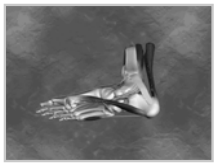
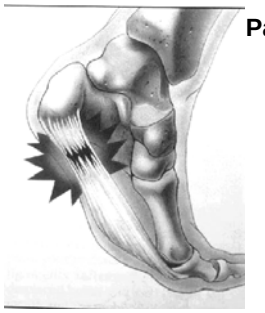
TREATING SUBCALCANEAL PAIN: Who gets the best outcomes?



DOUGLAS H. RICHIE, JR., D.P.M.
Seal Beach, California

Points of Confusion



Pathomechanics of Plantar Fascia overload:

- **Foot Pronation**
- **STJ Pronation**
- **MTJ Pronation**
- ***Longitudinal axis***
- ***Oblique axis***
- **1st Ray movement**
- **Arch Flattening**

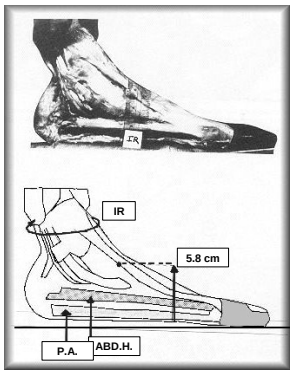


Fig. 15. Anatomic preparation of the foot with the plantar structures in view. Internal rotation is applied to the tibiotalar column and the foot is maintained in the plantigrade position. The height of the medial longitudinal arch measures 5.8 cm. It is lower as compared with a high arch situation measuring 7 cm. In the same specimen. The plantar aponeurosis (PA) and the abductor hallucis muscle (ABDH) are seen under tension. They are not undulant.

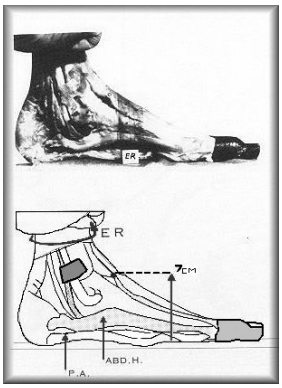


Fig. 12. Anatomic preparation of the foot with the plantar structures in view. External rotation is applied to the tibiotalar column and the foot is maintained in a plantigrade position. The height of the medial longitudinal arch measures 7 cm. It has increased as compared with a low arch situation measuring 5.8 cm in the same specimen. The plantar aponeurosis (PA) and the abductor hallucis muscle (ABD.H.) are seen relaxed and undulant.

PLANTAR FASCIITIS

Pronation of Subtalar Joint :

- **Cannot by itself cause strain of PF**
- **Can only influence PF thru MTJ**

- **84 Pts. Tx conservative for PF**
- **115 of 133 feet had MTJ supination on longitudinal axis (86%)**

Scherer et al: JAPMA 81:68, 1991

SUPP. OF MTJ LA

- **Everted Calc. past perpend.**
- **Flexible FF valgus**
- **Plantarflexed 1st Ray**

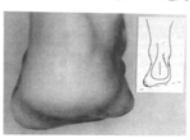


Figure 2. Type B, forefoot valgus.

Figure 3. Type C, plantarflexed first ray.

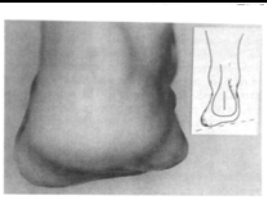


Figure 2. Type B, forefoot valgus.

Figure 3. Type C, plantarflexed first ray.

