury to the cavus foot.

Develop non operative and operative strategies to treat the complications of the subtle cavus foot.

# Cavus Foot Definition

Spectrum of foot shapes that result in a high arch and inverted foot.



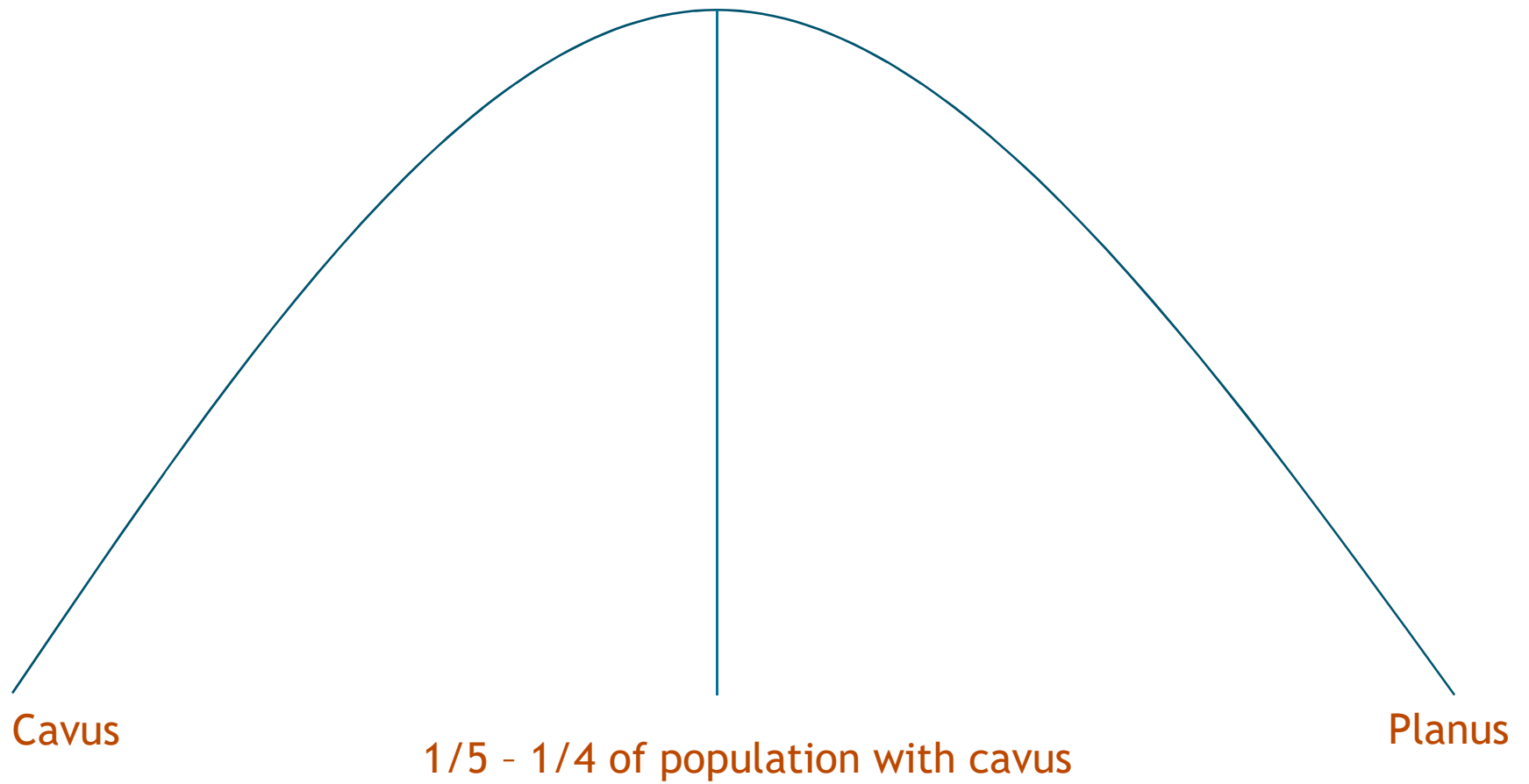
# Components of the Cavus Foot

Increased pitch and varus of the hindfoot

Plantar flexion of the midfoot

Varus and adduction of the forefoot

Lower extremity torsion (dynamic)





The subtle cavus foot is a variation of normal and is not associated with neurophysiologic deficits.

DiFabio, R et al  
Neurol Sci. December 2015

# The Problem

The cavus foot is less flexible and subject to altered walking mechanics.

Subtle cavus was designated as the “underpronator”.

Manoli, FAI, 1993

Most studies are level 4 and 5.



