Importance of Appropriate Footwear in a Patient with Diabetic Foot

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Back ground

- Diabetic Mellitus results from failure of the endocrine system to regulate blood glucose levels.
- Foot ulceration is the most common cause of amputation in diabetic patients.
- 85% of diabetes related lower extremity amputations are preceded by ulceration.

Background (Cont)

- Increased dynamic foot pressures is a major risk factor in the formation of diabetic foot ulcer.
- Foot related hospital admission constitutes 20% of all diabetic patients admission.
- Foot care and Patients footwear education are important initial treatment for diabetic feet at risk.

Background (Cont)

- Neuropathic ulcerations result from repetitive stress over areas of high pressure.
- Ulcers are predicted at a pressure greater than 30 Psi (207 Kpa).

Diabetic Care Cost

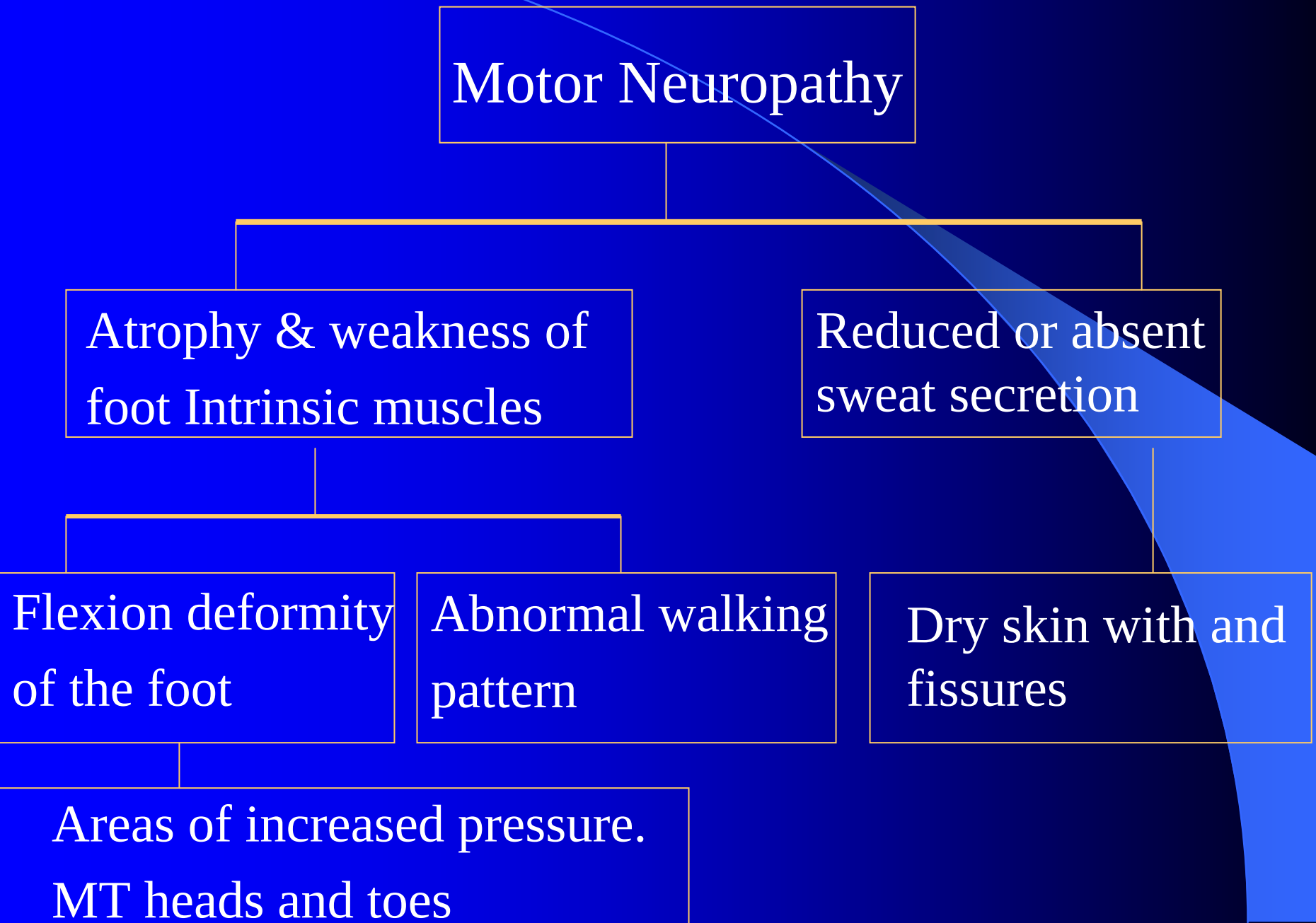
Below is incidence and cost and ulcers and amputations for diabetic related problems in the USA. (Jonathan J. Scarlet and others, 1989)