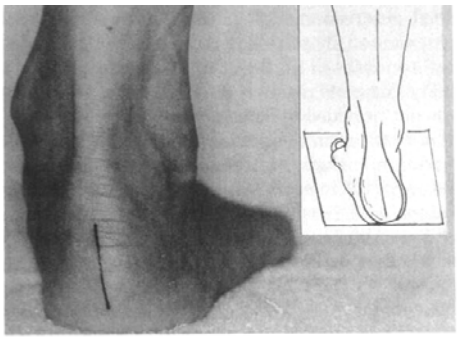
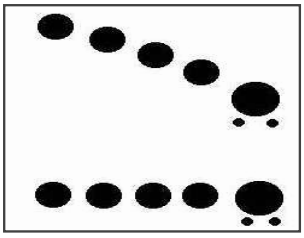


Figure 1. Type A, everted heel.

COMPENSATION FF VALGUS

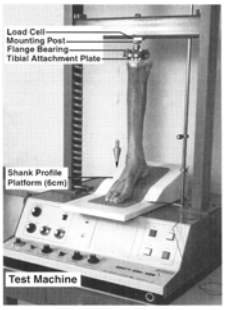
A.)

B.)



Elevate Heel?

- **12 cadaver limbs, static stance**
- **Strain transducer in central band PF**
- **2 load levels: 337 N, 450N**
- **Heel Heights 2.0, 4.0, 6.0 cm**
- **Blocks: No significant difference in p.f. strain**
- **Shank contour platforms: sig. Decrease in p.f. Strain with elevation ($p < 0.05$)**



Kogler G.F., Veer F.B., Verhulst S.J., et. al. "The effect of heel elevation on strain within the plantar apneurosis: In Vitro Study." Foot and Ankle 22:433-439, 2001.

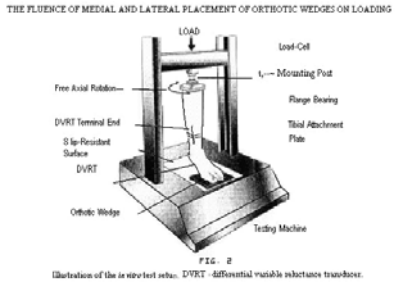
Foot types with a "normal" arch do not have any medial tarsal bone contact with the shank profile interface. Therefore, structural repositioning of the foot most likely occurs from lateral skeletal segments that touch the shank profile surface. This suggests that an extended support zone, from just under the calcaneus to the cuboid, decreases the medial truss-like action of the foot by permitting the metatarsals to plantarflex slightly.

Kogler G.F., Veer F.B., Verhulst S.J., et. al. "The effect of heel elevation on strain within the plantar apneurosis: In Vitro Study." Foot and Ankle 22:433-439, 2001.

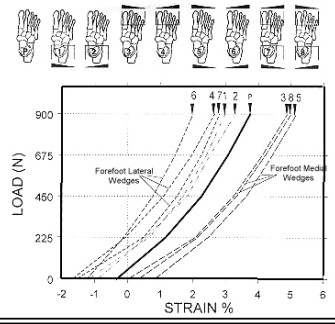
In-Vitro Study

- **Nine fresh frozen specimens**
- **Axial load in static stance 225-900N**
- **6 degree wedges: Medial & Lateral, RF & FF**
- **Strain in plantar fascia measured with reluctance transducer**

Kogler GF, Veer FB, Solomonidis SE, Paul JP: The influence of medial and lateral placement of orthotic wedges on loading of the plantar aponeurosis. Journal Bone Joint Surgery 81-A:1403, 1999



Kogler GF, Veer FB, Solomonidis SE, Paul JP: The influence of medial and lateral placement of orthotic wedges on loading of the plantar aponeurosis. Journal Bone Joint Surgery 81-A:1403, 1999



Kogler GF, Veer FB, Solomonidis SE, Paul JP: The influence of medial and lateral placement of orthotic wedges on loading of the plantar aponeurosis. Journal Bone Joint Surgery 81-A:1403, 1999

Plantar Fascia Strain

Wedge under <u>lateral</u> forefoot decreased strain (p<0.05)

Wedge under <u>medial</u> forefoot increased strain (p<0.05)