# Radiographic Definitions of the Cavus Foot

Calcaneal pitch angle  $>30^\circ$

Meary's angle  $>4^\circ$

Hibbs angle  $>45^\circ$

Increased navicular height relative to the cuboid

Posterior fibula

Flat top talus

Open sinus tarsi



Not a true lateral but more  
of a supinated oblique

# Calcaneal Pitch Angle



# Meary's Angle





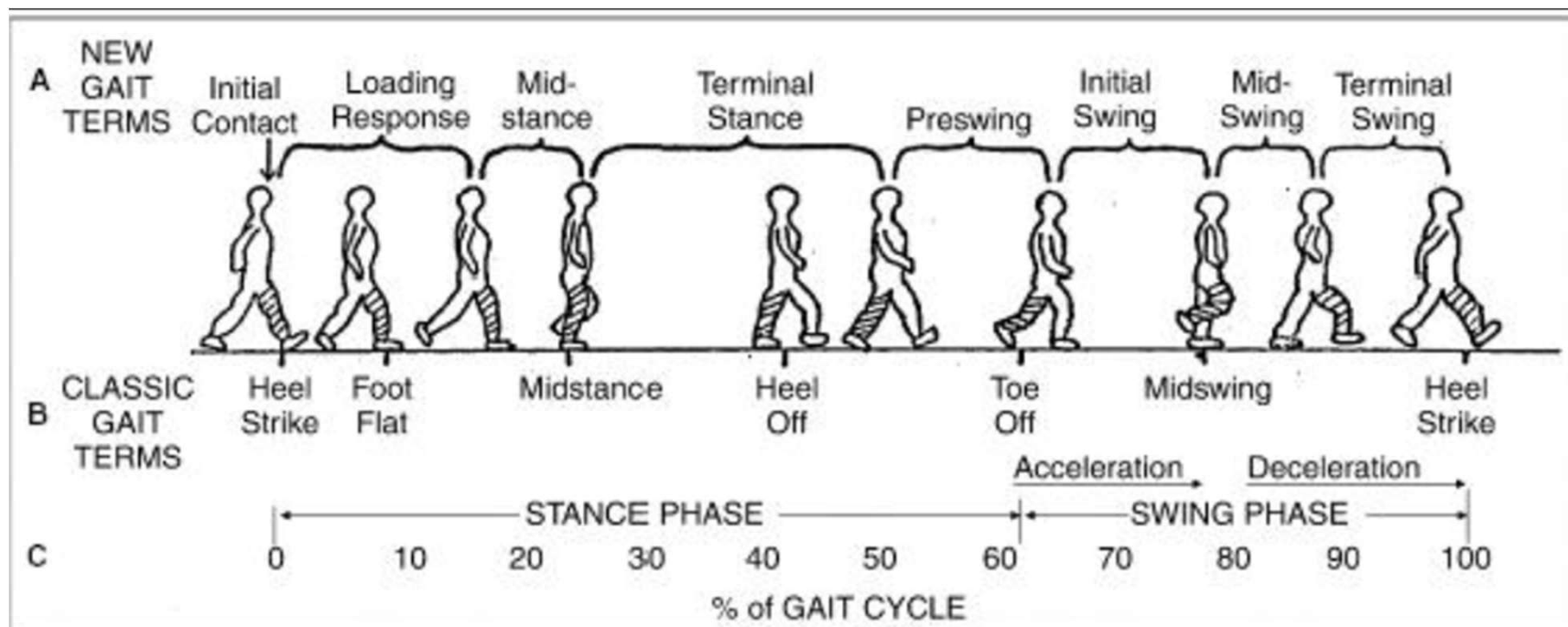
# Hibbs Angle



# Supinated Oblique Ankle



# Normal Gait Cycle





# Cavus Biomechanics

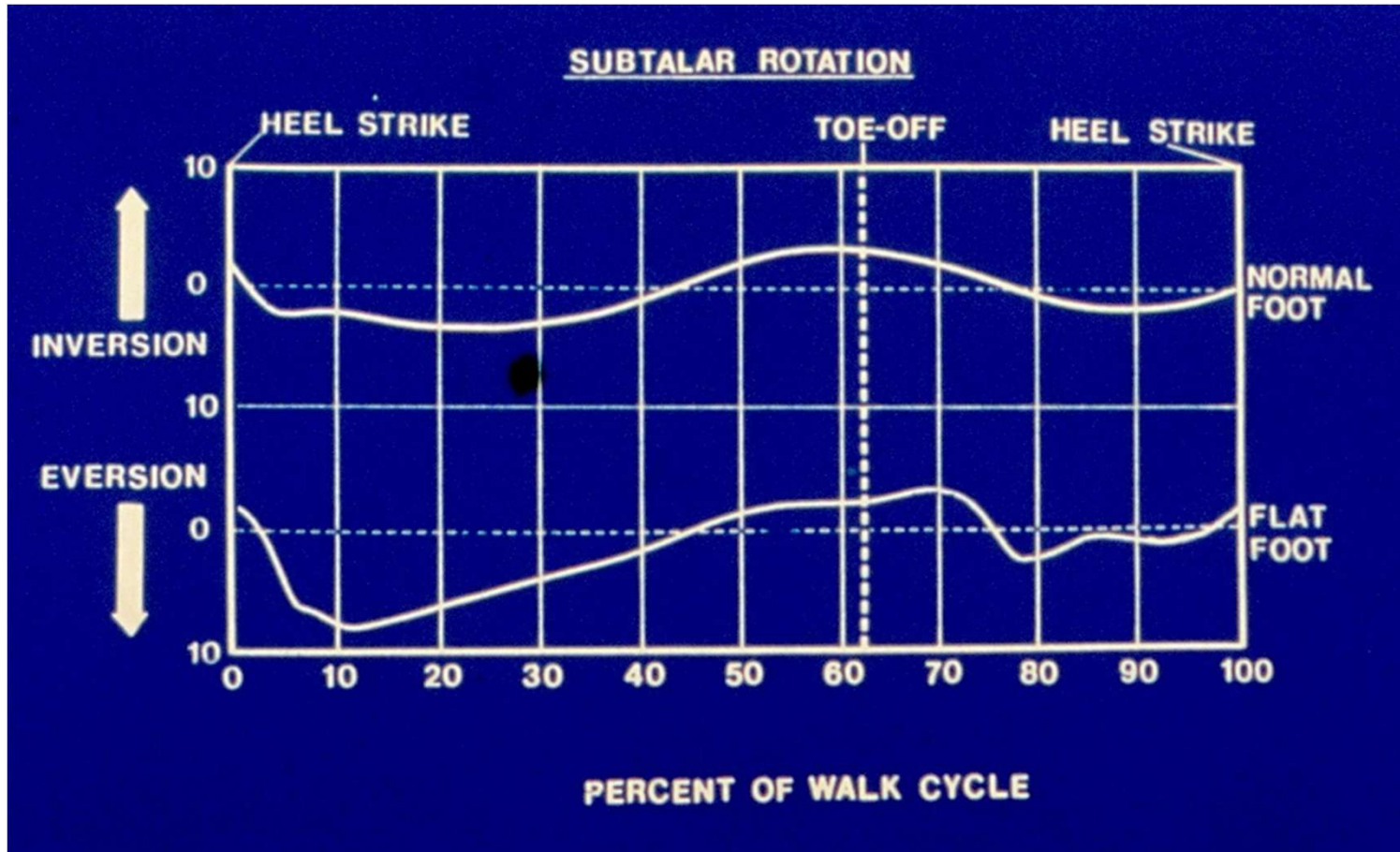
Navicular moves superior to cuboid

Locks hindfoot inversion

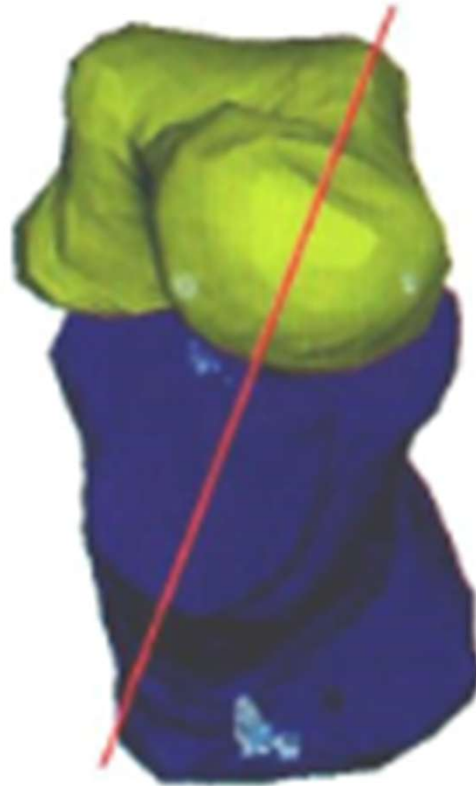
Varus throughout stance phase causes less stress dissipation because compensatory eversion is not possible.

# Biomechanics

## Subtalar Motion



# Cavus Blocks Chopart Joint Motion



# Complications of Cavus

Lateral column overload

Stress fractures

Peroneal tendinopathy

Ankle instability

Ankle arthritis

Plantar fasciitis

IT band syndrome

Athletes with foot pain

Navy Seals

Kaufman KR et al

Am J Sports

Med, 1999

Runners

Williams DS III

Clin Biomech, 2001

Army Recruits

Cowan DN

Arch Fam Med, 1993



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# Etiology of the Subtle Cavus Foot

