

# Off Loading, TCC , Shoe



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# DMF Protocol

## *VIPS approach*

- \* V : Vascular
- \* I : infection
- \* P : Pressure off
- \* S : specific wound care

# Ulcer/Pressure off& Biomechanics

- \* PVD vs Peripheral neuropathy
- \* NP + high pressure = Ulcer
- \* Pressure off : recurrence
  - \* Cast ( Total contact cast )
  - \* Shoe ( scotch boot , etc )
  - \* Surgery



# Ulcer healing: Off Loading

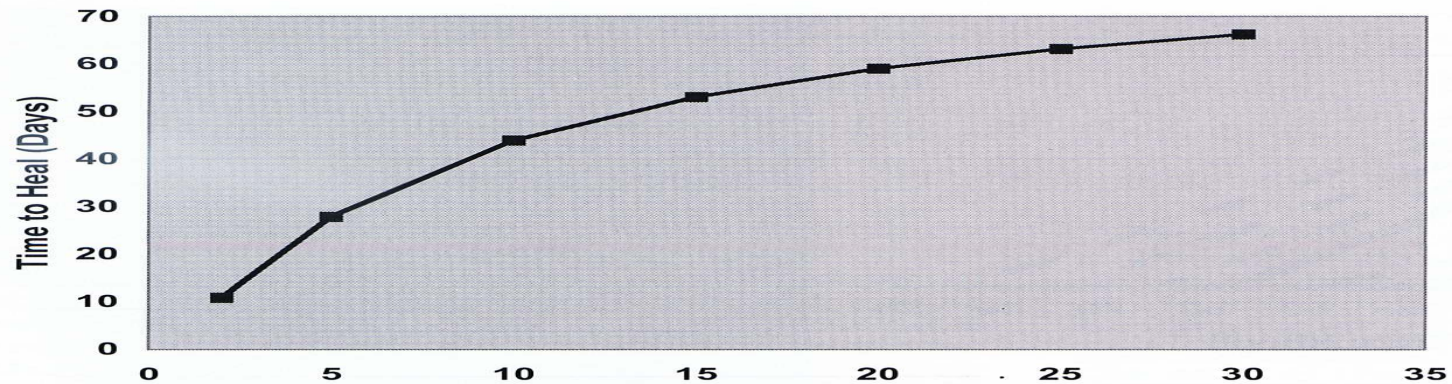
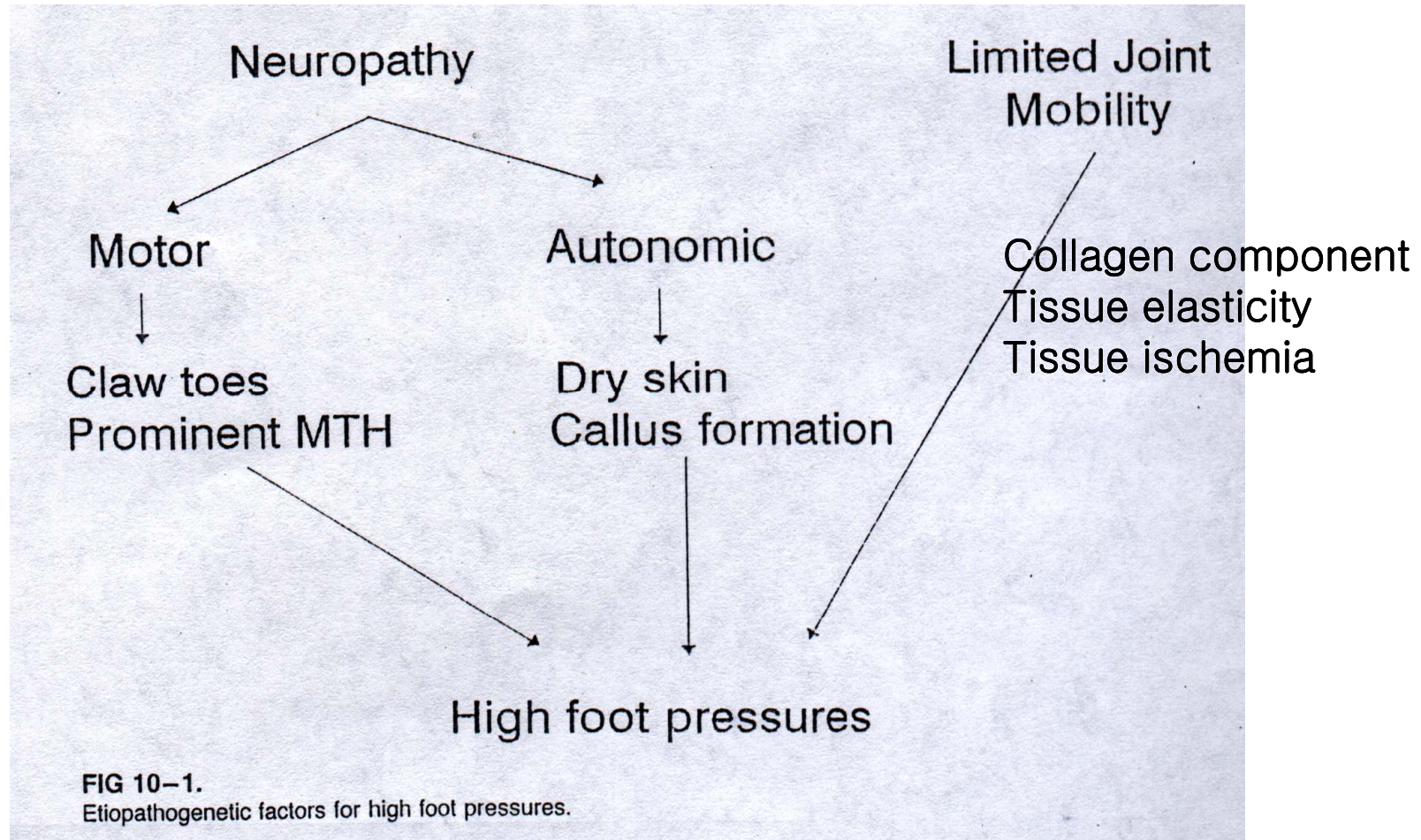


Table 6-2 ■ IDEAL HEALING TIMES FOR ULCERS OF DIFFERENT INITIAL SIZES

INITIAL SIZE (EQUIVALENT RADIUS) (MM)	INITIAL AREA (CM <sup>2</sup> )	TIME TO 50% REDUCTION IN RADIUS (DAYS)	TIME TO COMPLETE HEALING (DAYS)
2.5	0.2	4.7	14.3
5	0.8	12.3	27.9
10	3.1	21.2	43.9
15	7.1	26.3	53.1
20	12.6	29.6	59.0
25	19.6	31.9	63.2
30	28.3	33.6	66.2



# Pathophysiology of High pressure



# Uneven Distribution of pressure

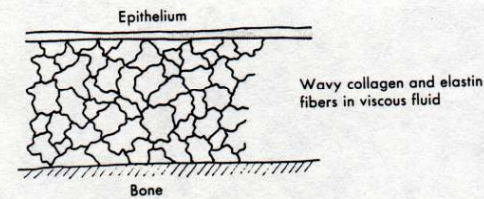
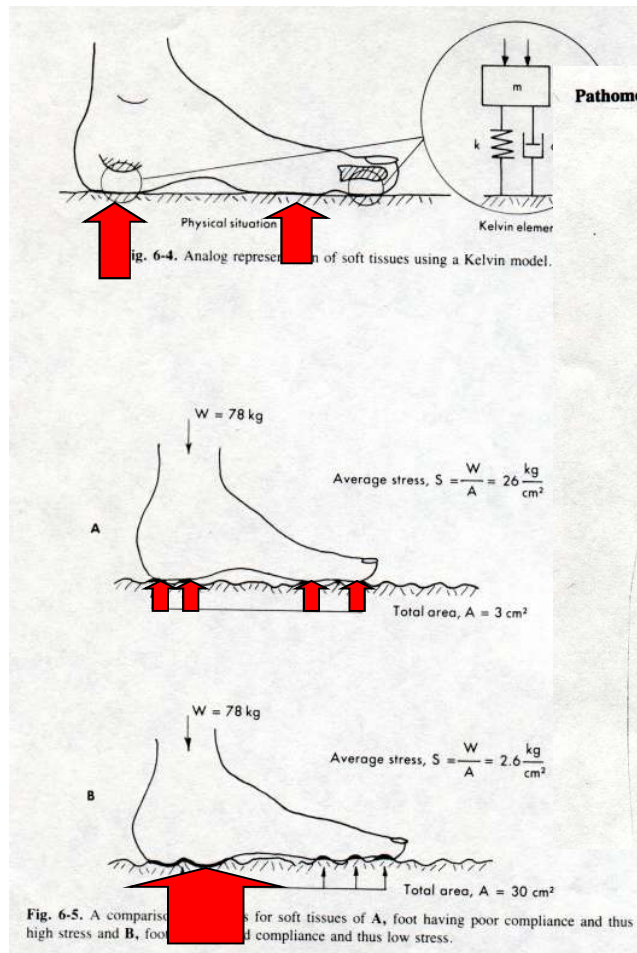


Fig. 6-1. A simplified model of soft tissue.

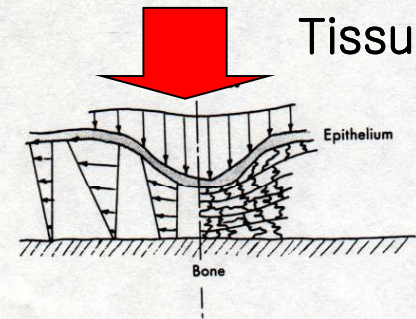
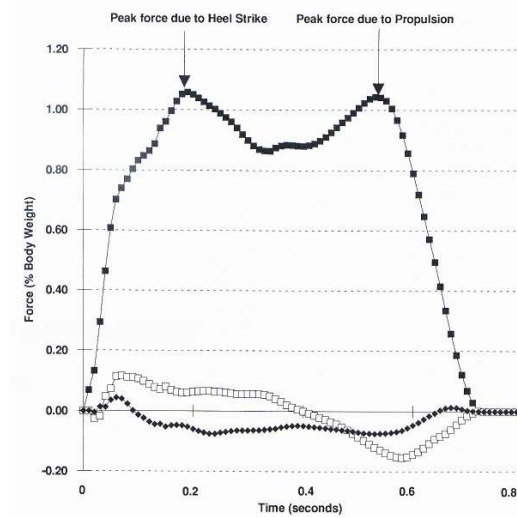


Fig. 6-2. Internal shear and tensile stresses produced from gradients in an externally applied normal stress (pressure).