Rearfoot wedges had no significant effect

Kogler GF, Veer FB, Solomonidis SE, Paul JP: The influence of medial and lateral placement of orthotic wedges on loading of the plantar aponeurosis. Journal Bone Joint Surgery 81-A:1403, 1999

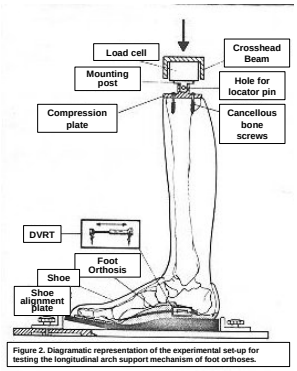


Figure 2. Diagramatic representation of the experimental set-up for testing the longitudinal arch support mechanism of foot orthoses.

Kogler GF, Veer FB, Solomonidis SE, Paul JP: Biomechanics of longitudinal arch support mechanisms in foot orthoses and their effect on plantar aponeurosis strain. Clinical Biomech 11:243, 1996

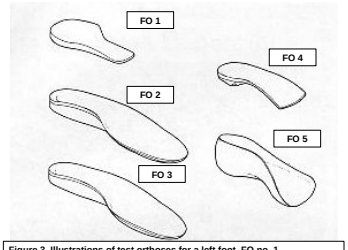


Figure 3. Illustrations of test orthoses for a left foot. FO no. 1, prefabricated stock orthosis; FO no2, custom viscoelastic orthosis; FO no. 3, custom semi-rigid orthosis; FO no. 4, custom rigid functional orthosis; FO no. 5, custom rigid UC-BL shoe insert

Plantar Fascia Strain

Effect of shoe inserts:

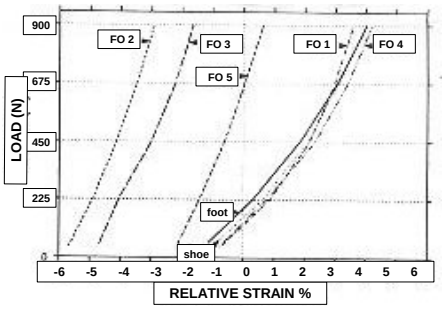
3 devices significantly reduced strain:

1.) UCBL
2.) Viscoelastic footbed
3.) Cork & rubber footbed

2 devices did not reduce strain:

1.) Custom rigid functional foot orthosis
2.) Pre-fabricated stock orthosis

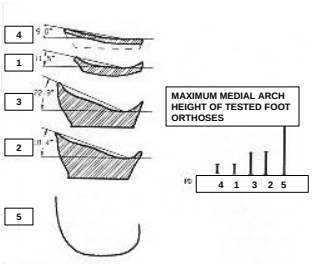
Kogler GF, Veer FB, Solomonidis SE, Paul JP: Biomechanics of longitudinal arch support mechanisms in foot orthoses and their effect on plantar aponeurosis strain. Clinical Biomech 11:243, 1996



Kogler GF, Veer FB, Solomonidis SE, Paul JP: Biomechanics of longitudinal arch support mechanisms in foot orthoses and their effect on plantar aponeurosis strain. Clinical Biomech 11:243, 1996

"One of the distinguishing features of the orthoses which decreased plantar aponeurosis strain was the surface contours of their medial and central regions and the angles related to their arch shape were more acute."

Kogler GF, Veer FB, Solomonidis SE, Paul JP: Biomechanics of longitudinal arch support mechanisms in foot orthoses and their effect on plantar aponeurosis strain. Clinical Biomech 11:243, 1996

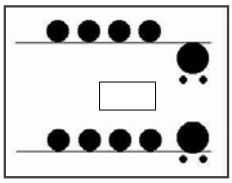


Kogler GF, Veer FB, Solomonidis SE, Paul JP: Biomechanics of longitudinal arch support mechanisms in foot orthoses and their effect on plantar aponeurosis strain. Clinical Biomech 11:243, 1996

COMPENSATION PFFR

A.)