Mild malalignment on the spectrum of normal

Aberrant anatomy of

Calcaneus

1<sup>st</sup> ray

Overactive peroneus longus

Tarsal coalition

Malunion of fractures

Sequela of compartment syndrome

Idiopathic

# History

Recurrent ankle instability

Lateral column pain or fractures

Peroneal tendon subluxation or tendinopathy

Heel or forefoot pain

Cumulative stresses presenting later in life

# Examination

“Peek-a-boo” sign

Achilles or gastrocnemius contracture

Coleman block test

Callosities on the plantar surface of the foot

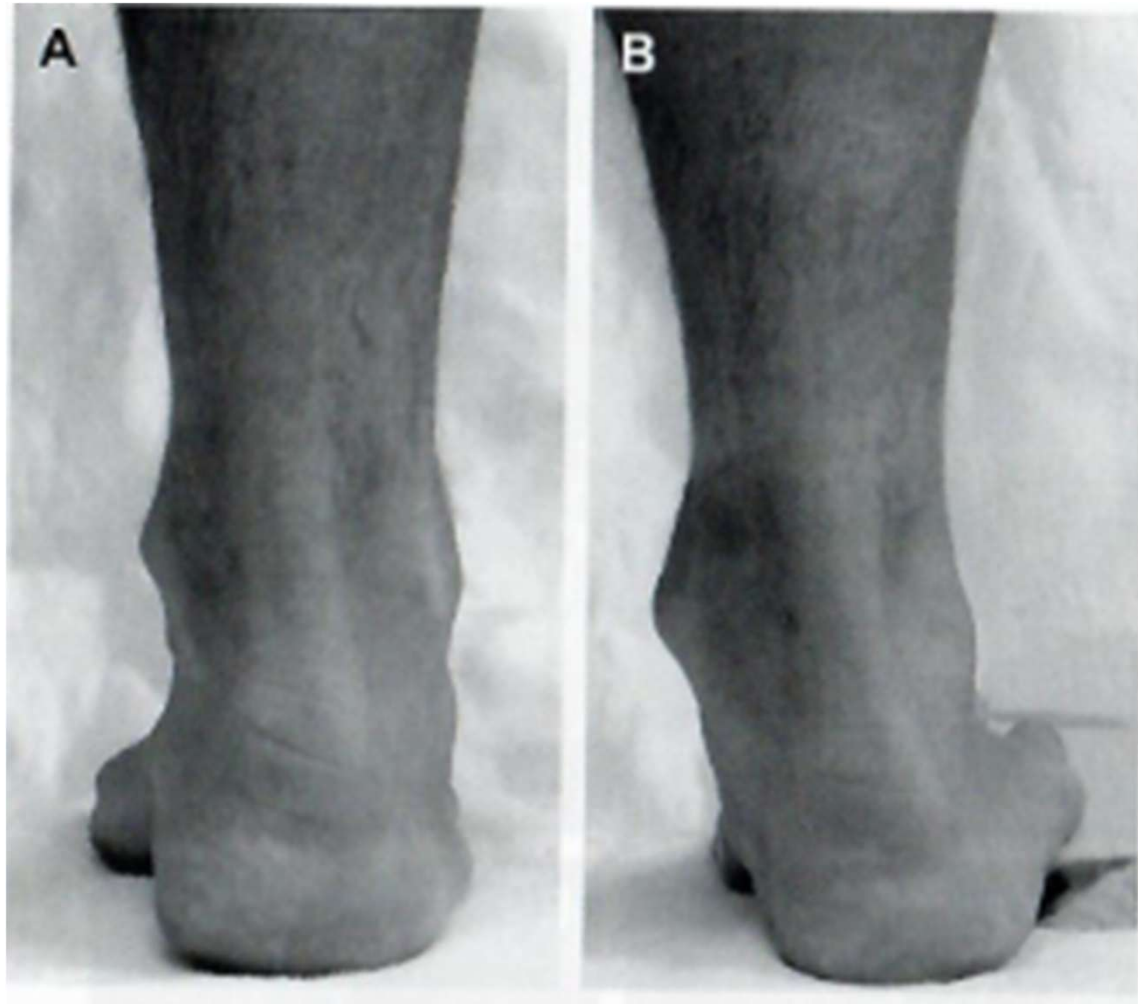
Torsional deformities of the lower extremities



