FutureFeet

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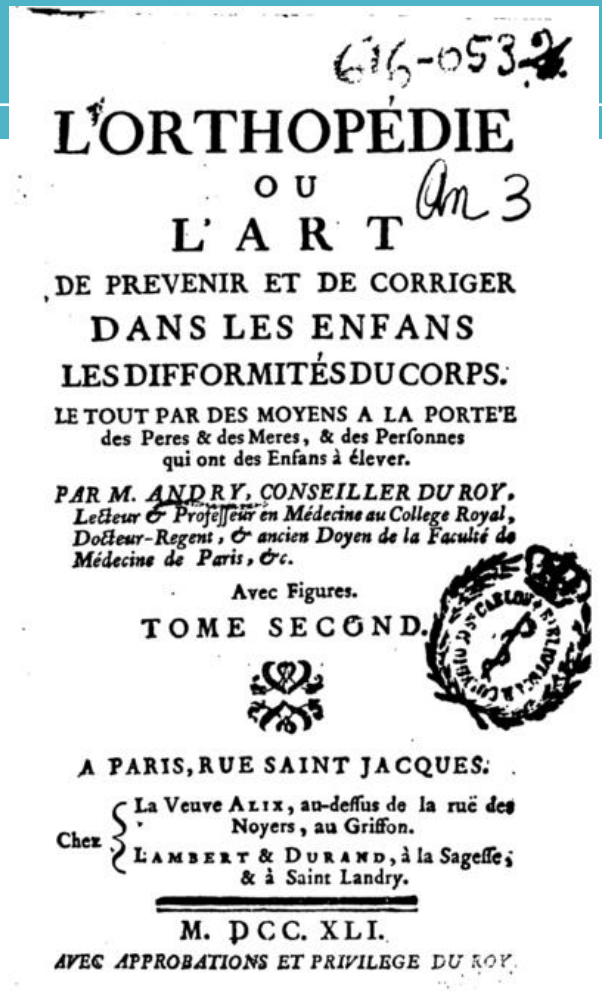
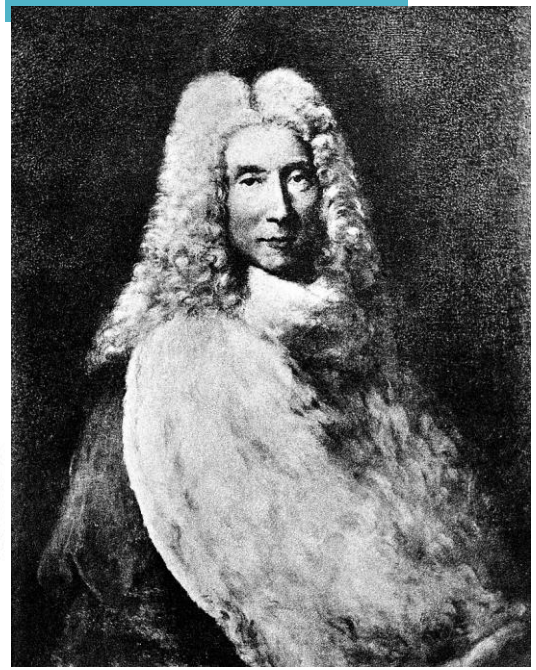
The evolution and history of the FO

Introduction

- The old documents say that a FO is: A corrective device which incorporates layers of wool inserted into sandals to relieve foot strain and fatigue. This gave the wearer a bit of extra cushioning which relieved the pain that comes with long-distance walking.
- **Nicolas Andry**, a French medical doctor (Lyon 1658–Paris 1742) who wrote the famous book "L'orthopedie" in 1741, which was soon after translated into English (1742) "Orthopaedia or the art of correcting and preventing deformities in children"


L'ORTHOPÉDIE
OU
L'ART
DE PREVENIR ET DE CORRIGER
DANS LES ENFANS
LES DIFFORMITÉS DU CORPS.
LE TOUT PAR DES MOYENS A LA PORTE'E des Peres & des Meres, & des Perſonnes qui ont des Enfans à élever.
PAR M. ANDRY, CONSEILLER DU ROY, Lecteur & Profeſſeur en Médecine au College Royal, Docteur-Regent, & ancien Doyen de la Faculté de Médecine de Paris, &c.
Avec Figures.
TOME SECOND.
A PARIS, RUE SAINT JACQUES.
Chez La Veuve ALIX, au-deſſus de la ruë des Noyers, au Griffon.
LAMBERT & DURAND, à la Sageſſe; & à Saint Landry.
M. DCC. XLI.
AVEC APPROBATIONS ET PRIVILEGE DU ROY.