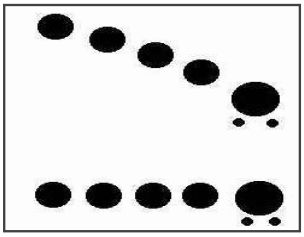
B.)

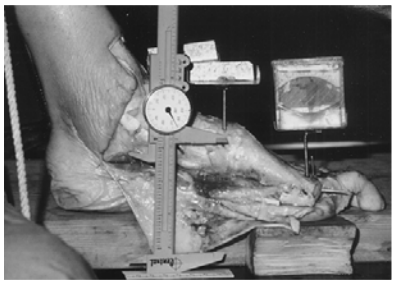


COMPENSATION FF VALGUS

A.)

B.)

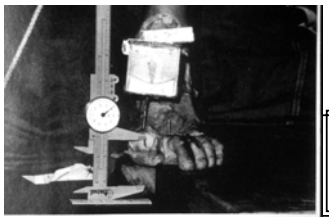




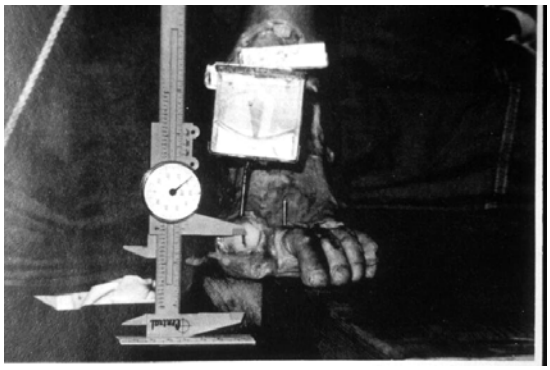
Medial view of first ray dissected free of skin and muscle attachments. Method of sagittal plane measurement is demonstrated showing calipers on pin in medial cuneiform and "Devil's Level" on platform on 1st metatarsal.

First Ray

- First Ray dorsiflexion preceeds MTJ supination about longt. axis.
- First Ray dorsiflexes and inverts.



Kelso SF, Richie DH, Cohen IR, Weed JH and Root M: Direction and range of motion of the first ray. JAPMA 72: 600, 1982



First Ray

Average total ROM = 12.38 mm

Total frontal plane motion = 8.23º

Sagittal / Frontal Ratio = 0.77º

Kelso SF, Richie DH, Cohen IR, Weed JH and Root M: Direction and range of motion of the first ray. JAPMA 72: 600, 1982

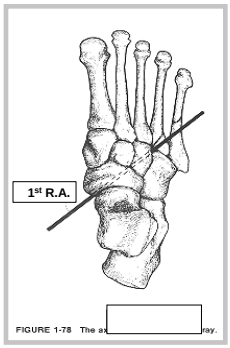
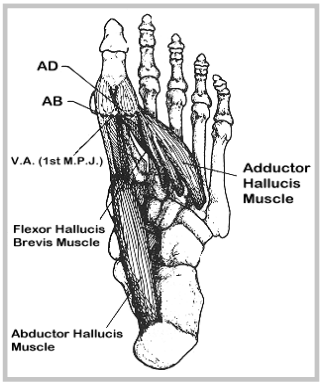
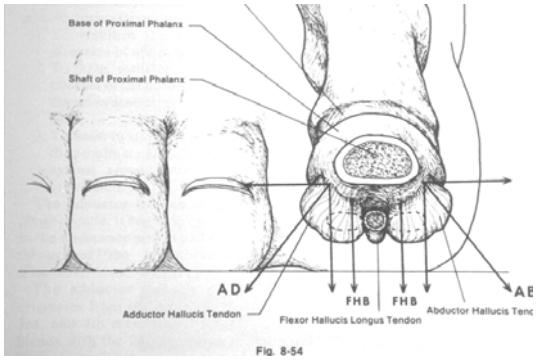
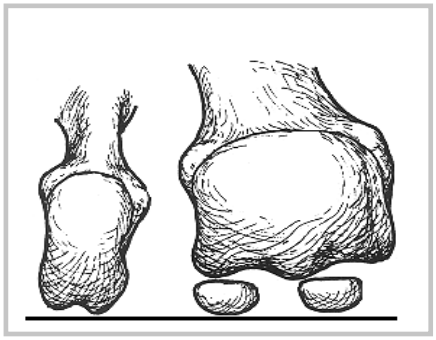