Diabetic Care Cost (Cont)

Type of Care	
• Diabetic hospital cost for diabetic foot infection (USA $ per year)	200,000,000
• Average length of stay in hospital.	22 weeks
• Cost per hospitalization (USA $)	6,600
• Cost of Amputation (USA $)	8000 –12000
• Admission due to foot problems	20% of all diabetic admission

Diabetic Care Cost (Cont)

Type of Care	
• Reduction in amputation due to podiatric care and patient's education.	50%
• Reduction in amputation due to improvement of foot care.	50%
• Amputation in diabetic patients as a percentage of all non-traumatic amputation.	50% - 70%
• Amputation of admitted patients with infected ulcers.	80%


Motor Neuropathy
Atrophy & weakness of foot Intrinsic muscles
Reduced or absent sweat secretion
Flexion deformity of the foot
Abnormal walking pattern
Dry skin with and fissures
Areas of increased pressure. MT heads and toes

Plantar Pressure

Biomechanical measurements of pressure distribution looks at Pressures between the foot plantar surface (sole) and the supporting surface.

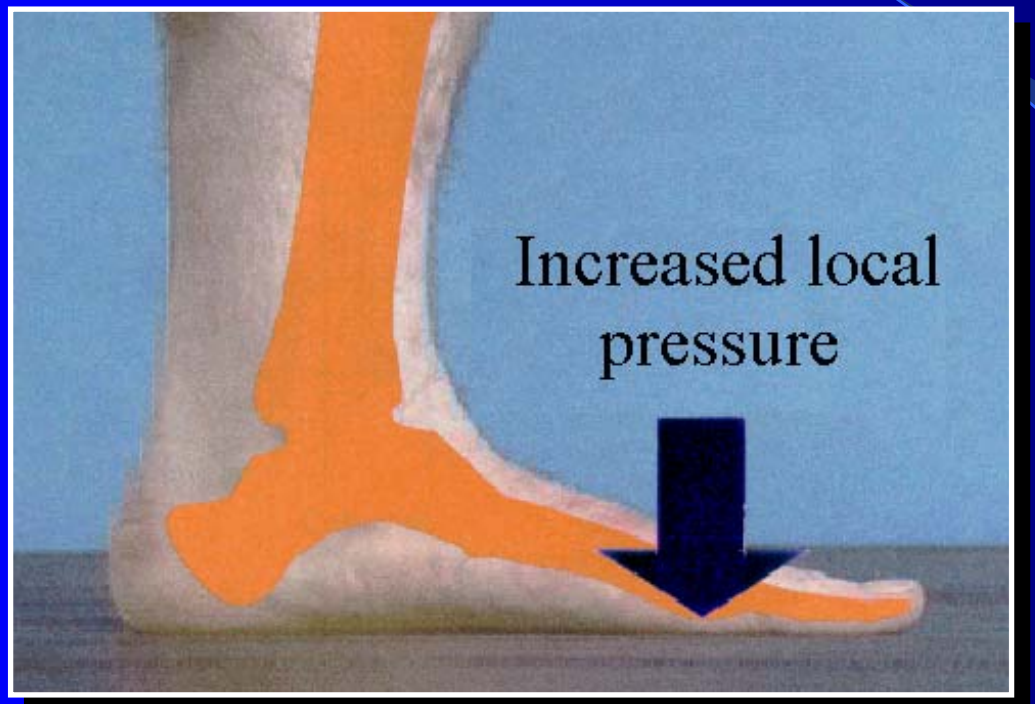
Plantar Pressure (Cont)

- There are various systems available for the measurements of pressures inside the shoe and insole and the plantar foot during functional activities.
- Pressures assessment are useful in the diagnosis and management of pressure related foot problems