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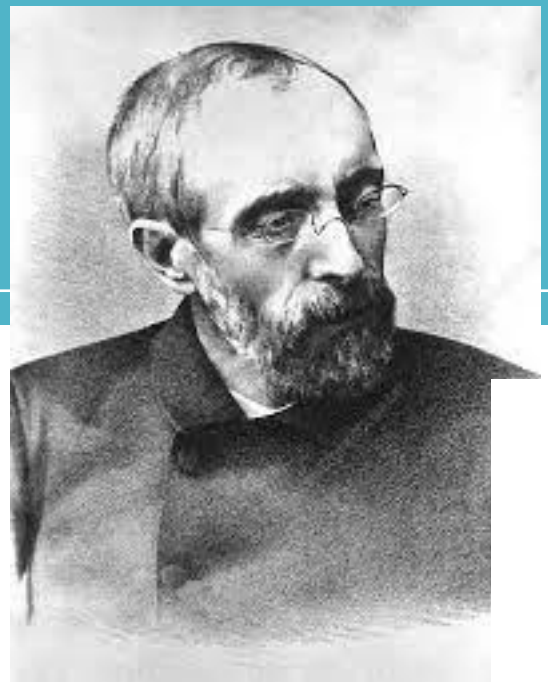
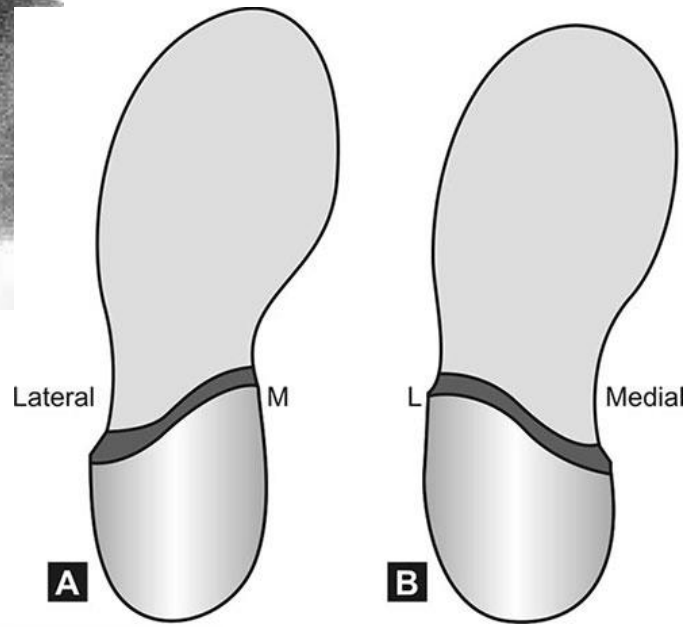
length

Introduction



- The first recorded use of an arch support was in 1865. In that year, a man named **Everett H. Dunbar** from Bridgewater, Massachusetts, relieved his foot pain located in the arch of his feet by inserting pieces of leather between the insoles of his shoes. He claimed that he felt an extra boost in his arch

- **Hugh Owen Thomas:** The 'Thomas heel' is a heel modification of a shoe for children with the following characteristics: one-half inch (12 mm) length and an eighth to a sixth of an inch (4 to 6 mm) height. It is used to change the raerfoot into a more varus position, and to prevent depression in the region of the head of the ankle bone



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Introduction

Newton M. Shaffer (1846-1928), a New York City orthopedist, first described high arched foot with multiple clawtoes

Became widely known as “Shaffer’s Foot”

Also designed a highmedial arched orthosis with a heel cup which became known as a “Shaffer Plate”

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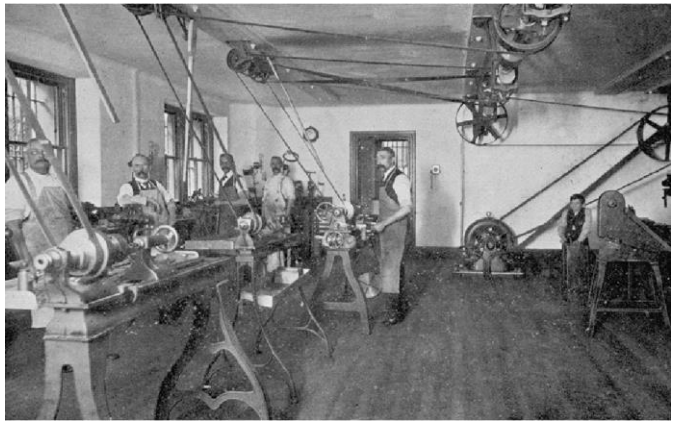
Royal Whitman

- Royal Whitman (1857-1946) was a 1882 Harvard Medical School graduate and New York City orthopedic surgeon that had a special interest in foot function
- He also wrote numerous textbooks on orthopedic surgery and taught orthopedics for 40 years

Fig. 2. Royal Whitman, M.D., was an Assistant Surgeon in the



Whitman R.: A study of the weak foot, with reference to its causes, its diagnosis, and its cure; with an analysis of a thousand cases of so-called flat-foot. J Bone Joint Surg Am. 1896;s-1-8:42–77.

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Whitman's "Weak Foot"

Whitman's description of "**weak foot**" very closely matches our current description of a pronated, flat-arched foot

Whitman's Three Grades of "Weak Foot"

1st Degree: The normal foot improperly used, as shown by the method of standing and walking

2nd Degree: The foot in which the range of voluntary motion is restricted, showing disuse of function, and in which the elements of deformity are apparent when weight is borne

3rd Degree: That in which the passive range of motion is restricted, or in which there are evident weakness and deformity. This limitation of motion depends, as a rule, on accommodative changes in structure to the habitual postures or to the deformity

Whitman R: A study of the weak foot, with reference to its causes, its diagnosis, and its cure; with an analysis thousand cases of so-called flat-foot. JBJS, 8:42-77, 1896.