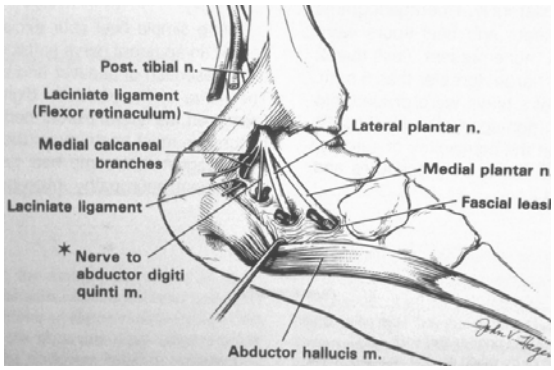
FIGURE 1-78 The ax ray.

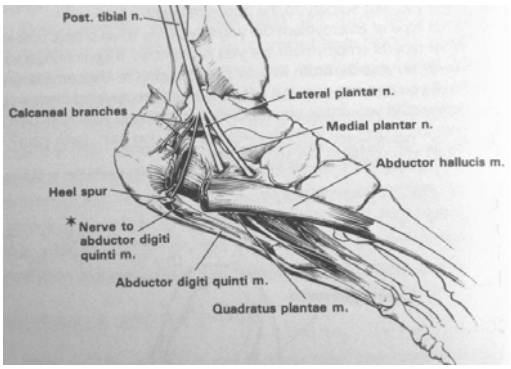
Figure 1-78 The axis of motion of the 1st ray.











Dynamic Gait

In terminal stance:

- **Foot inverts**
- **1st ray plantar flexes below 2-5**

  Due to: Peroneus longus
  Plantar intrinsics
  Windlass

First Ray Position

1. Same during gait vs. at rest?
2. Accurately depicted in neut susp cast?
3. Cast & orthotic modifications Based on activity?

Static Stance

- No windlass
- No plantar intrinsics
- No peroneus longus

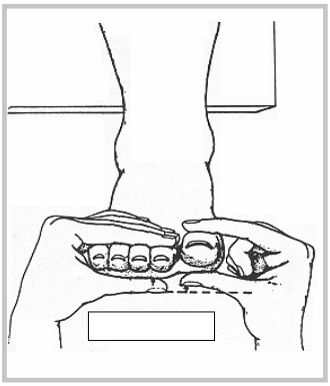
First Ray Position

Static stance

Plantar intrinsics and peroneus longus inactive

Position

1st ray dorsiflexed to at least level of 2nd Met or to end ROM



"Certain forms of treatment for the foot originated from the basis of thinking that only considers the foot as a static structure. Accommodative appliances and arch supports are typical examples of methods of treatment based upon static considerations. Such methods are relatively ineffective in comparison with methods designed to control function of the foot during kinetic stance."

Root, ML, Orien, WP, Weed, JH: Clinical Biomechanics: Normal and Abnormal Function of the Foot, Vol 2. Los Angeles, Clinical Biomechanics Corp, 1977.

"Static stance stability of the foot is of minor clinical significance. In most feet that function abnormally during kinetic conditions, the static stance periods are probably not very traumatic to the foot. Therefore, static stance can be considered to be clinically insignificant except in feet that are severely subluxed and pronated."

"Most symptomatology and trauma to the foot is occasioned by instability of the foot that primarily develops during kinetic function. Therefore, the foot should be clinically evaluated and treatment consideration should be based primarily upon kinetic requirements of the foot. Treatment based upon static considerations has usually failed to provide more than partial relief of symptoms and that relief may be only temporary."