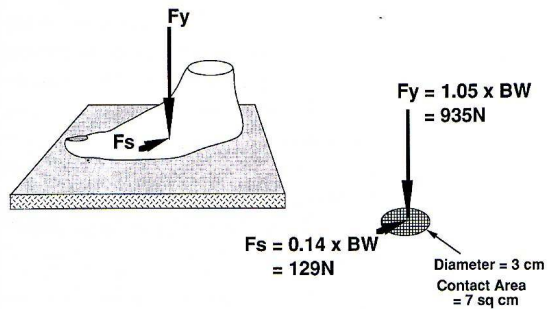


# Normal Pressure

## Vertical pressure & shear pressure



We cannot measure

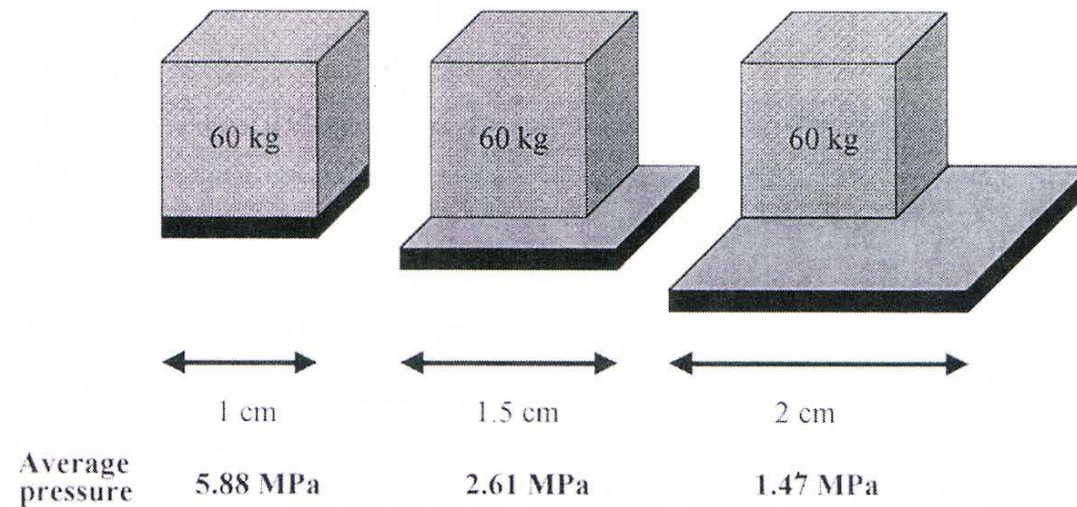


$$\text{Normal Stress} = 935 / (7 \times .0001) = 1340 \text{ kPa} = 1.34 \text{ MPa}$$

$$\text{Shear Stress} = 129 / (7 \times .0001) = 184 \text{ kPa}$$



# Size of the sensor



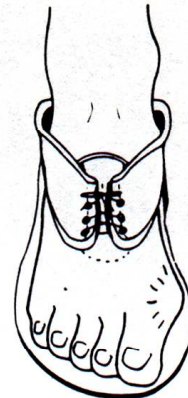
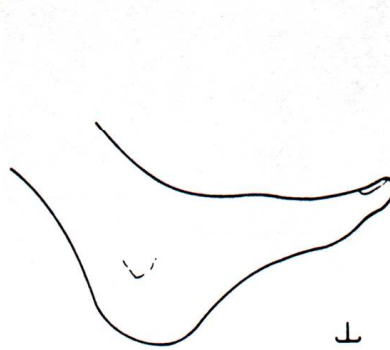
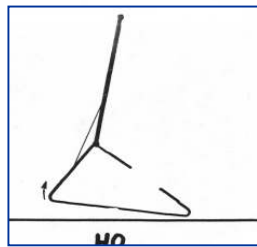
- \* Threshold of abnormal Pr.
  - \* EMED: 750kPa
  - \* Optical pedobarograph: 1080kPa
  - \* F-scan: 600kPa



# Cause of mechanical Pressure

mechanical cause of foot lesion

- a. Disrupting tissue
- b. Pressure causing ischaemia
- c. Repetitive stress causing necrosis



DISRUPTION

PRESSURE

REPEATED MECHANICAL STRESS

Fig. 6.1 Mechanical causes of foot lesions

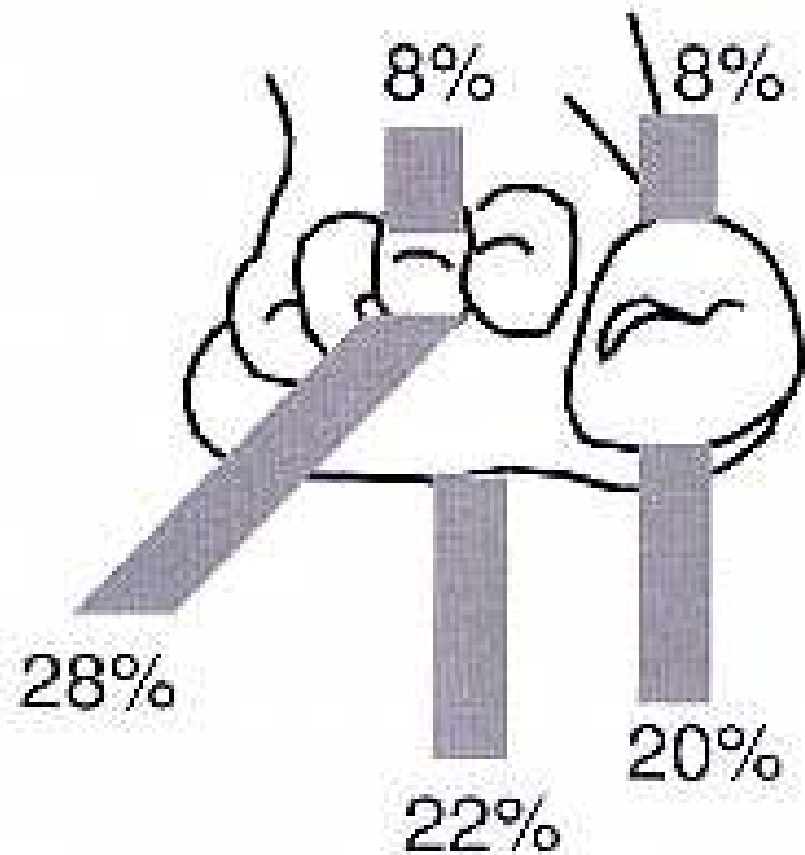


Callus



## 궤양의 위치 : most forefoot

- \* Toe: 51%
- \* Plantar MTH, midfoot, heel: 28%
- \* Dorsum of foot: 14%
- \* Multiple 7%

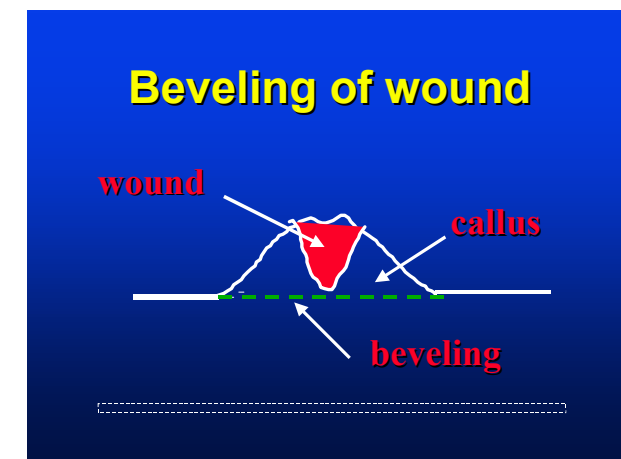


# Pressure off method

- \* Callus trimming
- \* Total contact cast
- \* Shoes and Orthotics

# Callus

- \* Callus
  - \* excessive keratosis due to vertical/shear pressure
  - \* Removal of Callus reduction of 29% foot pressure
  - \* Positive feedback