Reasons for investigating the foot function

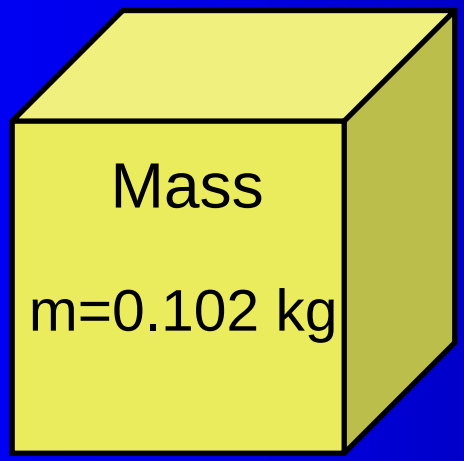
- better understanding of foot function (bio-mechanics and orthopaedics),
- disorders of foot function, e.g. after trauma,
- foot deformities (hallux valgus, rheumatology and diabetes)

Reasons for investigating the foot function

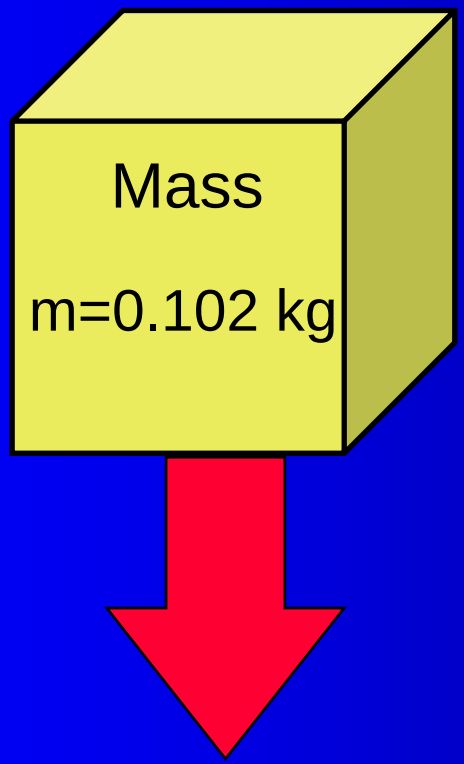


Result: ulcerations =>

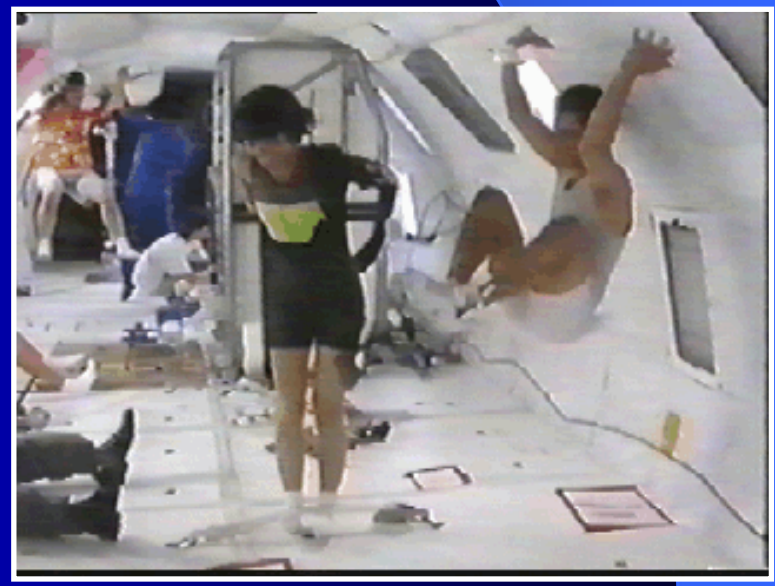
Mass, Weight, Force, Pressure



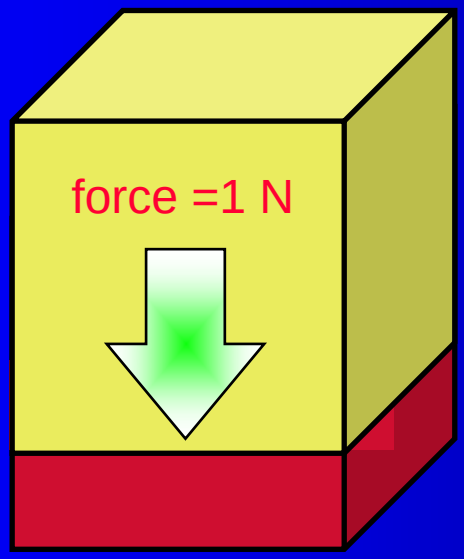
Mass, Weight, Force, Pressure



- The gravity is causing a weight (force) of this body of
  F= 1 N



Mass, Weight, Force, Pressure



- The gravity is causing a weight (force) of this body of
  F= 1 N
- Assuming a contact area of the body with the ground of 1 cm² a pressure (= force/area) of p=1 N/cm² occurs

Traditional methods for pressure distribution measurement

ink print

Podoscope and permanent deformable foam are not pressure distribution measurements!

Types of pressure distribution measurement:

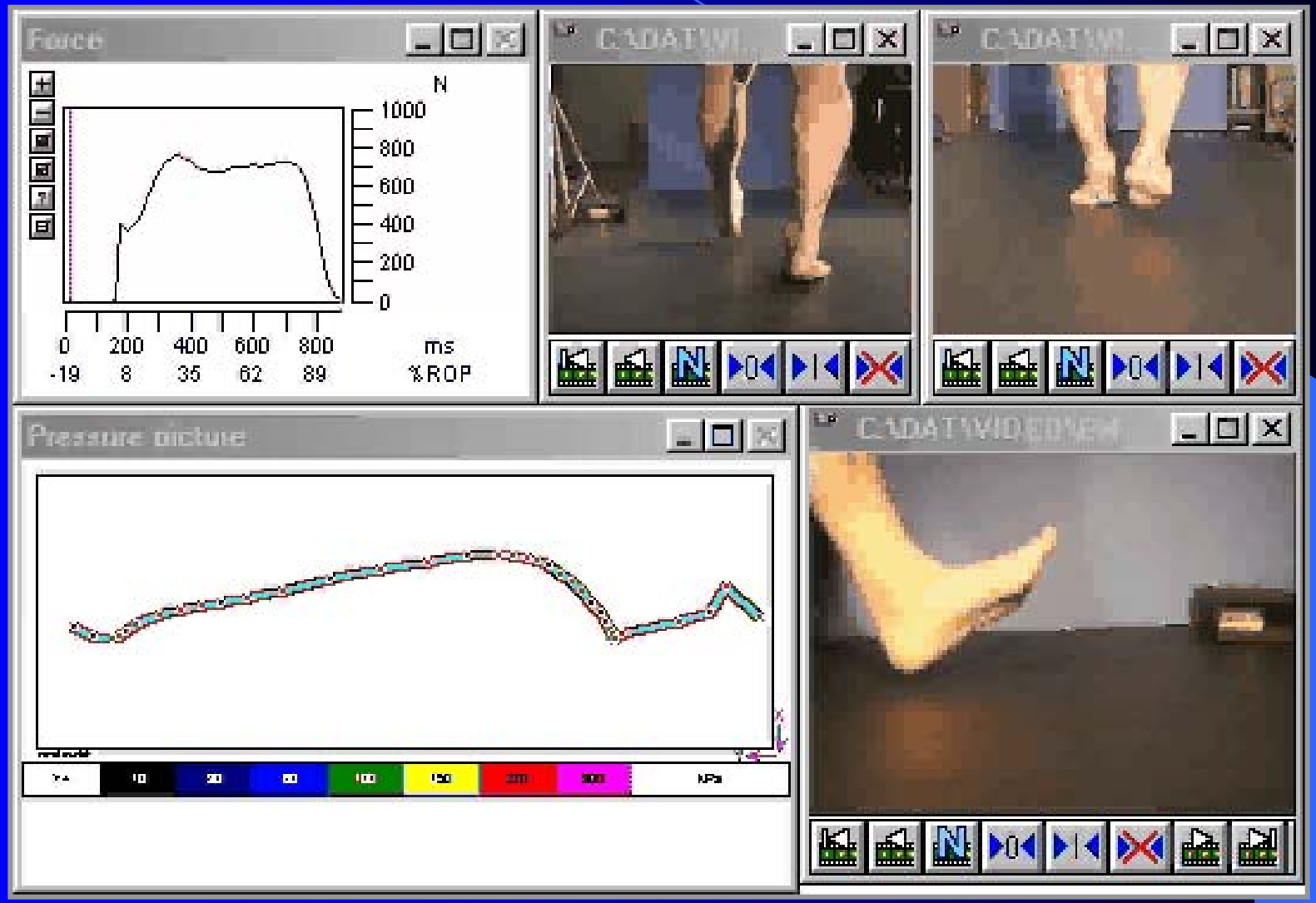
I. Diagnostics: barefoot measurement

- Investigations of foot deformities,
- gait analysis,
- recognition of areas with enhanced risk of ulceration