Root, ML, Orien, WP, Weed, JH: Clinical Biomechanics: Normal and Abnormal Function of the Foot, Vol 2. Los Angeles, Clinical Biomechanics Corp, 1977.

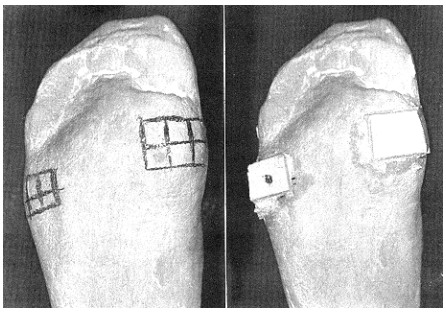


Figure A & B: A, Reference marking for intrinsic forefoot balancing during the positive cast correction technique. B, Reference and corrective platforms for intrinsic balancing of the positive cast.

First Ray Position

Static stance – with orthosis

1-5 valgus
2-5 varus

No PF of 1st Ray

AOFAS Study

Use of custom foot orthotics

	Rate of success
Standing less than 8 hrs. per day	85.7
Standing more than 8 hrs. per day	44.4

Pfeffer G et al: comparison of custom and prefabricated orthoses in the initial treatment of proximal plantar fasciitis. Foot & Ankle 20: 214, 1999

RELAXED STANCE

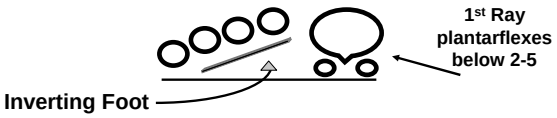
1. **Extrinsic foot muscles inactive**
2. **Arch integrity maintained solely by plantar fascia**

Basmajian, 1963
Huang, 1993
Reeser, 1983

Theory

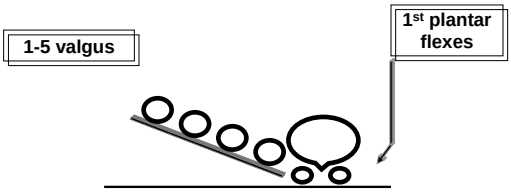
1. **The alignment of the First Ray is different in a neutral suspension cast position than it is in a weight bearing static stance position.**
2. **A functional foot orthosis (Root design) affects First Ray position differently in dynamic gait than during static stance.**