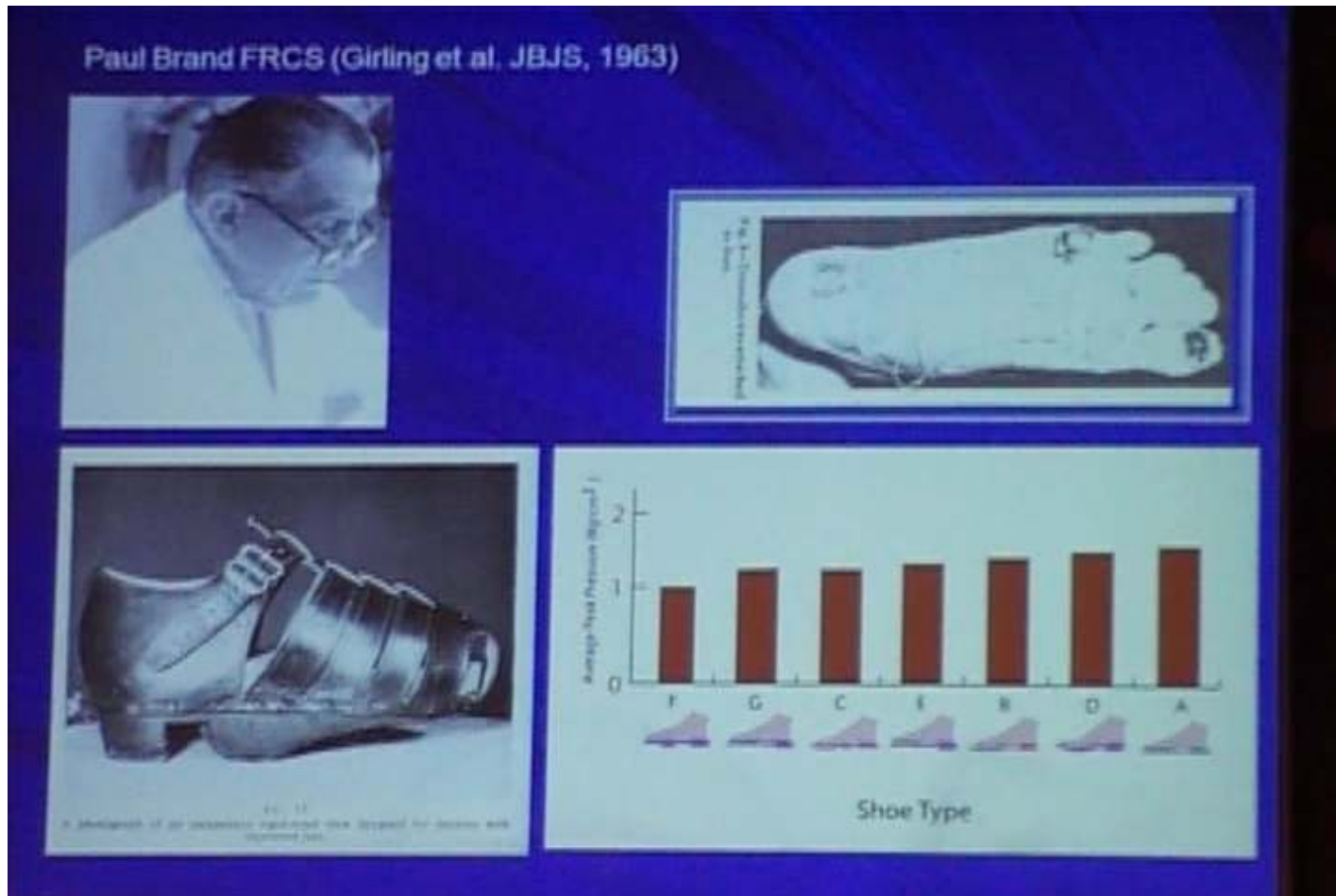
# Intractable Ulcer ????



Weight bearing surface

# Total Contact Cast

Paul Brand : Leprosy



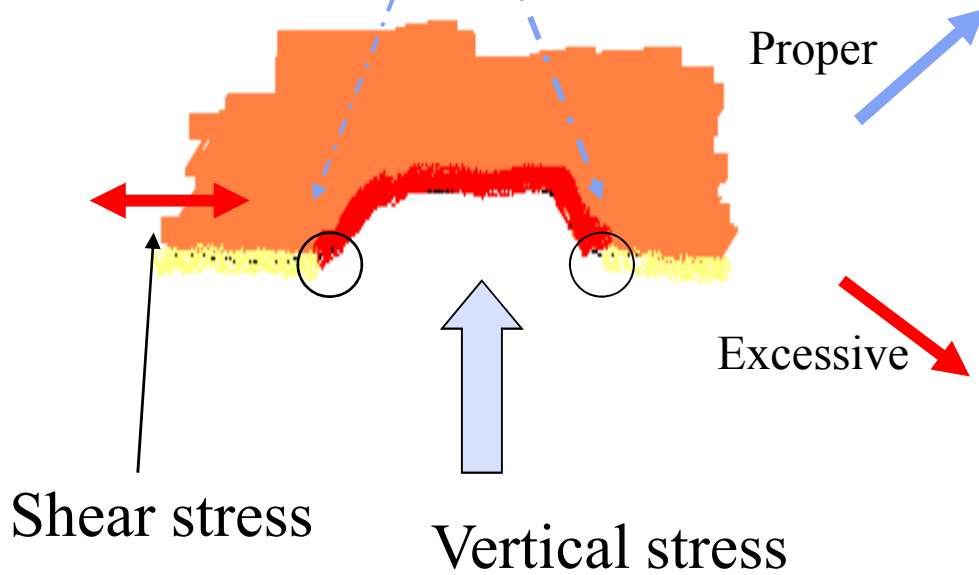
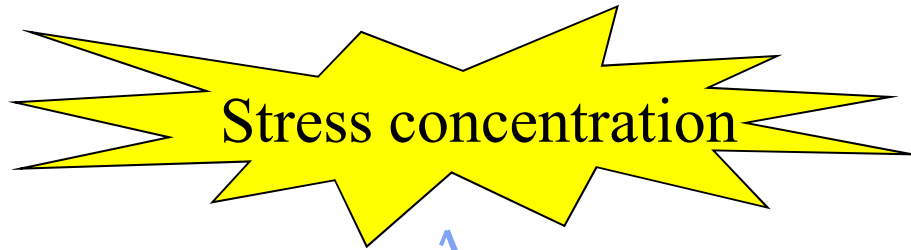
# Mechanism

## Total Contact Cast

- Redistribute Force
- Control Edema
- Protect Structure



# Edge effect



Peripheral hypertrophy

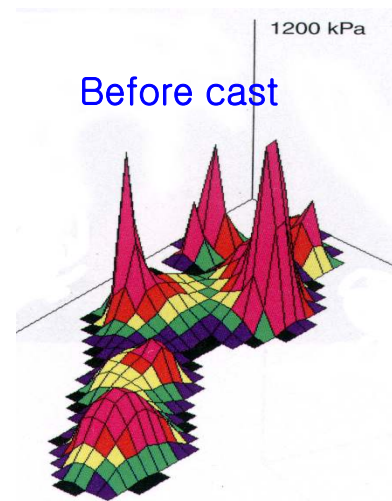
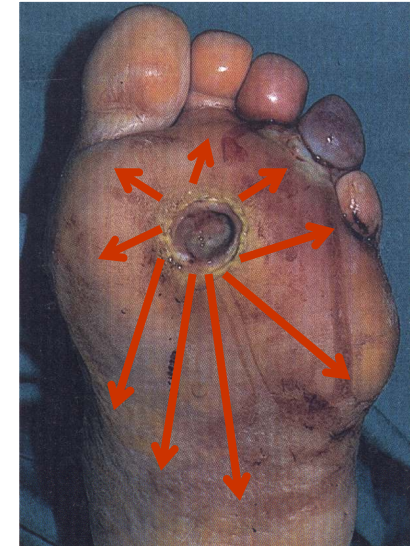
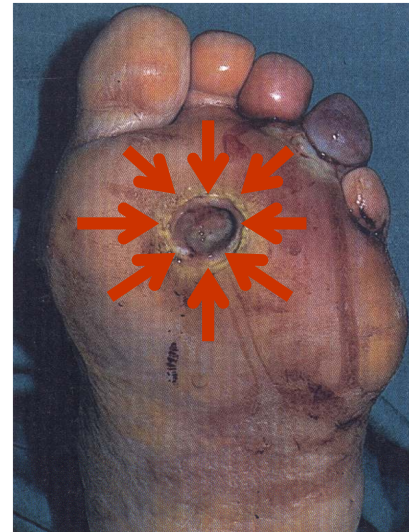


Enlarge

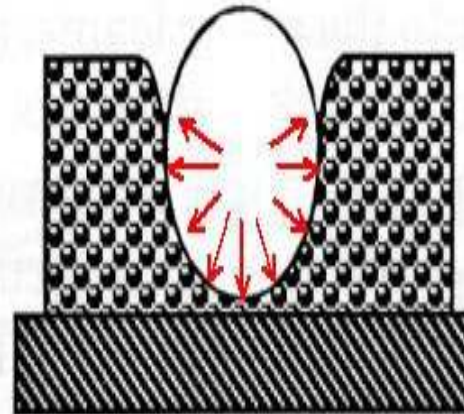
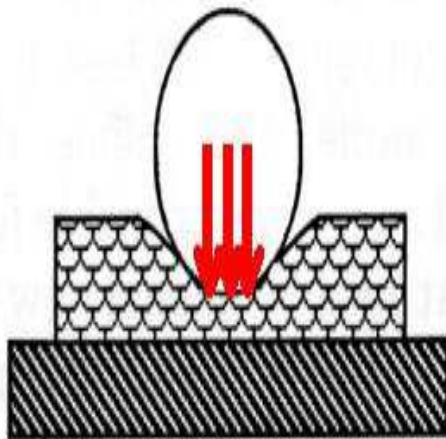


# Pressure redistribution

- \* Plantar peak pressure in a cast
- \* 1<sup>st</sup> & 3<sup>rd</sup> MT heads
- \* 75~85% ↓