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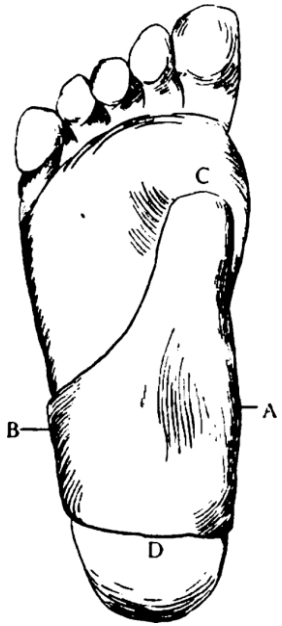
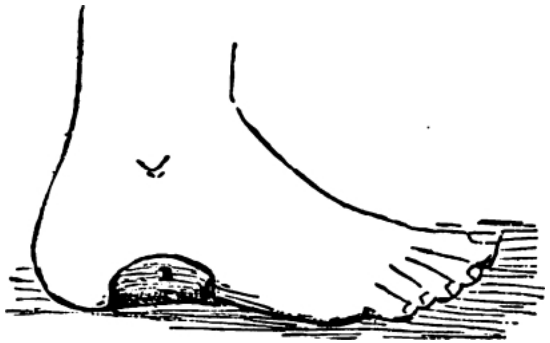
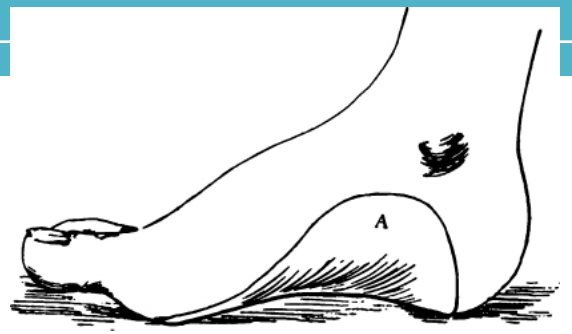
Whitman's Foot Brace





the external arm covers the calcaneocuboid and the outer aspect of the foot to a height sufficient to hold the foot securely



"It will be noticed that the brace clasps the weak part
of the foot and holds it together; the broad internal
upright portion covers and protects the astragaloscaphoid junction, rising well above the scaphoid

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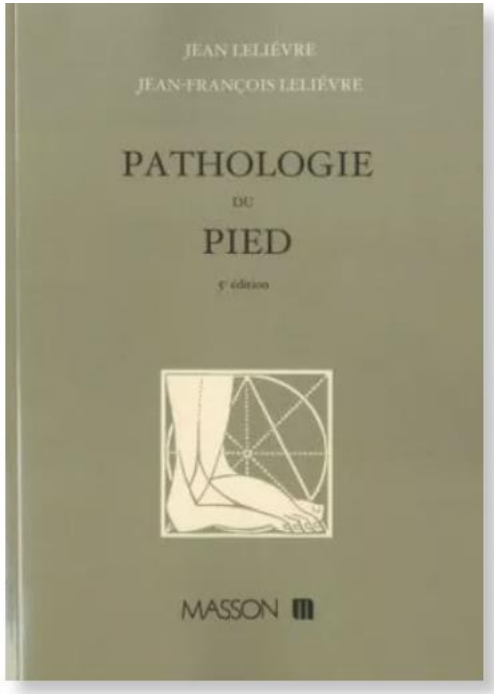
European FO Concept



Jean Leliévre (1914-1969).

Different wedges include in the sheet

1. Heel supination or pronation wedge
2. Medial Longitudinal Arch
3. Metatarsal bar
4. Metatarsal dome

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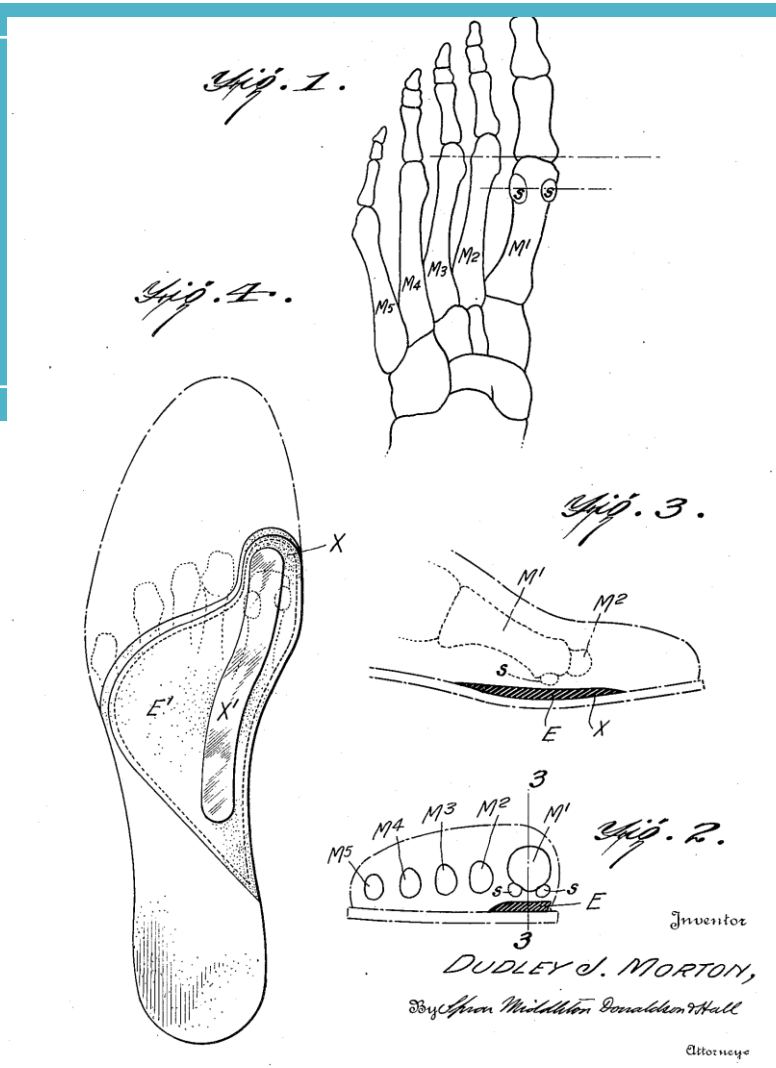
Dudley J. Morton