Dynamic Gait



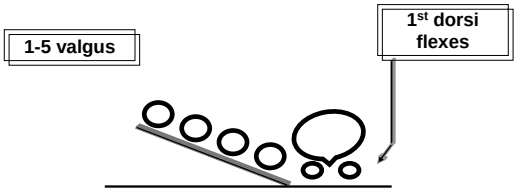
First Ray Position

Dynamic gait – with orthosis



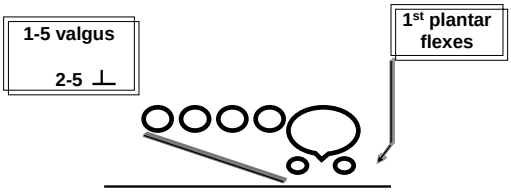
First Ray Position

Static stance – with orthosis



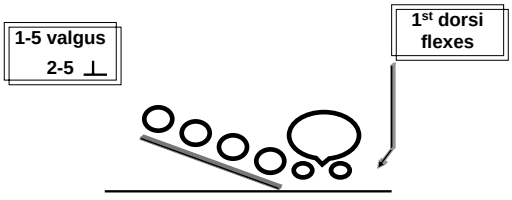
First Ray Position

Dynamic gait – with orthosis



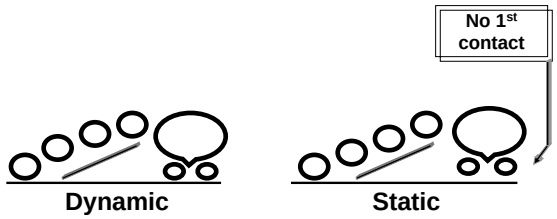
First Ray Position

Static stance – with orthosis



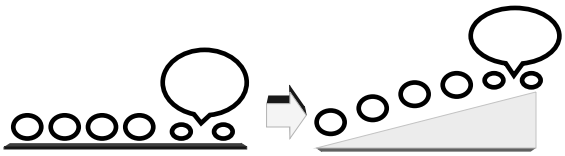
First Ray Position

1-5 varus : with orthosis



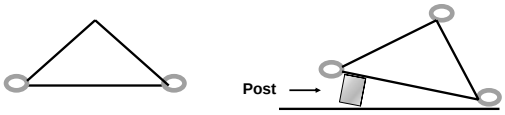
First Ray Overload

- **Orthosis too wide**
- **Supinated cast – "false FF Varus"**
- **FF Varus post with no true FF Varus**
- **2-5 varus with filler**



Adding a FF varus post when there is no FF varus

- **Post will push 1st met above 2 met**
- **1st ray overload**
- **Plantar fascia overload**

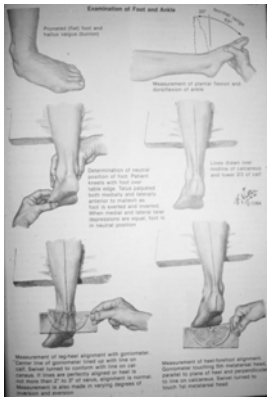


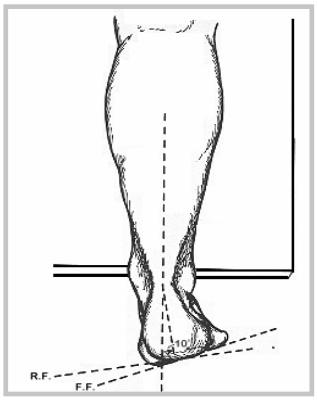
Plantar Heel Pain

Orthotic Treatment Proposal

Goal: Prevent dorsiflexion overload of First Ray

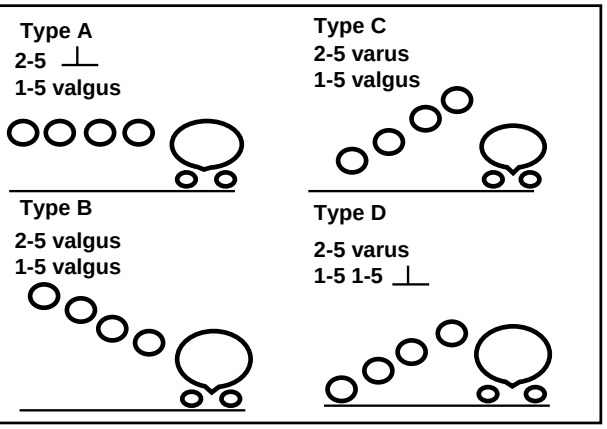
Strategy: Assure that the first metatarsal remains plantar to the plane of the lesser metatarsals during static stance and during gait





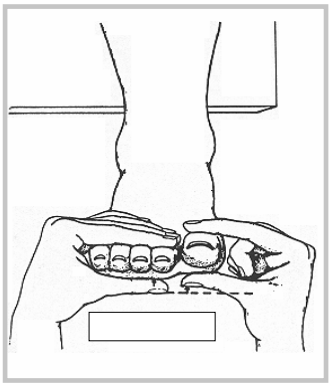
Step 1

- Neutral suspension cast position
- Subtalar neutral
- Load lateral column



Step 2

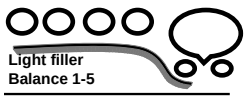
* Keep lateral column loaded
* Keep STJ in neutral
* Thumb under plane of 2-5
* Push up 1st metatarsal to end-ROM