Birke *J Rehabil Res Dev* 1985



plantar Wt. bearing surface increase

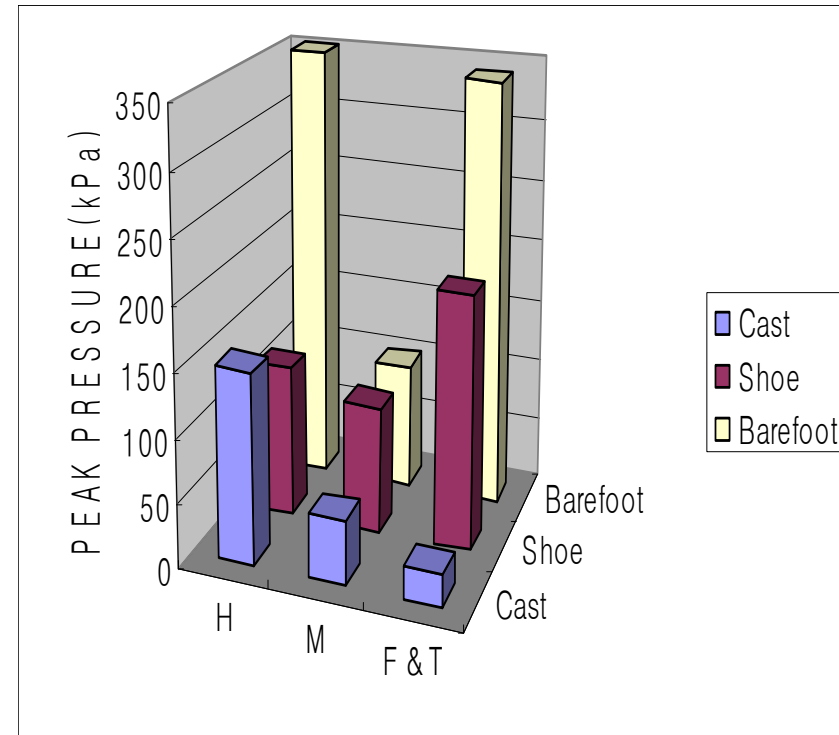
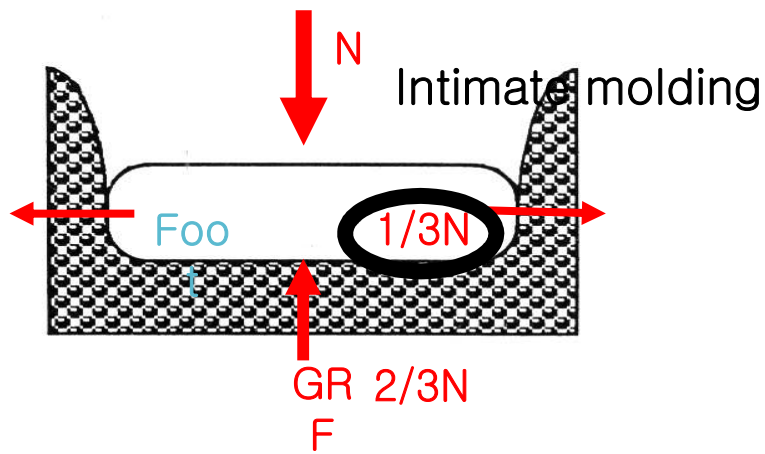
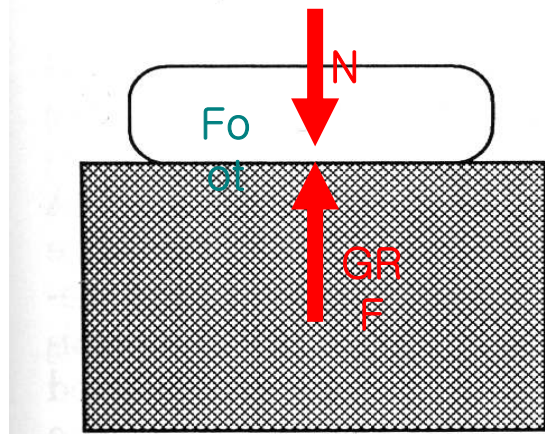
over the ulcer site – Avr. plantar prsssure reduction : 42~ 46%

Conti & Martin

S

h

*Plantar Pr. Measurement during ambulation in Wt bearing conventional SLC & TCC. Foot & Ankle Int 1996*



Shaw JE

\* *the mechanism of plantar unloading in TCC: Foot Ankle Int 1997;18:809-817*

# MECHANISM

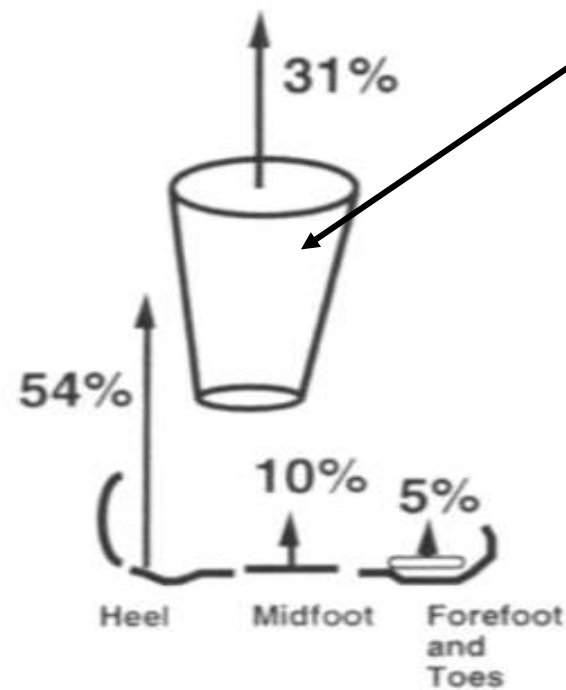
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Mean distribution of load during single step

SHOE



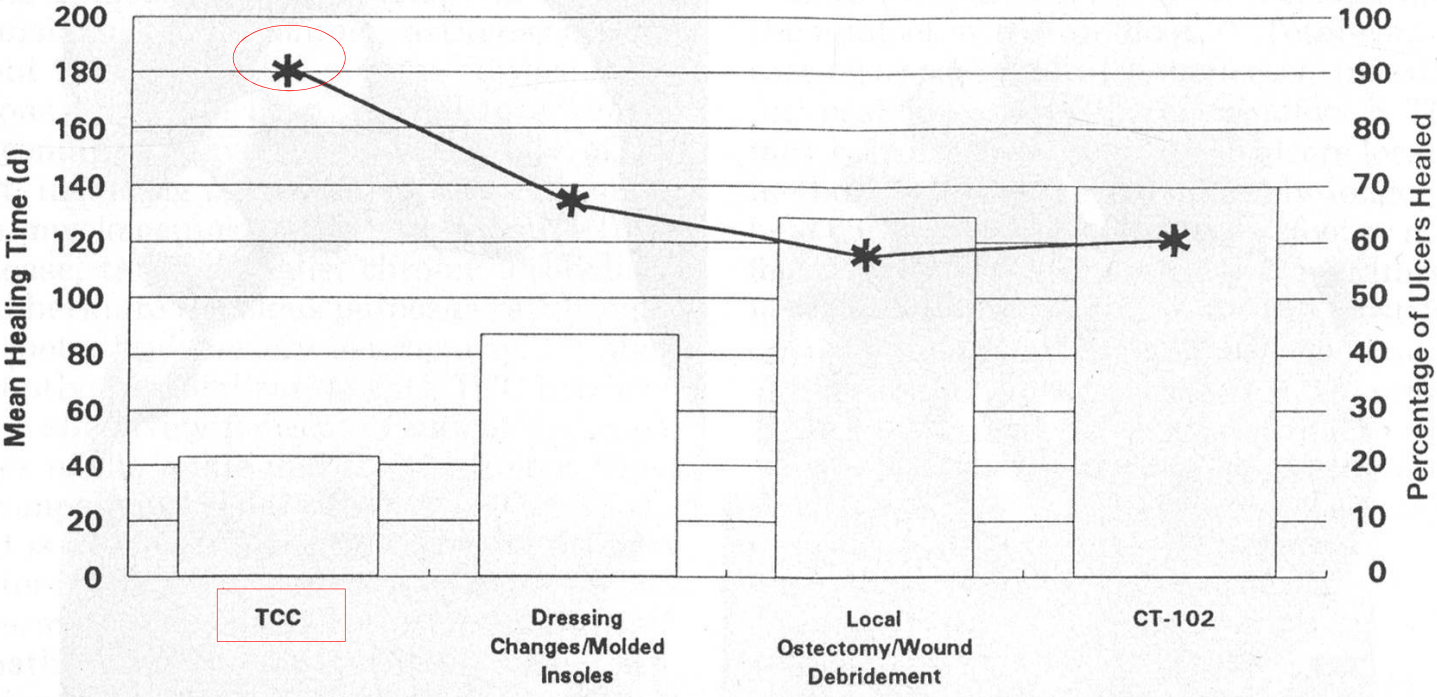
CAST



- 8x12x27cm  
: 840cm<sup>2</sup>
- shear stress  
: 2kPa



# Effectiveness & outcome of TCC



Sinacore *Phy Thre 1996*

# Effectiveness & outcome of TCC

	TCC	Traditional therapy
Mean healing time	42day	65days
Healing rate	91%	32%
Infection	no	26% ulcer → 2 forefoot amputation

Muller *Diabetes care 1989*

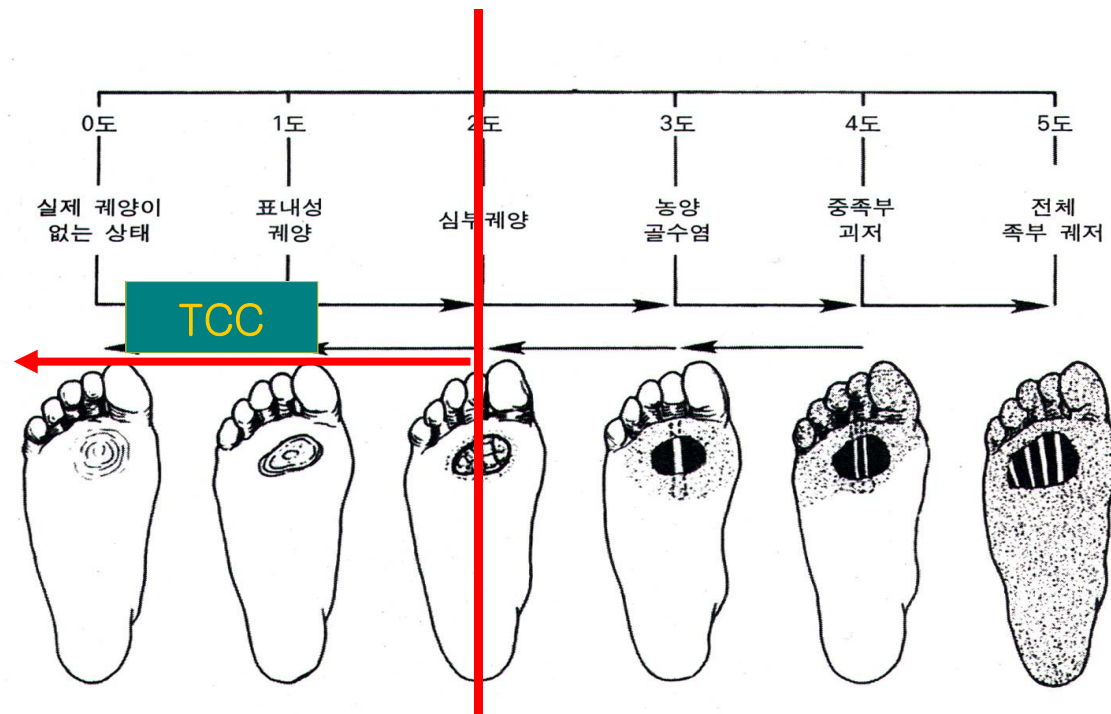
TCC

- ✓ the most effective ambulatory method in
  - reducing excessive plantar pressure
  - healing DM neuropathic ulcer