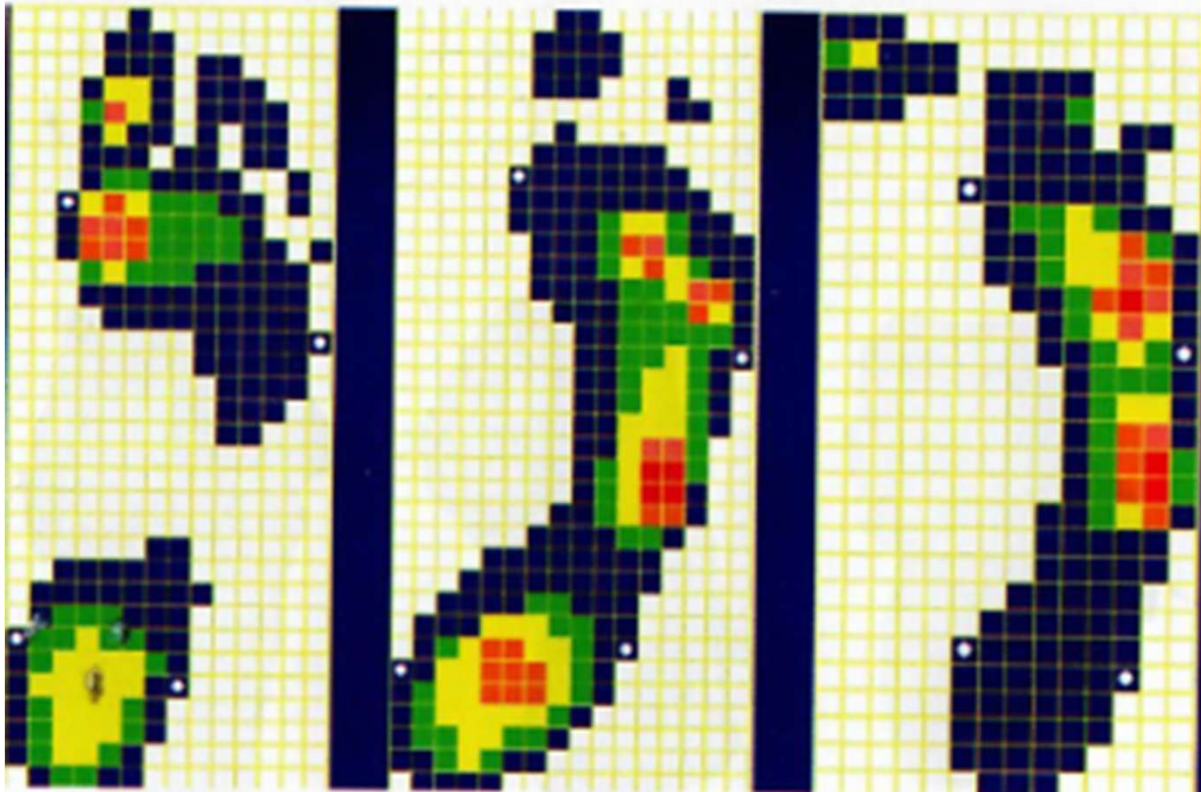
Peek-a-boo sign



# Coleman Block Test



# Plantar Pressures



# Non Operative Treatment

Cavus foot orthotics

1<sup>st</sup> ray depression, heel elevation and/or valgus heel posting

Custom orthotics are better than sham orthotics.

Burns J et al

Podiatric Med Assoc, 2006

J Am

Running shoes for cavus feet reduced peak plantar pressures.

Ascics Nimbus VI

Brooks Glycerin 3

Wegener C et al

Sports Med, 2008

Orthotics improve symptoms of ankle instability.

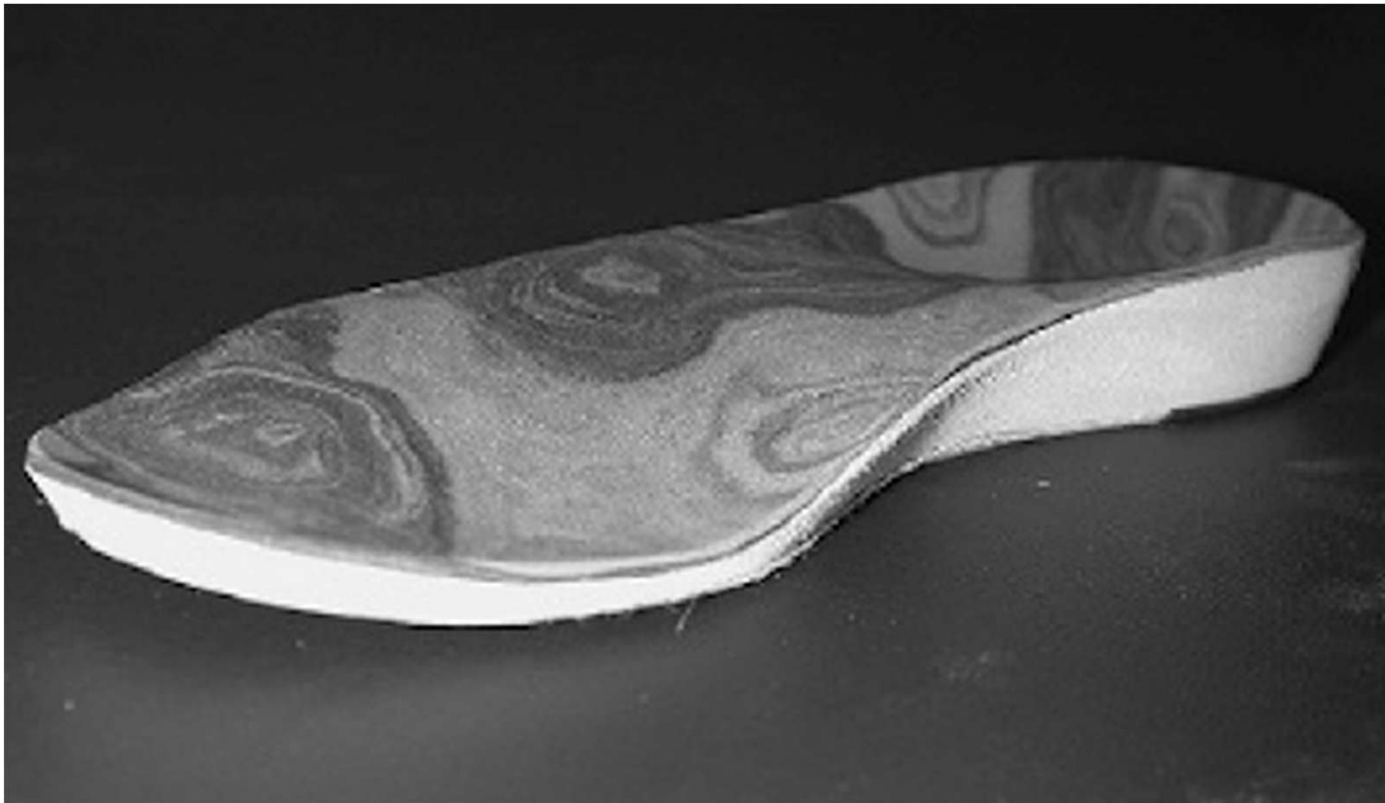
Am J

Piccolo M et al

Surg Orthop Adv, 2010

Lo

# Cavus Foot Orthotic





# Surgical Treatment

Usually indicated for the complications of the deformity

Stepwise correction process with many options

In adults there is usually a forefoot and hindfoot component.