- Protocols:
  - first step,
  - free walking

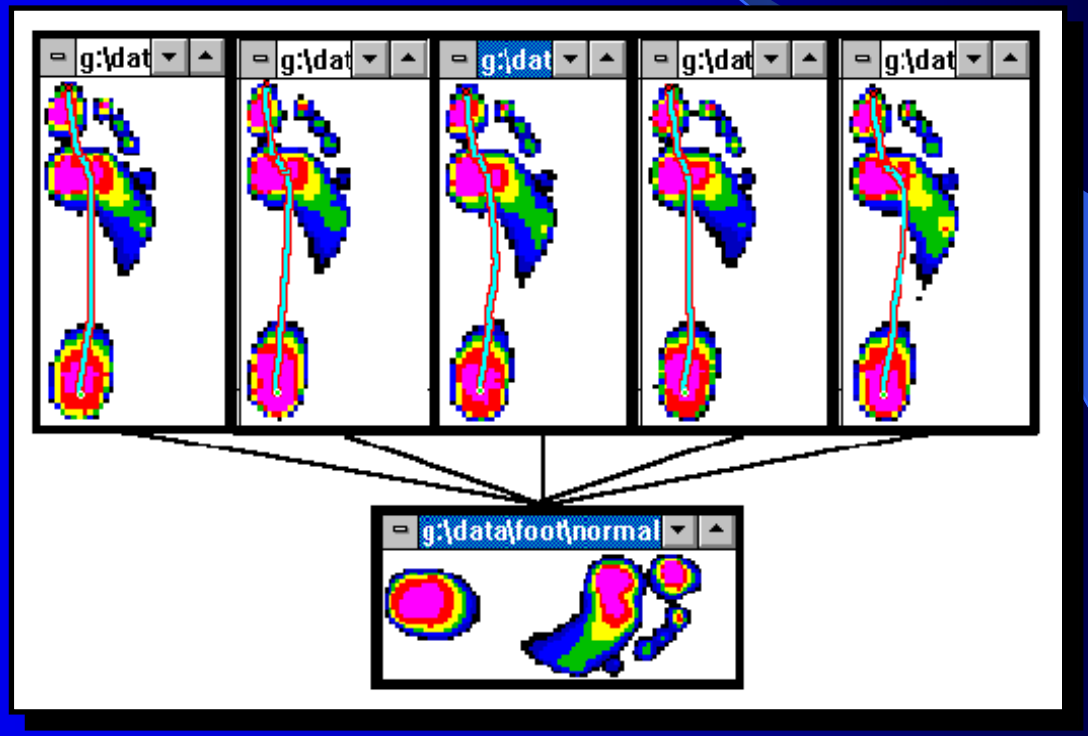
Only the dynamic barefoot measurement on the platform can be used for functional diagnostics!