Sinacore *Phy Thre 1996*

# Indication

- 1) uninfected superficial forefoot & midfoot plantar ulceration  
(Wagner grade 1 and 2 ulcers)



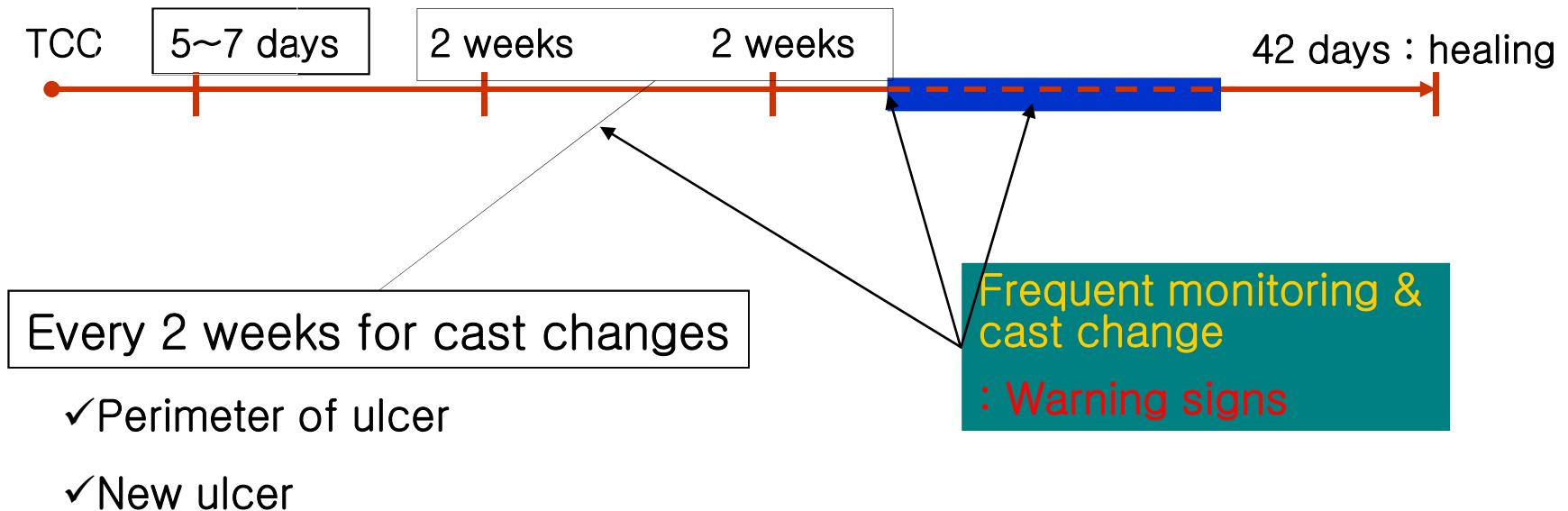
# Postcasting Care

## Cast Change

- ✓ Perimeter of ulcer
- ✓ Cast loose – skin irritation or New ulcer
- ✓ Patient's response to the cast

## first cast change

Rapid edema reduction



Every 2 weeks for cast changes

- ✓ Perimeter of ulcer
- ✓ New ulcer

Frequent monitoring & cast change  
: Warning signs

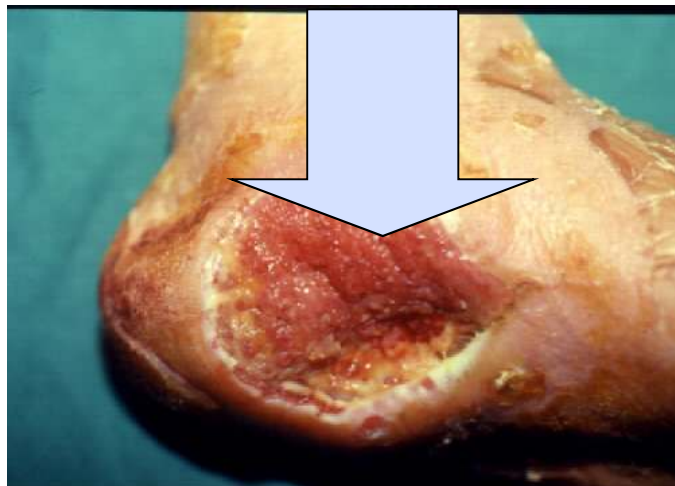
# WARNING SIGNS

→ Remove the cast ↑

- 1) Excessive swelling of the leg or foot
- 2) Loosening of excessive mobility
- 3) Drainage on the outside
- 4) Deep cracks or soft spots in the cast
- 5) Sudden tenderness in the inguinal lymph nodes
- 6) Sudden increase in fever or chills
- 7) Complaints of discomfort or pain



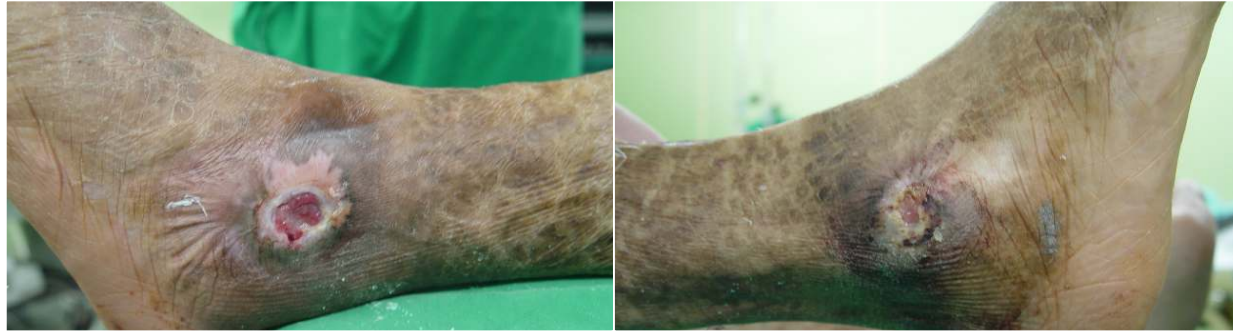
# Case



53 male CRF

3 months classic treatment at local clinic

Dep. of IM



1st TCC



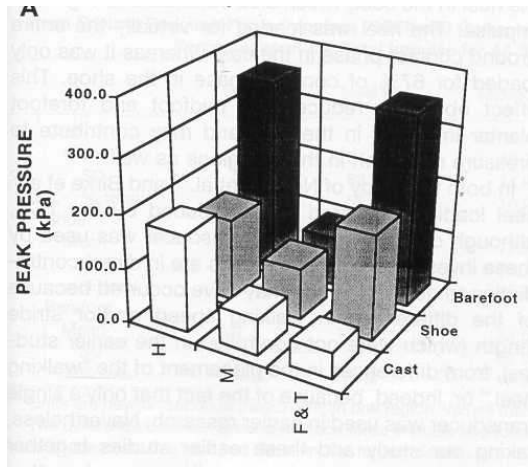
3rd TCC:  
5weeks



# Alternative Methods



# Scotch boot : india



# Half shoe

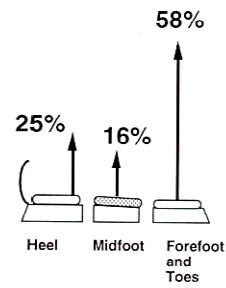


- \* Complication
  - \* Blunt trauma
  - \* Falling down
  - \* New ulcer

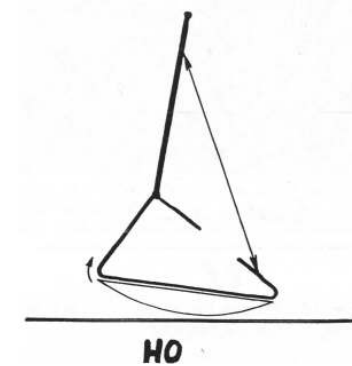
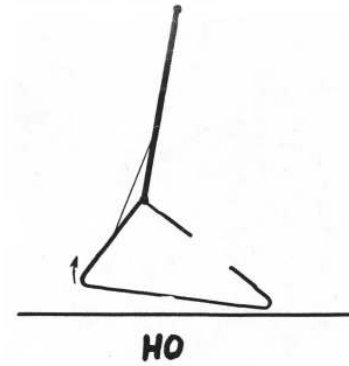
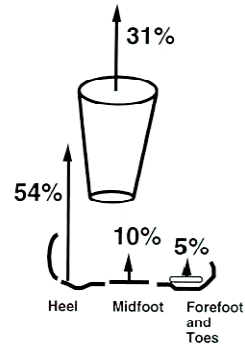