I. Loaded Forefoot Valgus

CLASSIFICATION

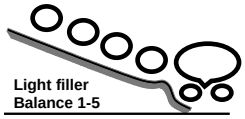
A 2-5 ⊥
1-5 valgus



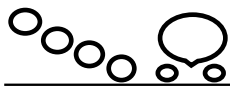
Push-up 1st

Remains a 1-5 valgus
1st Met end ROM

B 2-5 valgus
1-5 valgus



Push-up 1st

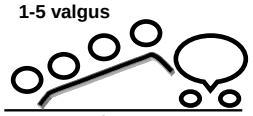


1st Met moves to 2nd

II. Loaded Forefoot Varus

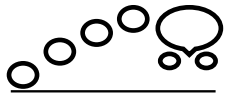
CLASSIFICATION

A 2-5 varus
1-5 valgus



Balance 2-5
1st cut out

Push-up
1st

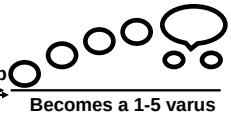


Becomes a 1-5 varus

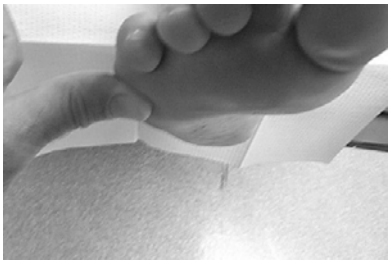
B 2-5 varus
1-5

Balance 2-5
1st cut out

Push-up
1st



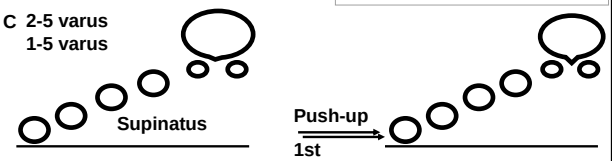
Becomes a 1-5 varus



II. Loaded Forefoot Varus

CLASSIFICATION

C 2-5 varus
1-5 varus



Solution

"The Seal Beach Protocol"

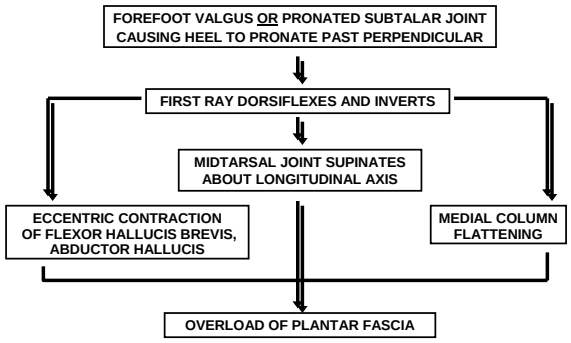
Orthotic Management of Subcalcaneal Pain

Loaded FF Varus ⟹	• Balance 2-5 • First Ray Cut Out
Loaded FF Valgus ⟹	• Balance 1-5 • Light filler between platform • No cut out

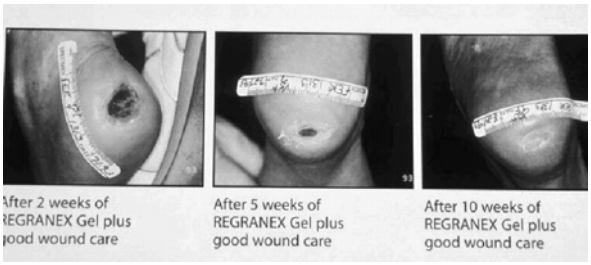
PROPOSED MECHANISM

1. 1st Ray dorsiflexes & inverts
2. MTJ supp. about long. axis
3. Eccentric cont. of abd. hallucis and FHB
4. Elongation strain of PF
5. Oblique MTJ pronation

MECHANISM OF PLANTAR FASCIAL OVERLOAD



Time Heals All Wounds…



Time Wounds All Heels…