Morton's extension

The short, "hypermobile" first ray



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Dudley J. Morton

Dudley Joy Morton (1884-1960) was a physician, anatomist and anthropologist

His work focused on shortened 1st metatarsal, hypermobility of 1st metatarsal segment and correlation of 1st ray mechanics to excessive foot pronation

He published the book « The Human Foot, It's Evolution, Physiology and Functional Disorders », in 1935

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Morton's Compensating Insole

In the 1930s, Morton designed a "compensating insole" that focused on elevating the first metatarsal head and preventing pronation compensation for short, hypermobile first ray

Morton also designed an inshoe support with high medial arch, designed to resist pronation

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John H. Hicks

John H. Hicks (1915-1992), an orthopedic surgeon from Birmingham, UK, had great interest in and performed pioneering research in foot biomechanics

He wrote a series of classic scientific papers from 1953- 1961 on biomechanics of foot, plantar fascial function and biomechanics of balance

He also determined axes of motion of ankle joint, STJ, MTJ, 1st ray and 5th ray

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Negative model acquisition

Plaster bandage casting

Plaster of Paris bandage! Early pioneers had used direct measurements and “tracings” and “the last makers art”. Trays of grease and plaster were also used.

Reed E.N.: A simple method for making plaster casts of feet! The Journal of Bone & Joint Surgery. 1933; 17:1007

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Merton Louis Root

Merton L. Root (1922-2002) became interested in research as a WW II army paratrooper

After the war, he decided to pursue career in podiatry in 1948 after seeing the need for better research in podiatry

Graduated from California College of Chiropody in 1952

He started the world's first Department of Podiatric Biomechanics in 1966 at CCPM in San Francisco

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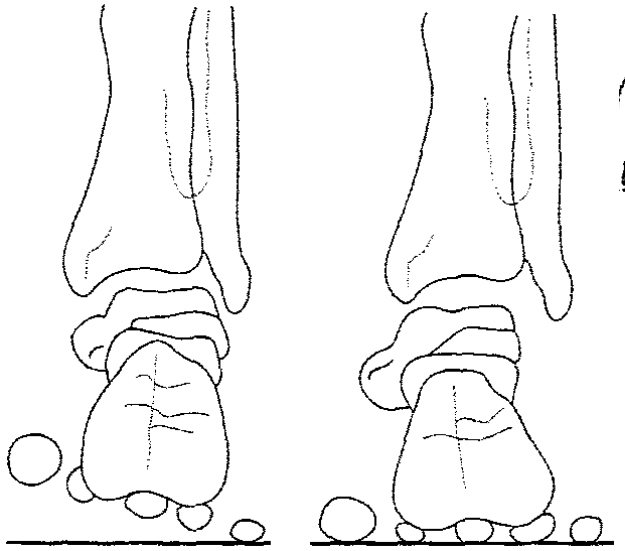
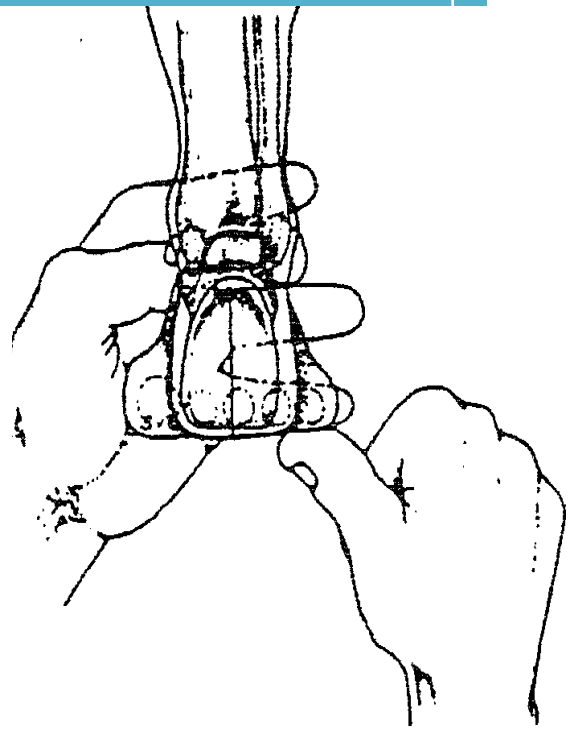
Root's "Deformities" Based on STJ Neutral

Root developed a biomechanical classification system based on the concept that STJ neutral is the ideal foot position during gait

Root classified "foot types" with frontal plane positions of rearfoot to tibia, forefoot to rearfoot, and first ray position relative to 1st -5th metatarsal





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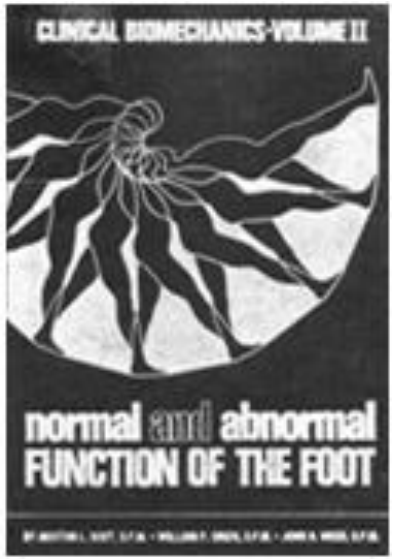
Normal and Abnormal Function of the Foot