# Brace ; Compliance ( Non-removable )

SHOE



CAST



Body Armor Walker



Air cast

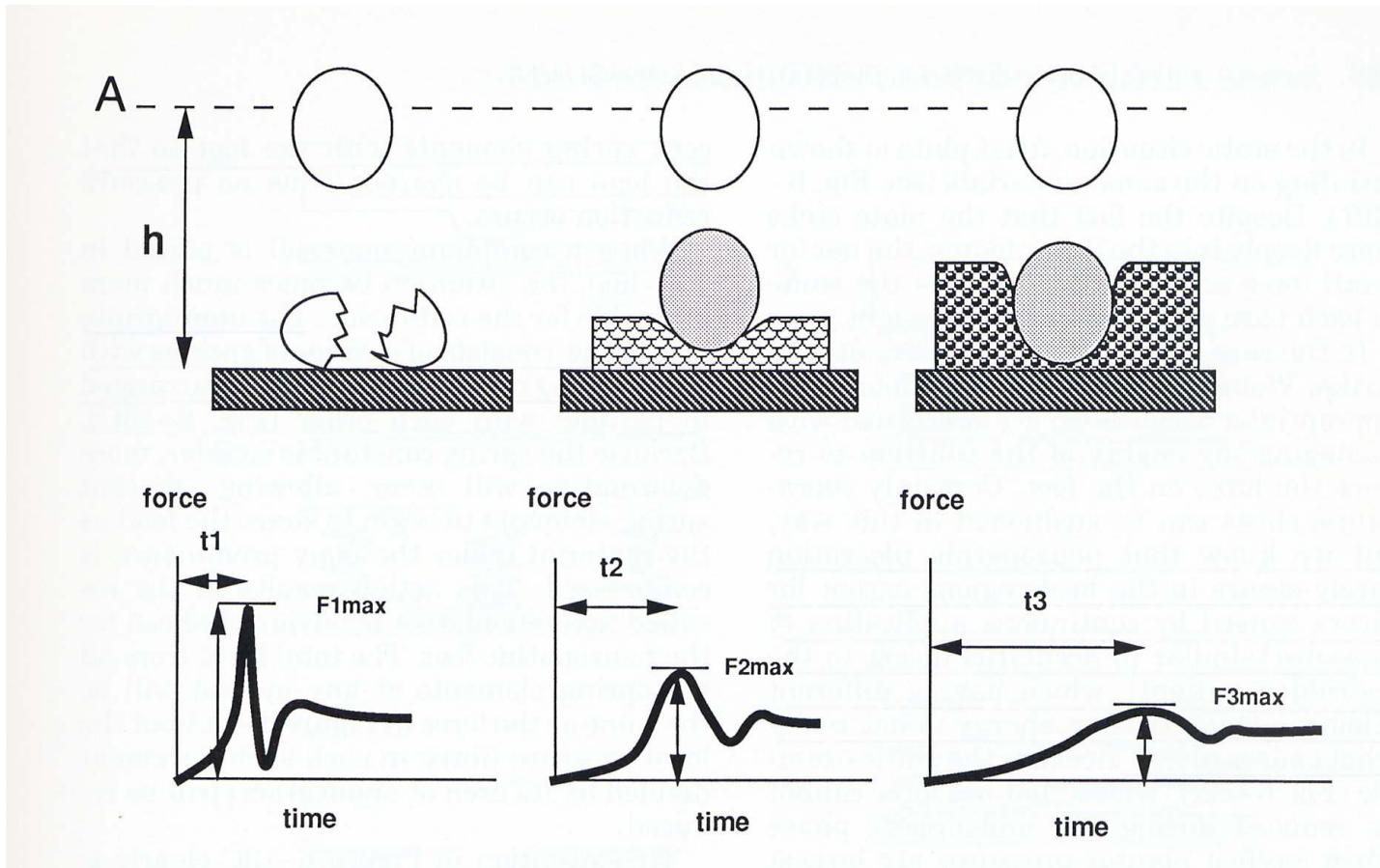


DH Walker

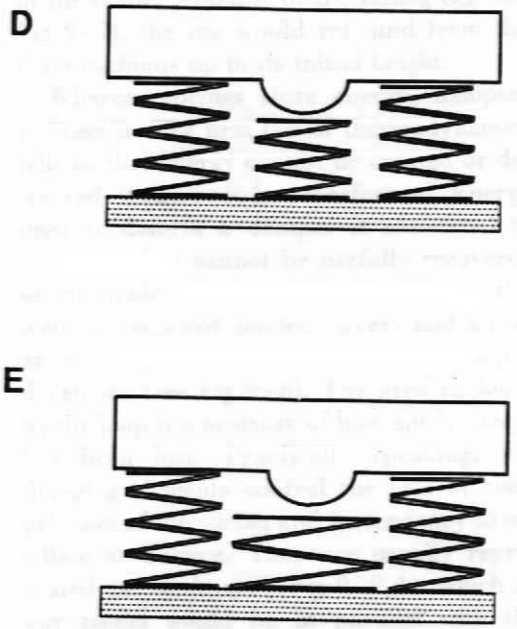
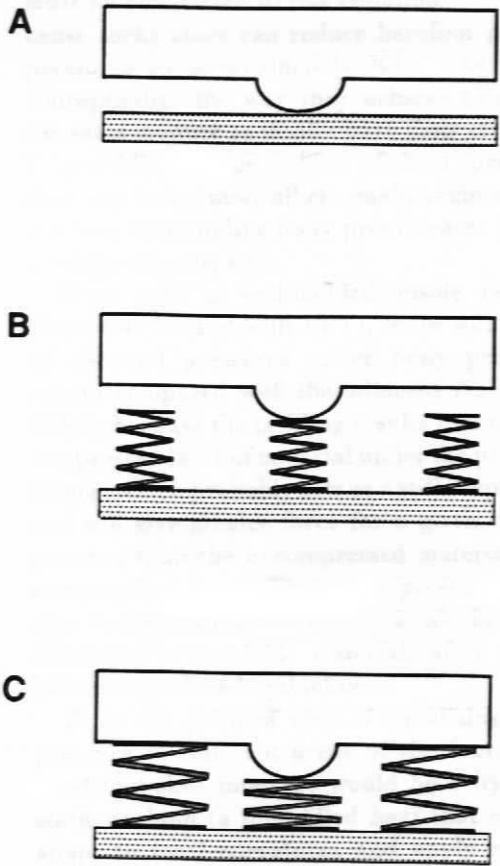
Felt



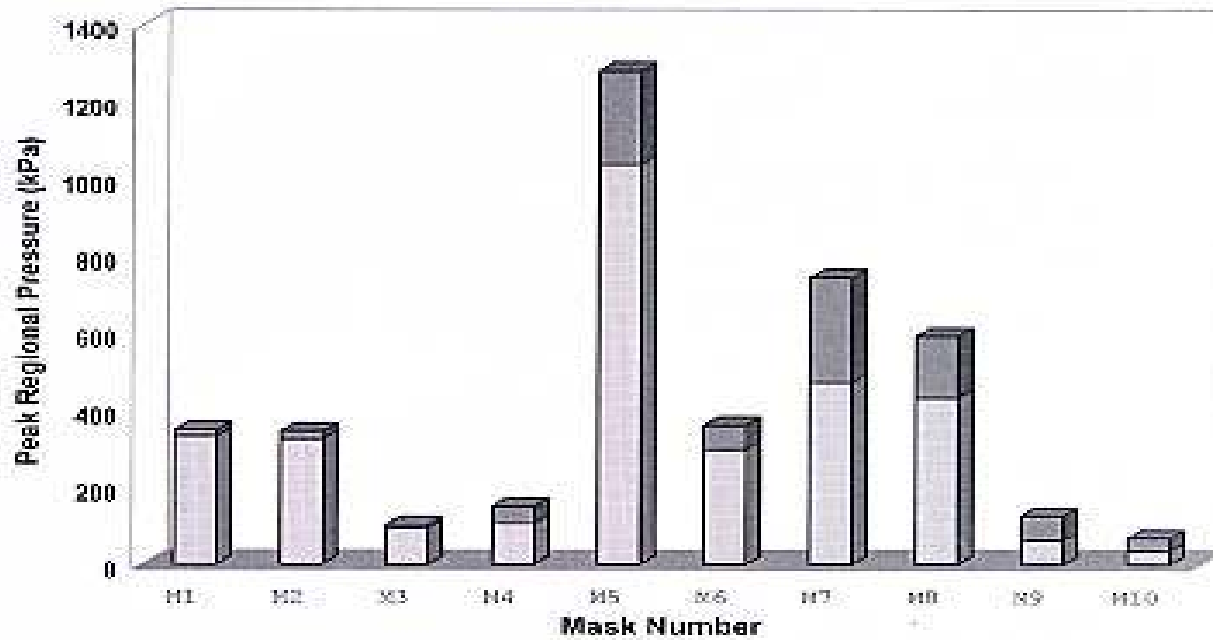
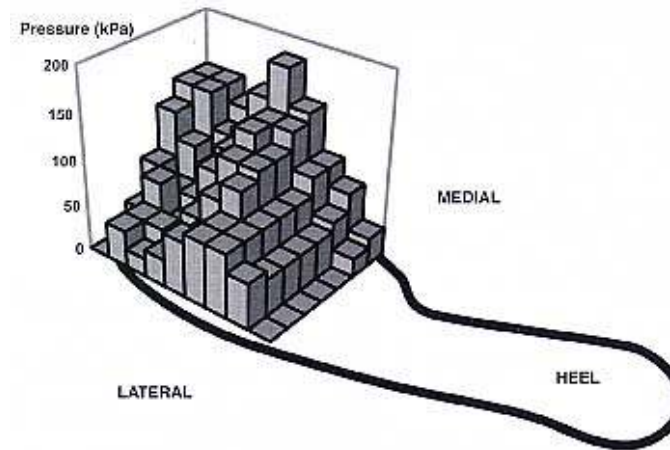
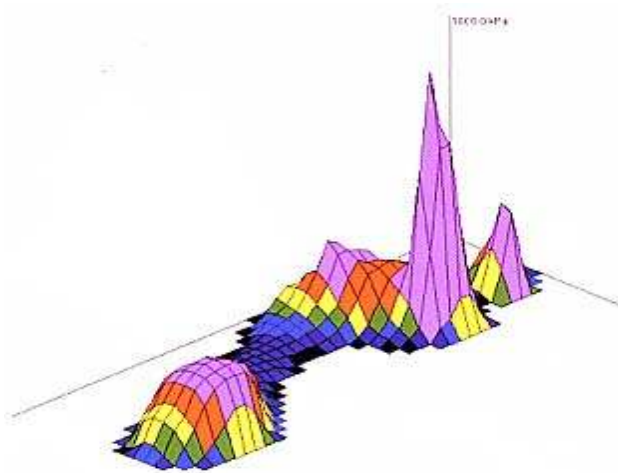
# Footwear: Cushioning