If patients elect not to address the deformity, they will require custom orthotics post operatively.

# Surgical Options

Gastrocnemius or Achilles lengthening

Peroneus Longus to Peroneus Brevis tendon transfer

Plantar Fascia release or Steindler Stripping

Lateralizing Calcaneal Osteotomy

Dorsiflexion First Metatarsal Osteotomy

# Surgical Options

Gastrocnemius or Achilles lengthening  
Reduces forefoot pressure

Peroneus Longus to Peroneus Brevis tendon transfer  
Eliminates a deforming force

Plantar Fascia release or Steindler Stripping  
Relaxes the arch

Lateralizing Calcaneal Osteotomy  
Corrects heel varus

Dorsiflexion First Metatarsal Osteotomy  
Reduces forefoot varus moment

# Complications of Osteotomies

## First Metatarsal Osteotomy

Non union

Transfer metatarsalgia

## Calcaneal Osteotomy

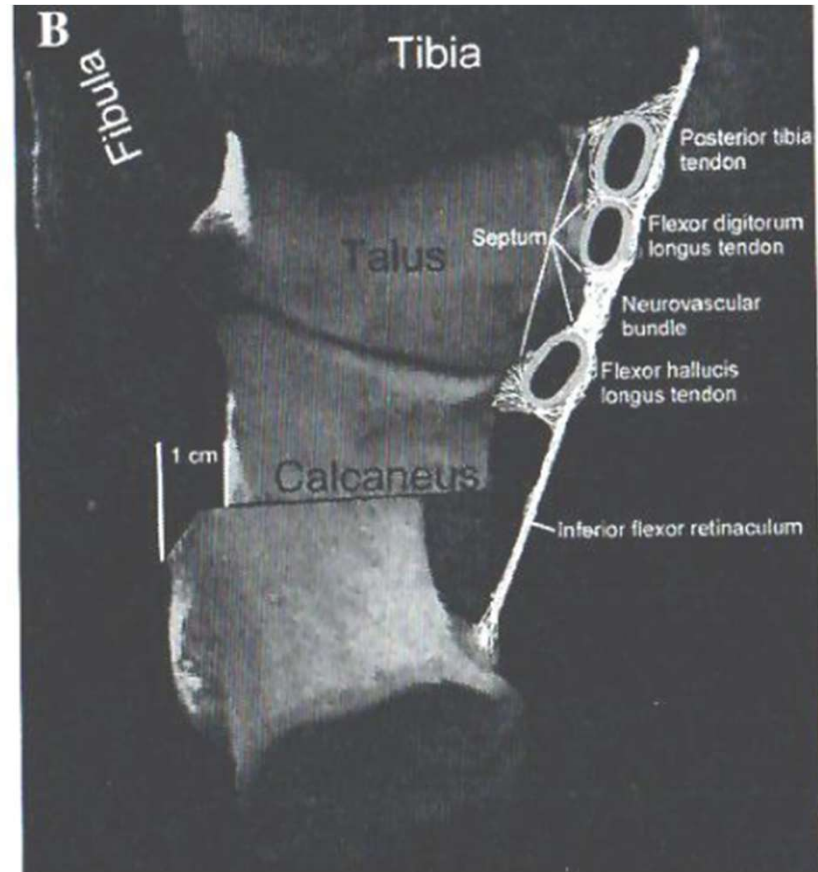
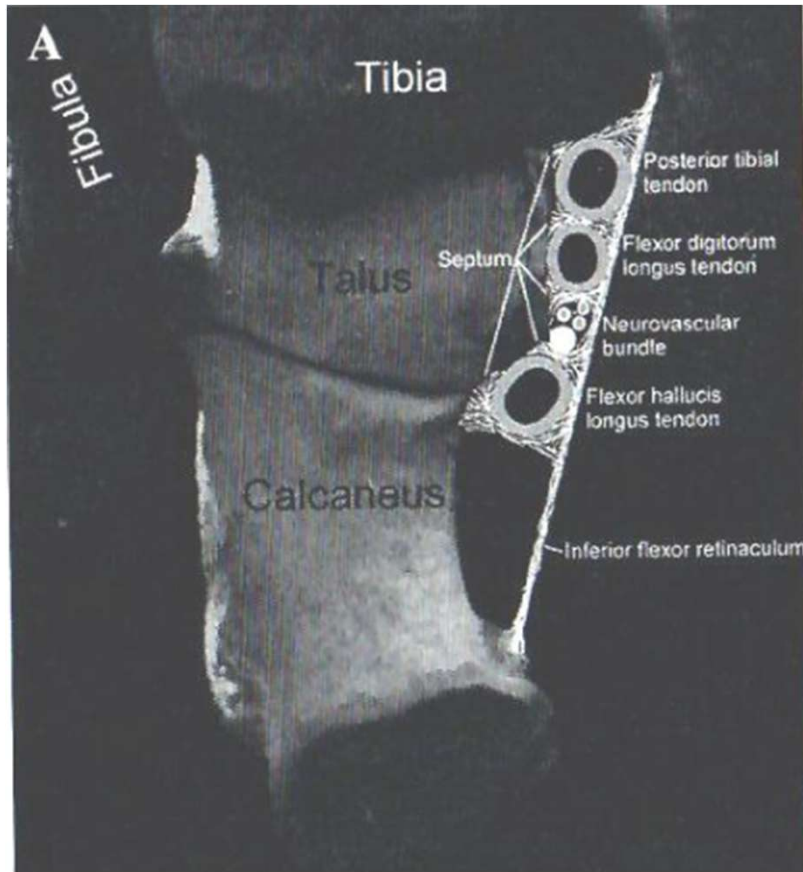
Tarsal tunnel syndrome