Normal and Abnormal Function of the Foot, by Root, Orien and Weed in 1977, represented a giant leap forward for podiatric biomechanics

Classic textbook detailed normal and abnormal mechanics of foot and lower extremity, biomechanics of foot pathologies and how structure may predict function of foot and lower extremity



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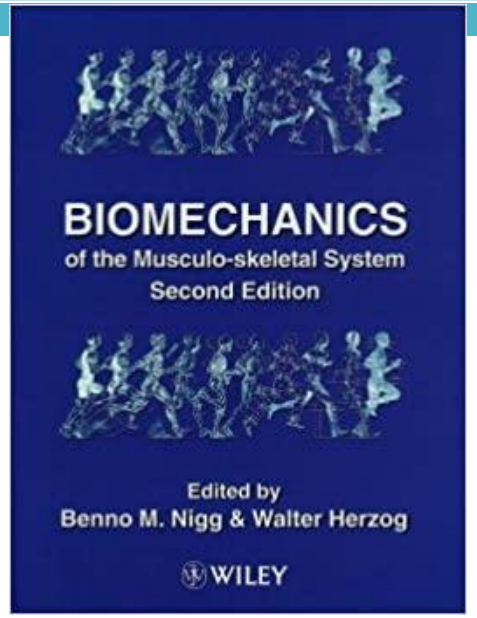
Benno M. Nigg

Benno Nigg, trained as nuclear physicist, he became interested in biomechanics in 1971

He founded and developed the world's largest biomechanics research facility at The University of Calgary in 1981

He has authored/edited 10 books and has authored 290 scientific papers on sports shoes and foot and lower extremity biomechanics



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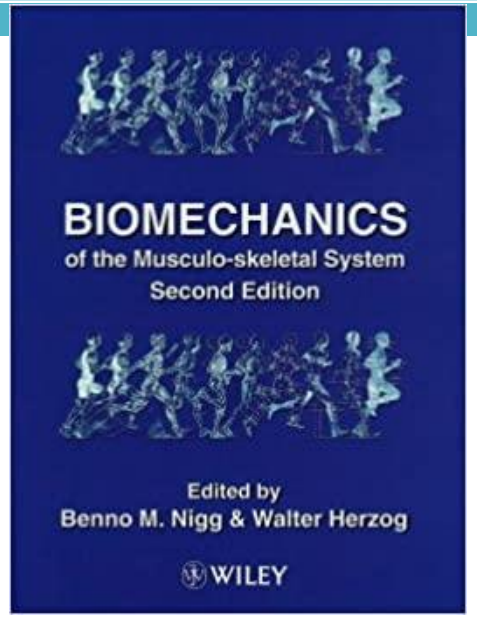
Benno M. Nigg

Nigg proposes that orthoses do not function by realigning skeleton but rather alter input signals to the plantar aspect of the foot which change “muscle tuning

Nigg BM: The role of impact forces and foo pronation: a new paradigm. Clin J Sport Med, 11:2-9, 2001.



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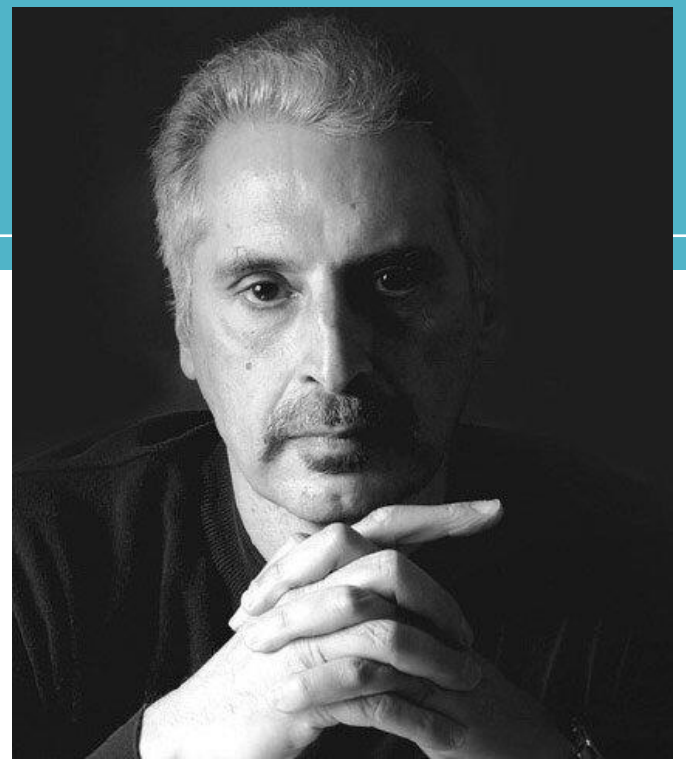
Howard J. Dananberg



Howard Dananberg popularized the concept that functional hallux limitus was key to abnormal foot function

FnHL was thought to produce “sagittal plane blockade“ during walking that caused pronation of the foot as a result

He patented “kinetic wedge” to address his theory of “sagital plane blockade”

Dananberg, HJ: Gait style as an etiology to chronic postural pain. Part I. Functional hallux limitus. JAPMA, 83:433-441, 1993.