# Cushioning



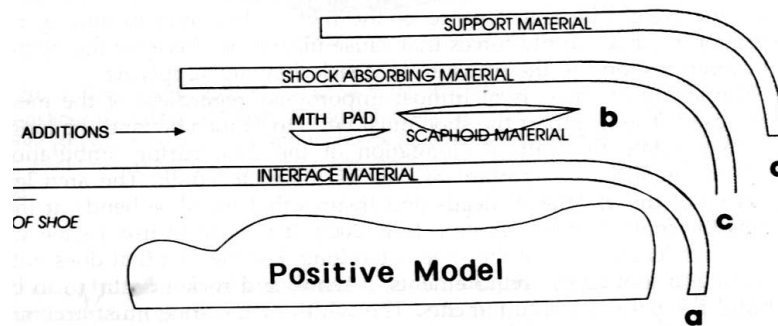
# 신발의 효과





# Insole: polyethylene(PE)

- \* Plastazote
- Alipast
- \* 다양한 경도
- \* Heat modable
- \* Open cell



# Rubber & polyurethane(PU)

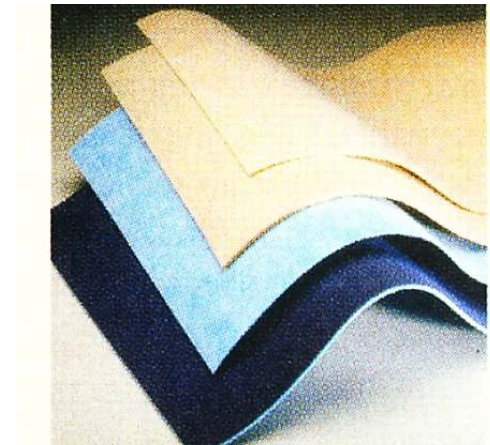
- \* Closed cell / open cell
- \* Not heat modable
- \* Durable: sustained/cyclic compression test



Spenco Neoprene



Poron



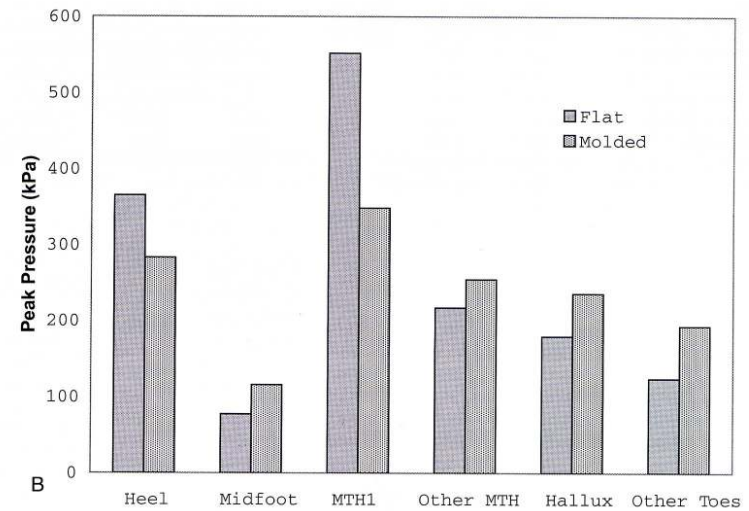
PPT

# Thickness of insole

- \* 2-6kPa/mm의 압력 감소 효과
- \* 최소한 ¼ inch: extra-depth shoe
- \* 고위험군은 ½ inch: super-depth shoe
  - \* Insole 만으로 25%의 압력 감소 효과

# Total contact insole

- \* Metatarsal pad
  - \* 3/16 – 5/16 inch high
  - \* 3/16– 1/4 inch proximal to MTH
  - \* 12-60%의 압력 감소 효과



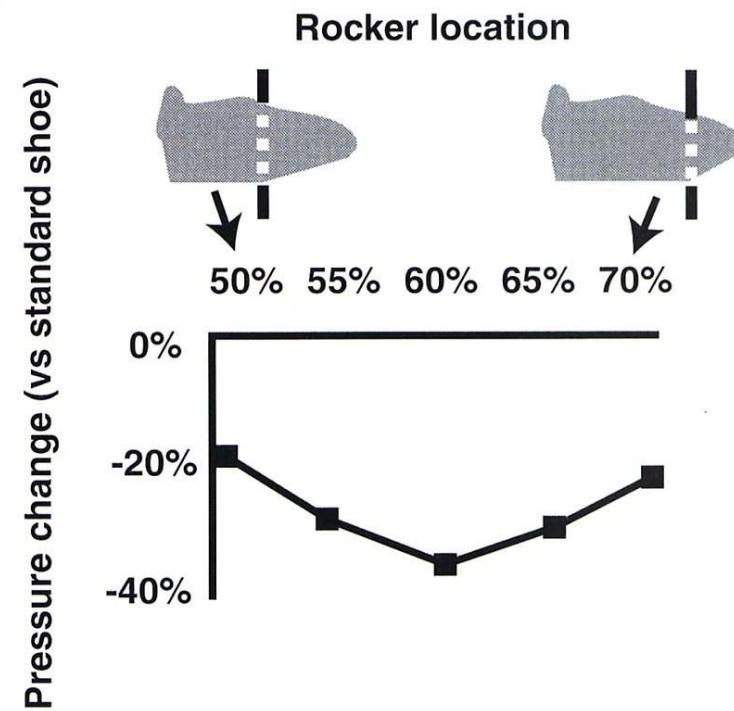
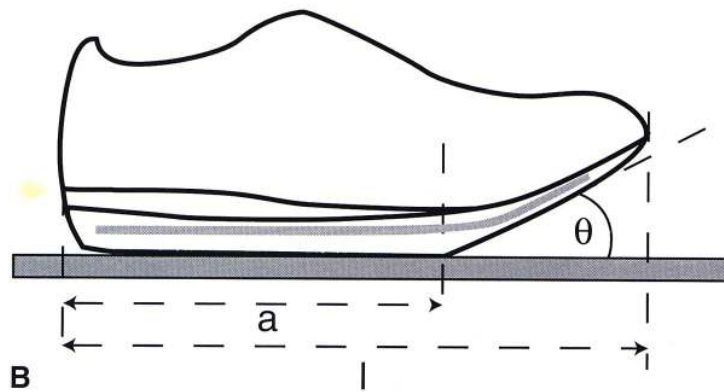
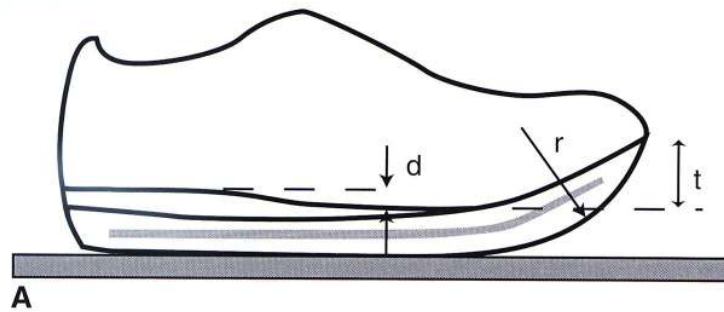
# Removal of pr. point