Lateral plantar nerve injury

Crossing posterior tibial artery branch

Sural nerve injury

# Tibial Nerve Palsy



# The modified Dwyer osteotomy produces the most lateral displacement



Cody A et al  
FAI 2018

# SURGICAL TREATMENT OF ADULT IDIOPATHIC CAVUS FOOT WITH PLANTAR FASCIOTOMY, NAVICULOCUNEIFORM ARTHRODESIS, AND CUBOID OSTEOTOMY

A REVIEW OF THIRTY-NINE CASES

BY SANDRO GIANNINI, MD, FRANCESCO CECCARELLI, MD,  
MARIA GRAZIA BENEDETTI, MD, CESARE FALDINI, MD, AND GIANLUCA GRANDI, MD

JBJS 2002

69 feet in 39 patients

## Results

Excellent 23 feet (33%)

Good 27 feet (39%)  
dehiscences

Fair 17 feet (25%)

Poor 2 feet (3%)

Complications 2 non unions

4 wound

## Pre Op

Ankle dorsiflexion -5.5°

Ankle plantar flexion 42°

Heel varus 6°

## Post Op

9°

31°

2° valgus

## Surgical Management and Treatment Algorithm for the Subtle Cavovarus Foot

Michael P. Maskill, DPM; John D. Maskill, MD; Gregory C. Pomeroy, MD  
Portage, MI

**Table 1: Procedures Performed**

Procedure	# of Feet	% Patients
Lateral displacement calcaneus osteotomy	29	100%
Peroneus longus to peroneus brevis transfer	25	86%
Dorsiflexion first metatarsal osteotomy	25	86%
Percutaneous tendo-achilles lengthening	8	28%
Gastrocnemius recession	5	17%
*Peroneal tendon repair	9	31%
*Ankle ligament reconstruction	5	17%



## Surgical Management and Treatment Algorithm for the Subtle Cavovarus Foot

Michael P. Maskill, DPM; John D. Maskill, MD; Gregory C. Pomeroy, MD  
*Portage, MI*

### Results

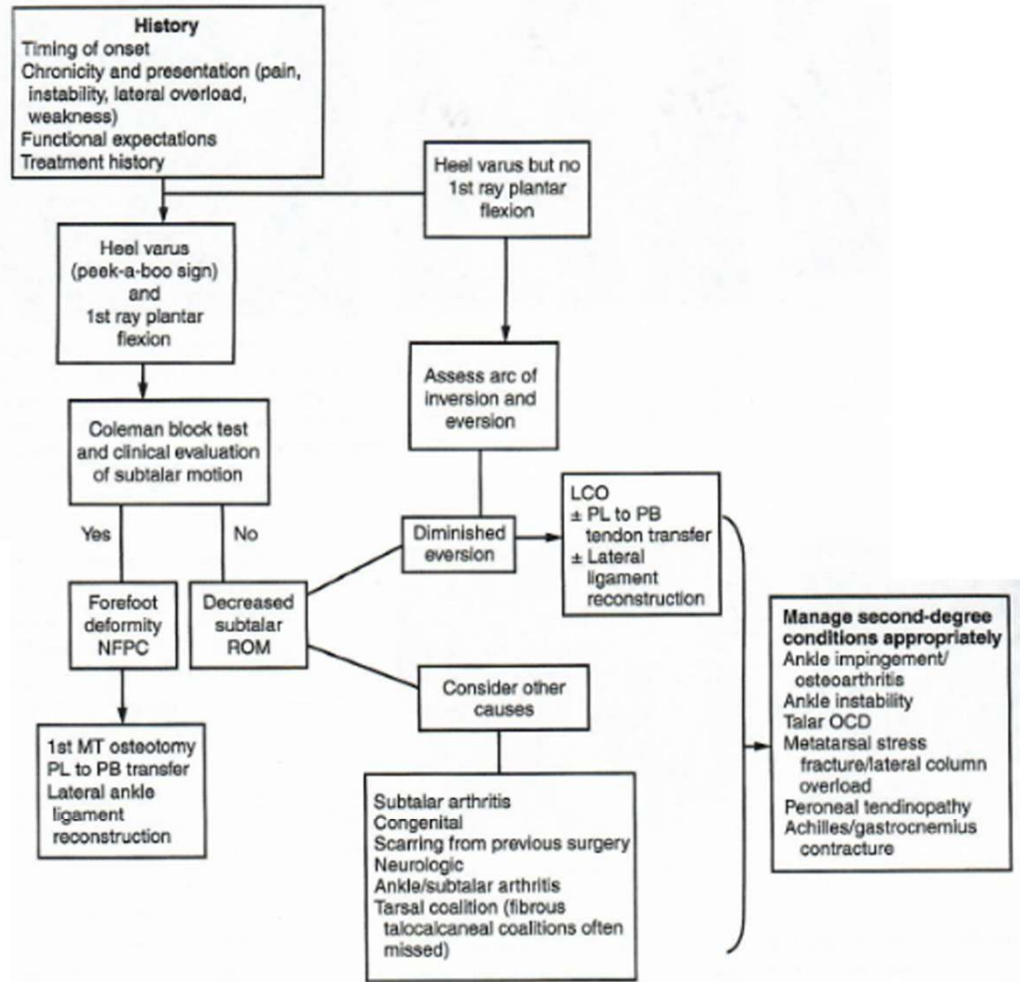
AOFAS ankle hindfoot score improved from 45 to 90.