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Sagittal Plane Blockade

Kinetic wedge functional forefoot extension

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Richard L. Blake

Dr. Blake developed his Blake Invertion Orthosis(BIO), he discovered that increasing levels of cast inversion increased pronation control from his inverted orthosis due to increased MLA height and inverted heel cup

However, as cast inversion approached 100 degrees, Dr. Blake noted new orthosis problems:

– Plantar fascial irritation

– The foot slid laterally off of orthosis plate

– Excessive orthosis arch height caused late midstance pronation, instead of late midstance supination, during walking

Blake R.L.: Inverted functional Orthoses JAPMA Vol 76, No. 5 p.275-276 1986

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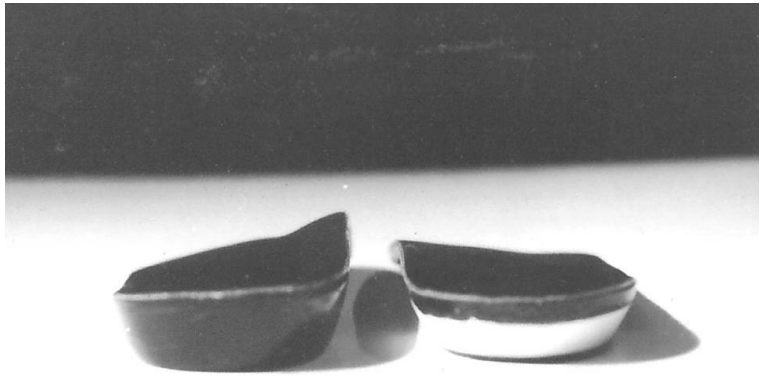
Blake Inverted Orthosis

Positive cast of BIO inverted 15, 25 or 35º which causes varus heel cup and makes a higher medial arch orthosis

Modified medial arch fill and plantar fascial accommodation are added to prevent plantar fascial irritation

Heel cups of 20 mm and flat rearfoot posts are standard



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Kevin Kirby

Written extensively on orthosis therapy

Invented several clinical tests

Invented the medial/ lateral heel skive

Developed theory of foot function-SALRE and

Tissue stress approach to biomechanical therapy of the foot and lower extremity

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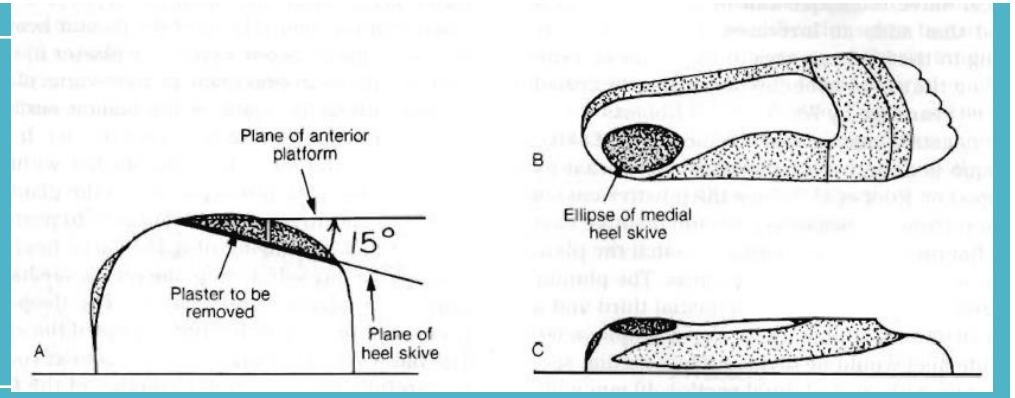
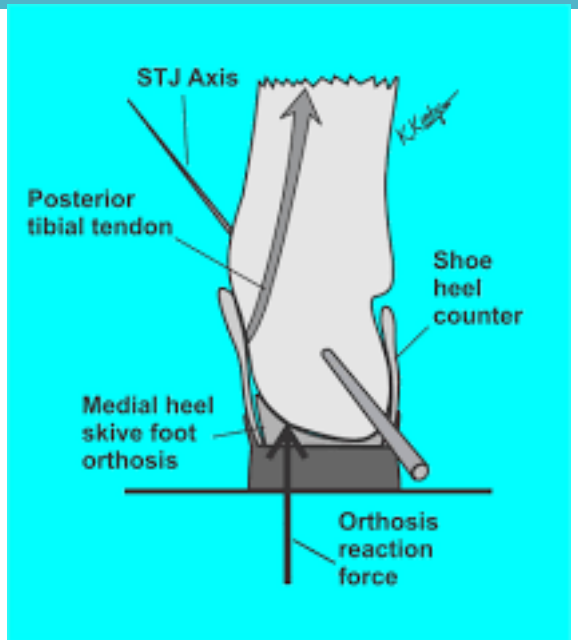
Heel Skive



The medial heel skive technique involves selectively removing small amounts of the medial portion of the plantar heel of the positive cast of the foot to create a unique varus wedging effect within the heel cup of the foot orthosis.

The resulting increase in supination moment across the subtalar joint axis of the foot clinically produces significantly improved pronation control on pediatric flexible flat feet, posterior tibial dysfunction, and other types of excessively pronated feet



Kirby K.A: The medial heel skive technique. Improving pronation control in foot orthoses JAPMA Vol 82, No. 4 p.177-188,1992!