- \* Plugging
- \* Insole relief
- \* Inshoe relief

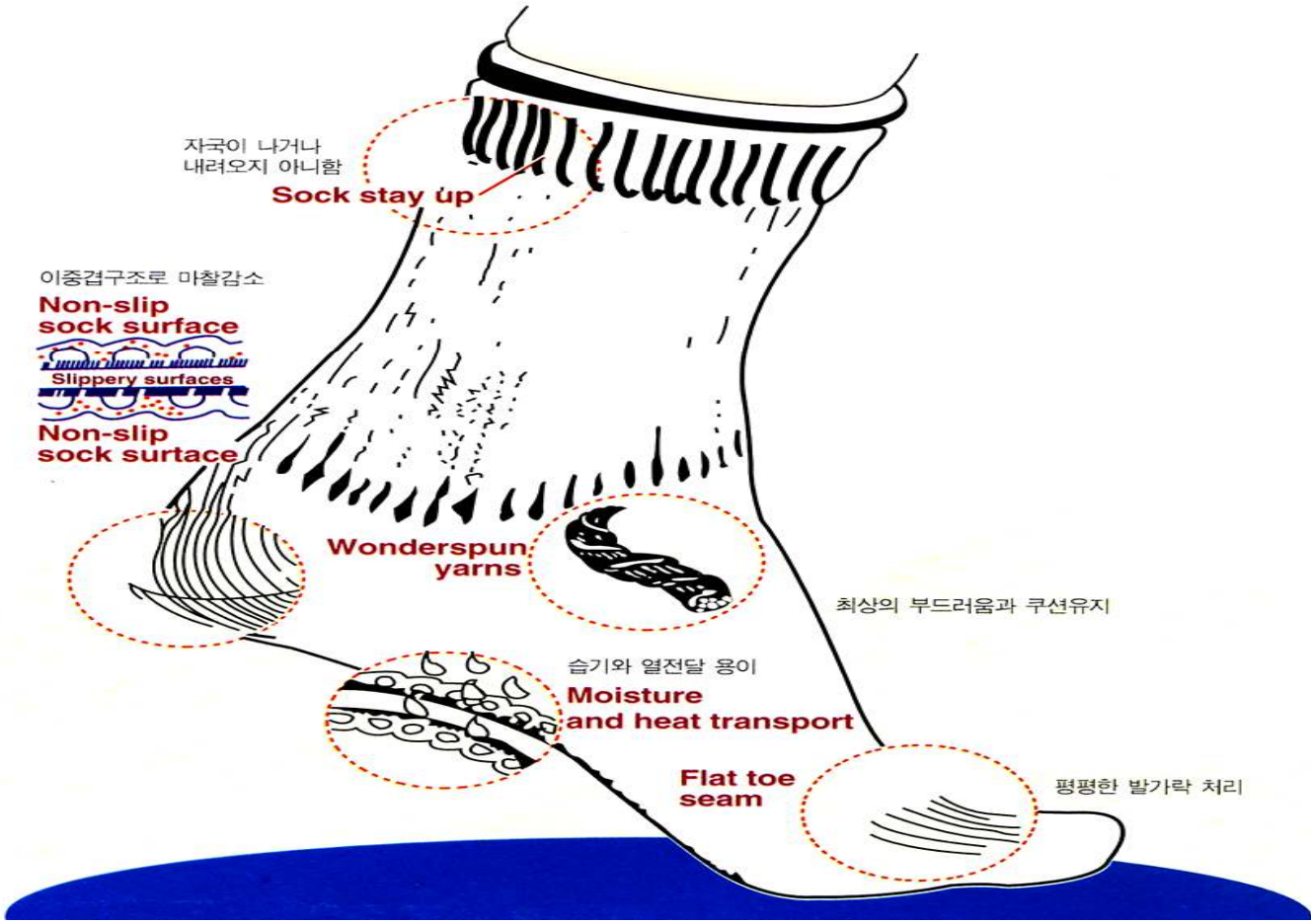




# Roller shoe & rocker shoe

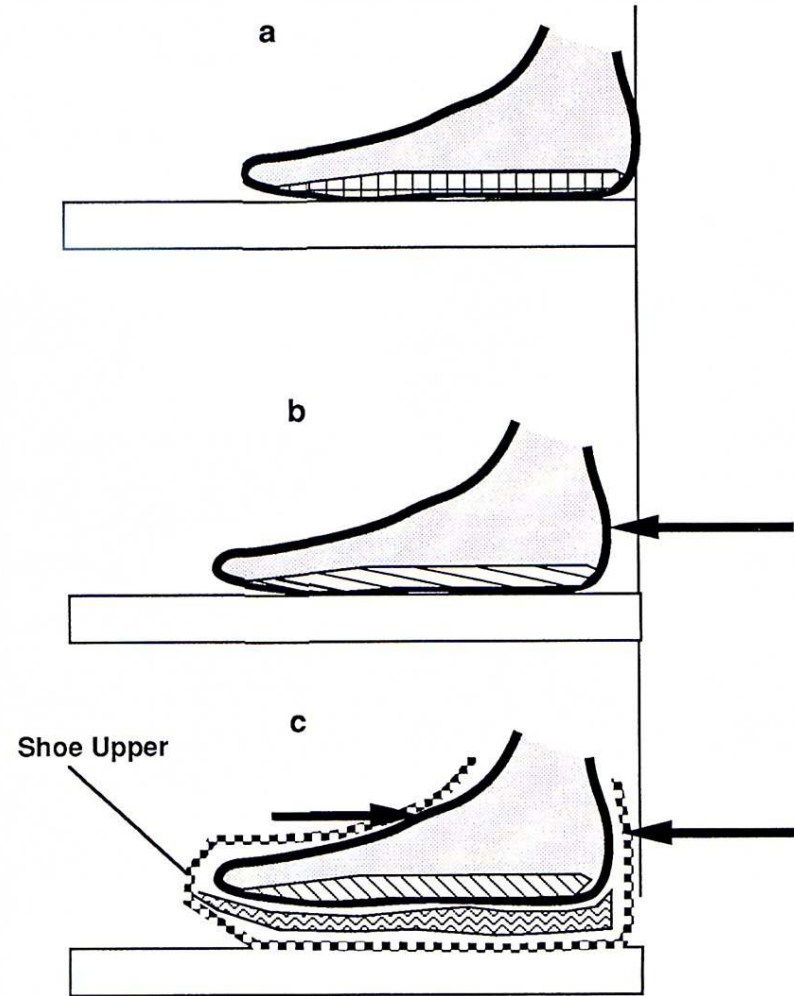


# Sock

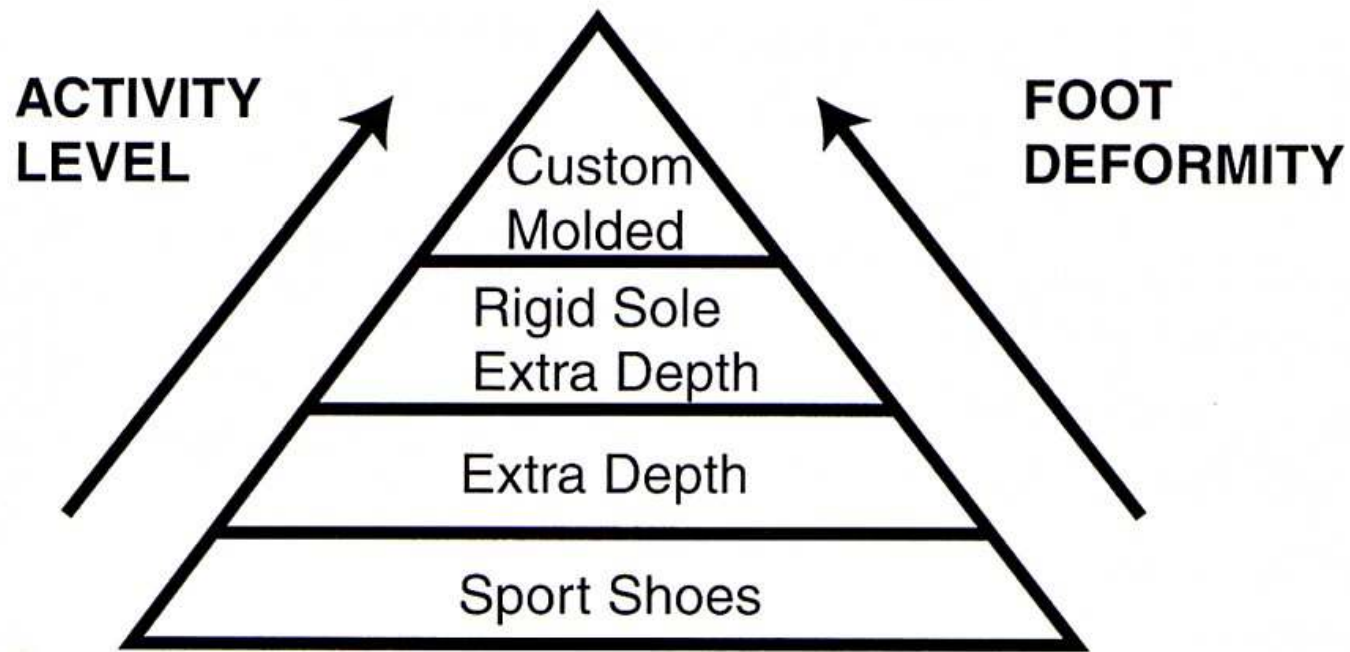


30% pressure relief

# Upper



# Footwear pyramid



# Surgery—pressure off

- \* HV
- \* Bunionette
- \* Plantar deformity
- \* Toe deformity
- \* Heel cord lengthening



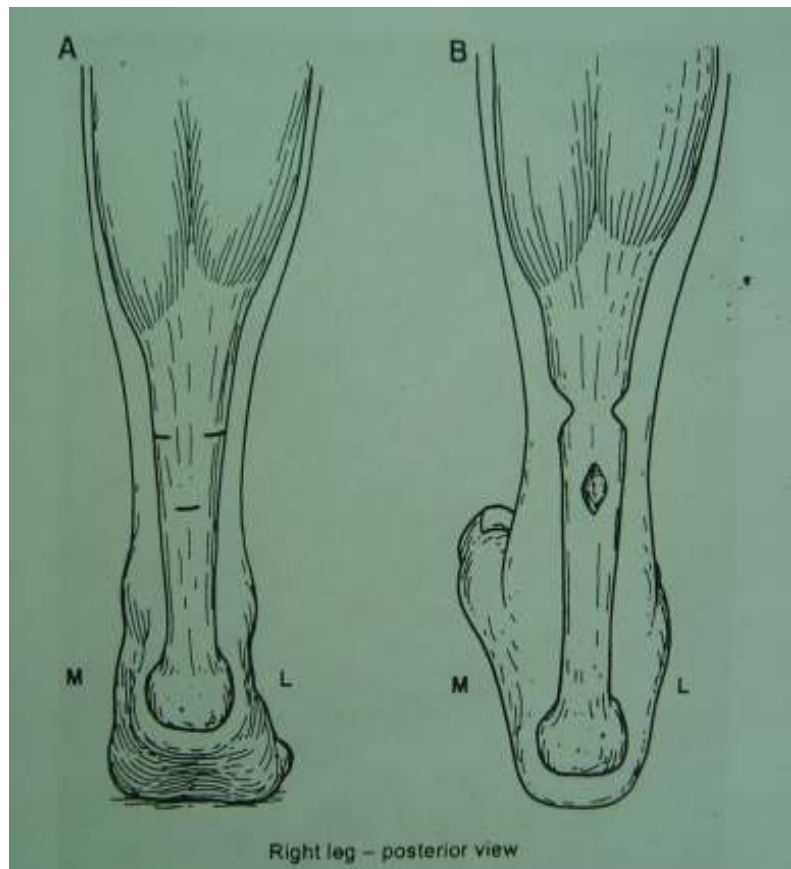
# With Bunionette



# Plantar ulcer with deformity



# Heel cord lengthening in fore-foot ulcer



# Off-loading Evidence

- \* 98.7% of literature on footwear and off loading was not eligible for systemic review
- \* Difficult of definition “ custom

**Evidence table example**

Reference	Study design - quality	Study population and characteristics	Intervention and control conditions	Outcome category	Results on primary/secondary outcomes - statistics	Level of evidence (GRADE)	Comments / weaknesses
Madden et al., 2003 (46)	RCT Quality 3/9	Patients: 130, C-33  Dequarant Neuropathic plantar foot/heel ulcers  Study location: UK Lead to study: 1  Follow-up 1: 7 months Lead to follow-up: 8  Follow-up 2: 2.1 (SD 0.7) years Lead to follow-up: 0	CTOC + TAL  C-TOC  Pain loading Pressure Shoes and insoles	Ulcer treatment  Ulcer recurrence (prevention)	Healing proportion: C-TOC 30 (100%) C-TOC 29/30 (96%) P = 0.12  Ulcer recurrence at 7 months: TAL 14/27 (51%) C-TOC 10/27 (37%) P = 0.001 RR = 1.3 (95%CI = 1.2-1.5)  Ulcer recurrence at 2.1 years: TAL 10/26 (38%) C-TOC 21/26 (81%) P = 0.002 RR = 2.1 (95%CI = 1.7-2.6)	1+	Confusing primary outcome Powered on 7-month recurrence Plantar pressure not measured

# Off Loading – Ulcer treatment

- \* TCC : Strong Evidence
- \* Alternative casting device :  
in need of controlled studies
- \* Amking removal devices non removal  
: strong evidence
- \* Surgical offloading : does not reduce  
proportion healed, only time to healing
- \* Felt foam : limited evidence



Thank you