Medial cuneiform to floor height changed from 3.5 cm to 3.0cm.

Talo-first metatarsal angle improved 7.5°.

no required hardware removal.

No non unions.



“All men from Washington are liars”

Spotted Tail, Dakota war chief



# 25 yo man with recurrent 5<sup>th</sup> metatarsal fracture





# 25 yo man with recurrent 5<sup>th</sup> metatarsal fracture



# 57 yo woman with 2 yrs of lateral ankle pain



# 57 yo woman with 2 yrs of lateral ankle pain





“The country (above the Rio Grande) should be given back to Nature and the Indians.” - Report of the inspector general, the Marqués de Rubí

“If I owned both Texas and Hell, I would rent out Texas and live in Hell.”  
- General Philip

Sheridan





42 yo veteran with ankle instability following multiple sprains.  
Hindfoot and forefoot driven cavus.



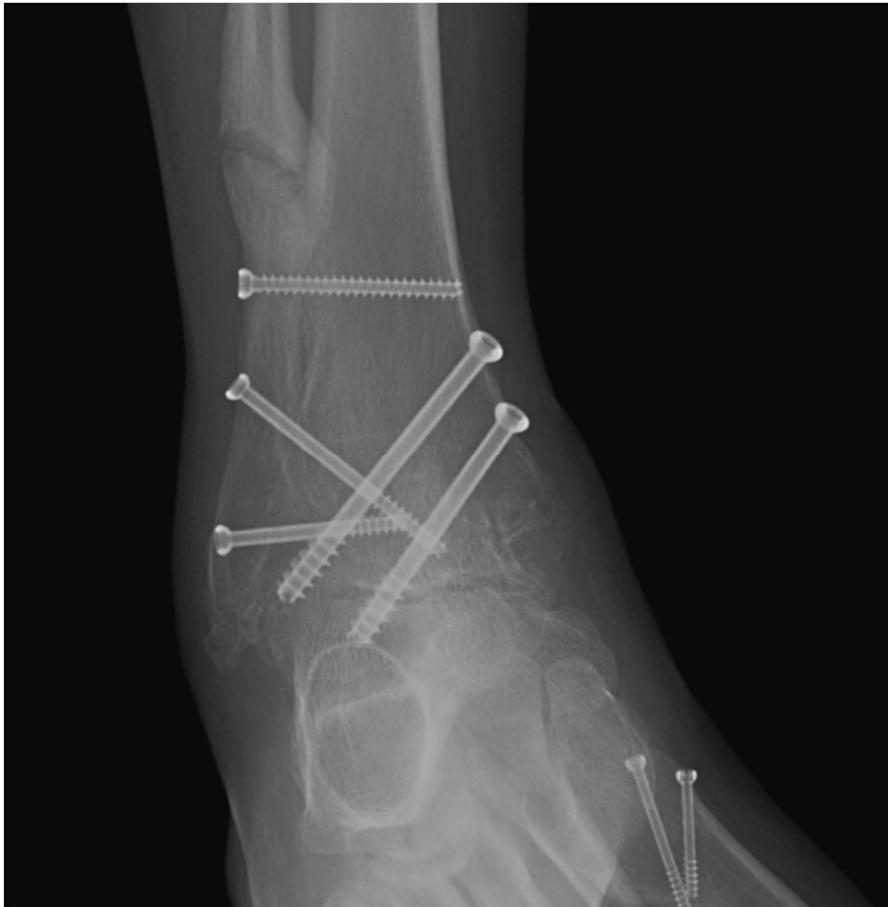
42 yo veteran with ankle instability following multiple sprains.  
Hindfoot and forefoot driven cavus.



38 yo veteran with bilateral end stage ankle arthritis and forefoot driven cavus



38 yo veteran with bilateral end stage ankle arthritis and forefoot driven cavus



# Conclusion

The subtle cavus foot is a variation of normal. Late complications of the deformity usually bring it to attention. Non operative and operative solutions are based on addressing the presenting symptoms and correcting the deformity. Current recommendations are based at best on level III evidence. More research is needed to determine the most appropriate treatment approaches.



# The End