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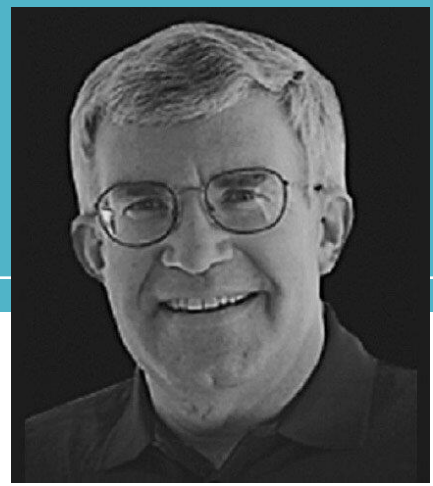
Tissue Stress Model



Tissue stress model first proposed as a model for mechanical foot therapy in 1995 by McPoil and Hunt

McPoil TG, Hunt GC: Evaluation and management of foot and ankle disorders: Present problems and future directions. JOSPT, 21:381-388, 1995.

The tissue stress model is not a novel idea since it is based on same ideas that are already in current use in treatment of parts of the body other than the foot and lower extremity

The tissue stress model doesn't rely on "unreliable measurement techniques

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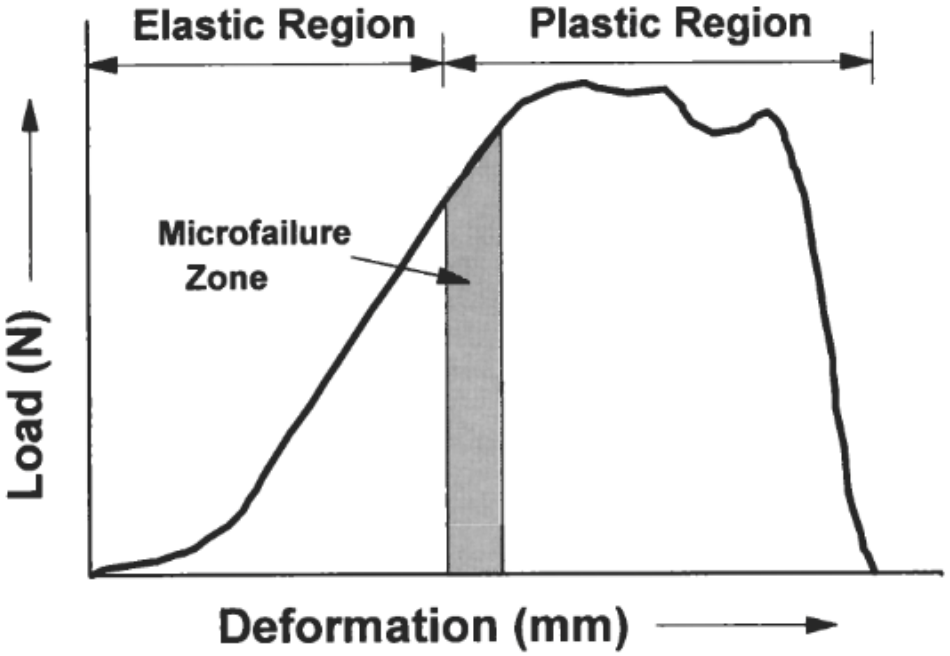
Tissue Stress Model

Soft tissues are not the usual cause of foot deformity but the result of being traumatized by forces greater than soft tissue can or was intended to resist.

The tissue stress model allows the clinician the flexibility to adapt their evaluation and treatment procedures based on the identification of those tissues which are inflamed or injured secondary to excessive mechanical loading

The tissue stress model can be explained by the load deformation curve which illustrates how body tissues can be damaged



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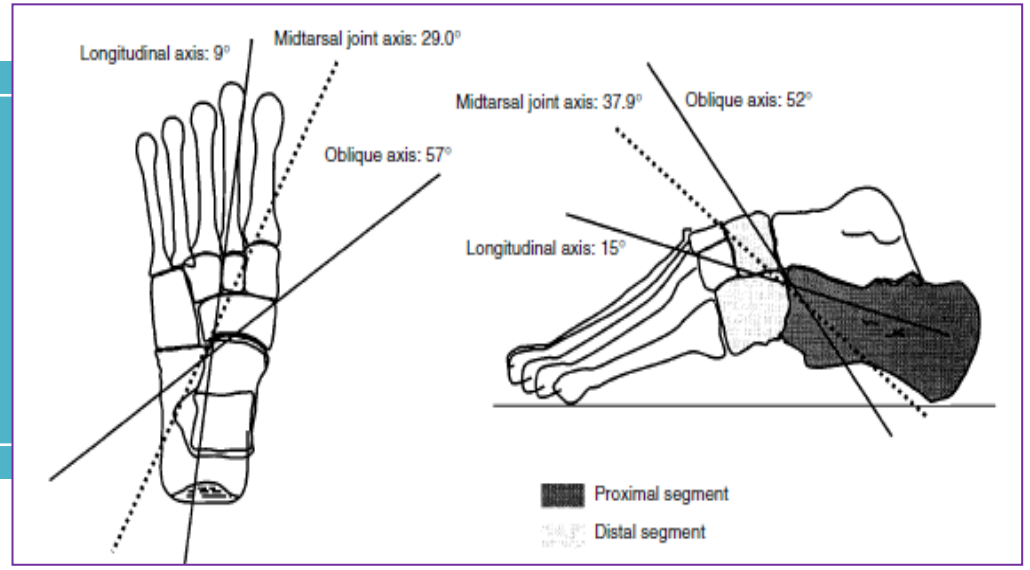
Chris Nester



Professor Nester and coworkers were the first to suggest that the previous model of simultaneously occurring oblique and longitudinal MTJ axes can not occur and should be replaced by a single moving MTJ axis

The simple concept described by Nester et al is very important for understanding MTJ biomechanics: “axes of rotation do not determine the motion at a joint; rather, the motion determines the axis

Nester C, Findlow A, Bowker P. Scientific approach to the axis of rotation of midtarsal joint. JAPMA,91(2):68-73,2001

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Chris Nester

The changes in ankle and subtalar kinematics in response to the foot orthosis contradict existing orthotic paradigms that assume that changes occur only at the subtalar joint.

The kinematic changes due to the orthosis are indicative of a strong interaction between the often common function of the ankle and subtalar joints

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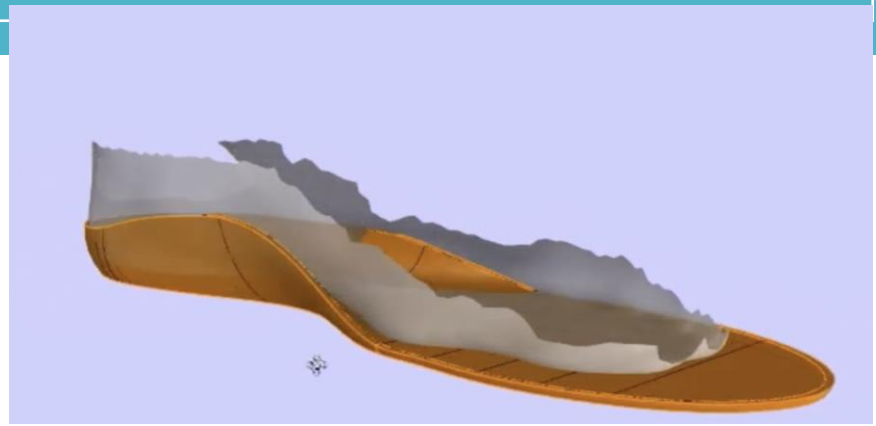
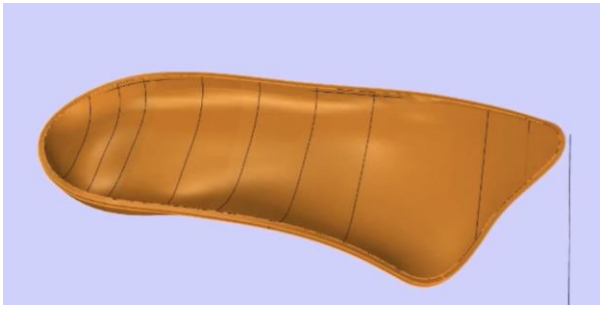
Orthotic design/ manufacture CAD/CAM

Positive cast manipulation CAD
Yet still orthotic designs are reflecting the designs which were, in part, restricted by the limitations of the manufacturing techniques available in the 1960's





Staats T.B., Kriechbaum B.A.: Computer Aided Design and Computer Aided Manufacturing of Foot Orthoses Journal of Prosthetics an Orthotics 1989 Vol. 1, Num. 3 pp. 182-186

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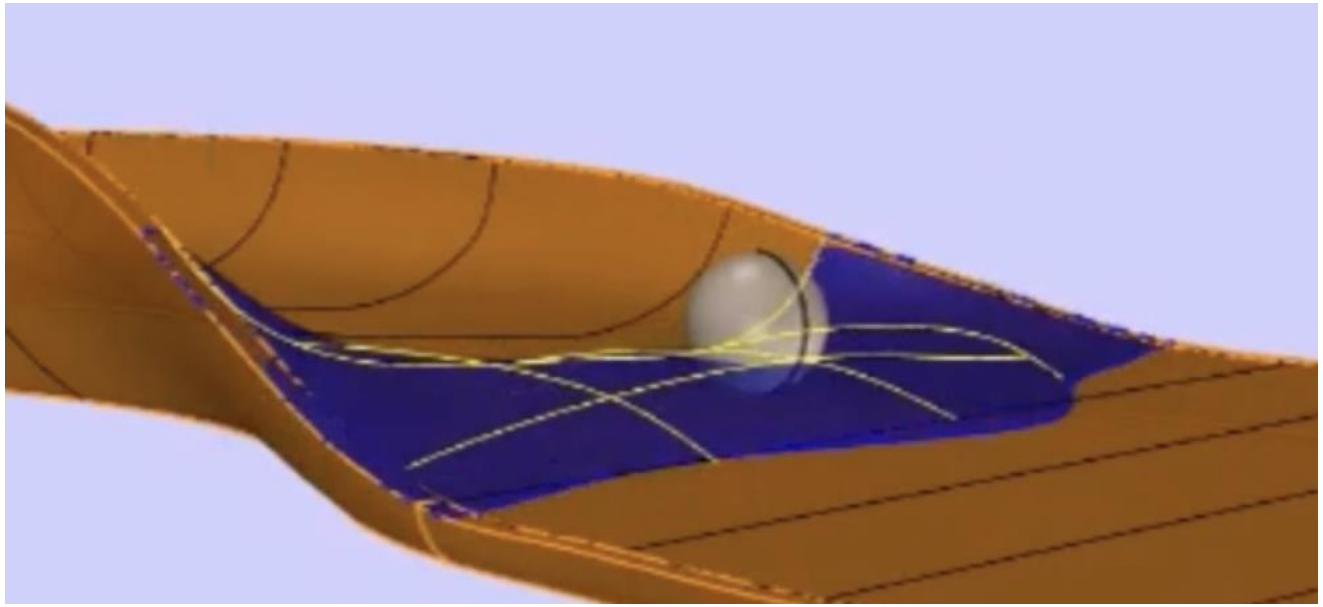
We should decide the new pathways



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