Example of a dynamic pressure distribution measurement



Calculation of averaged pressure distribution

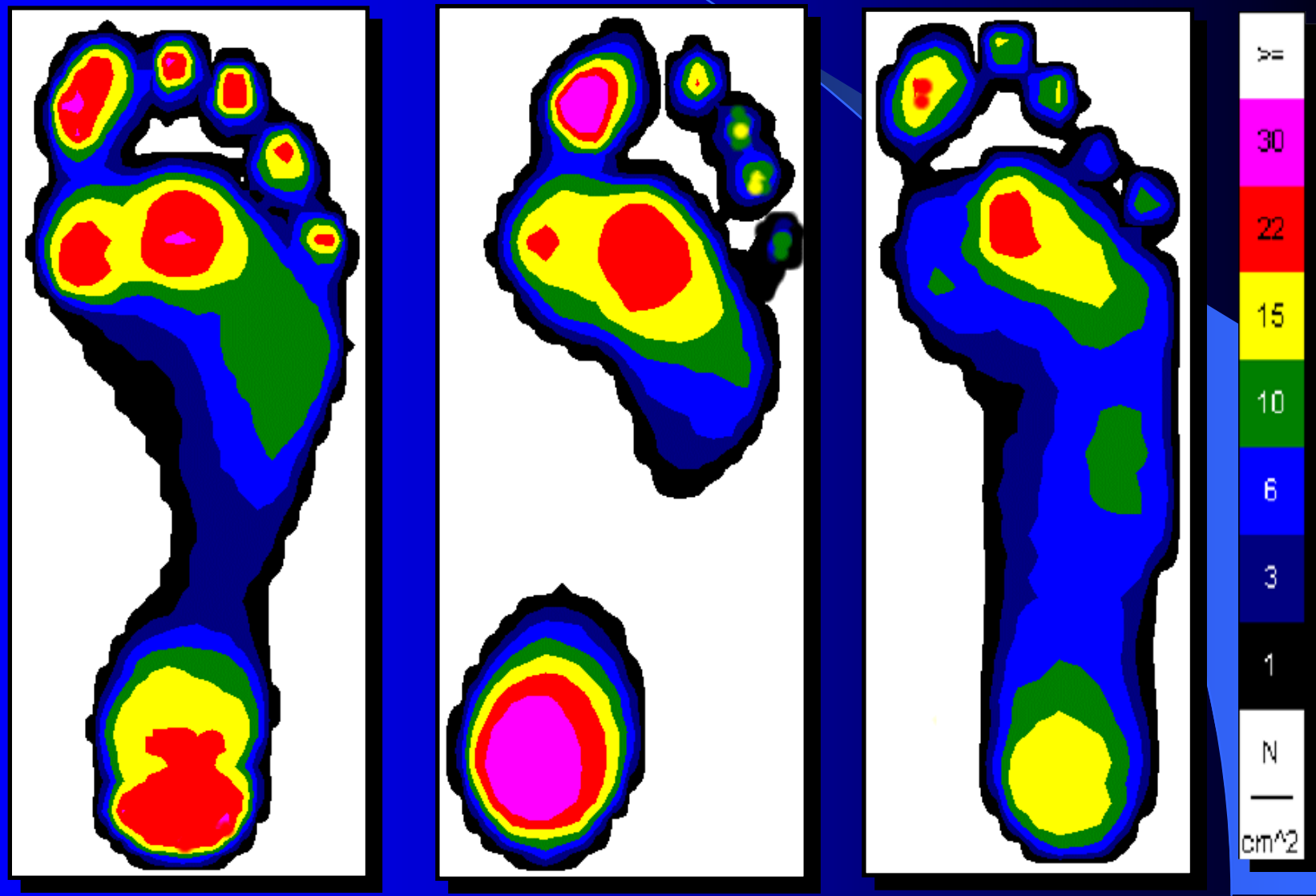
5 trials



Averaged pressure distribution for whole roll over process

Maximum pressure picture (MPP) for:

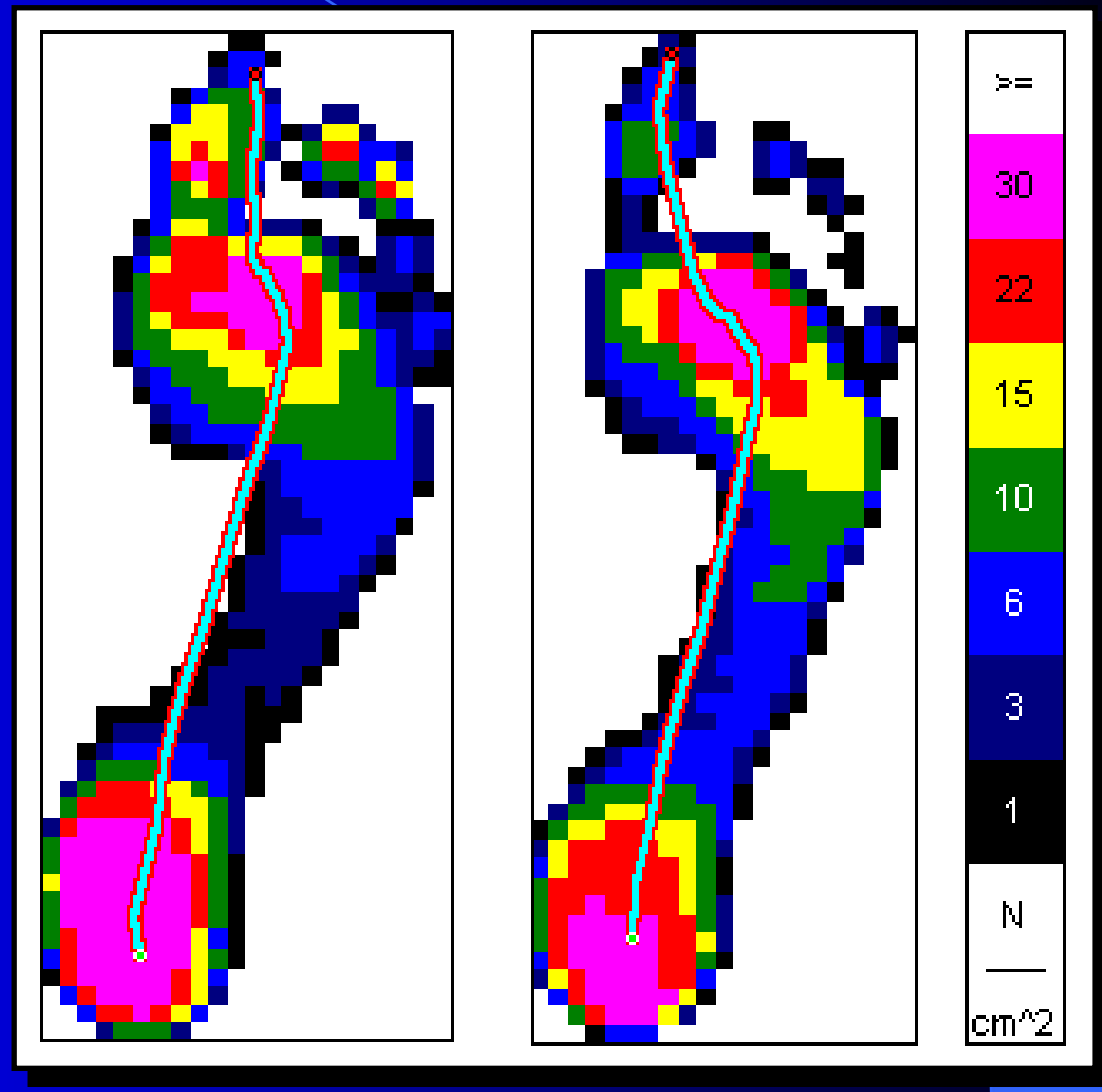
common roll over high arch type flat foot



Toe function without and with hallux brace

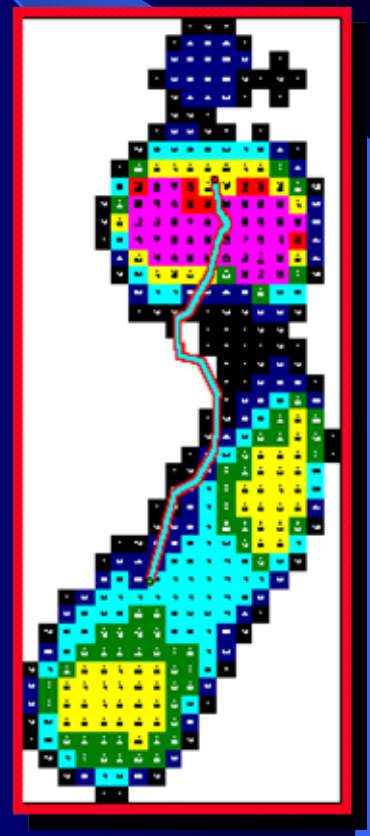
without

with



Important!

Patients with a diabetic foot syndrome have to get special therapeutical footware and special insoles!



Where do(es) the additional force(s) come from?

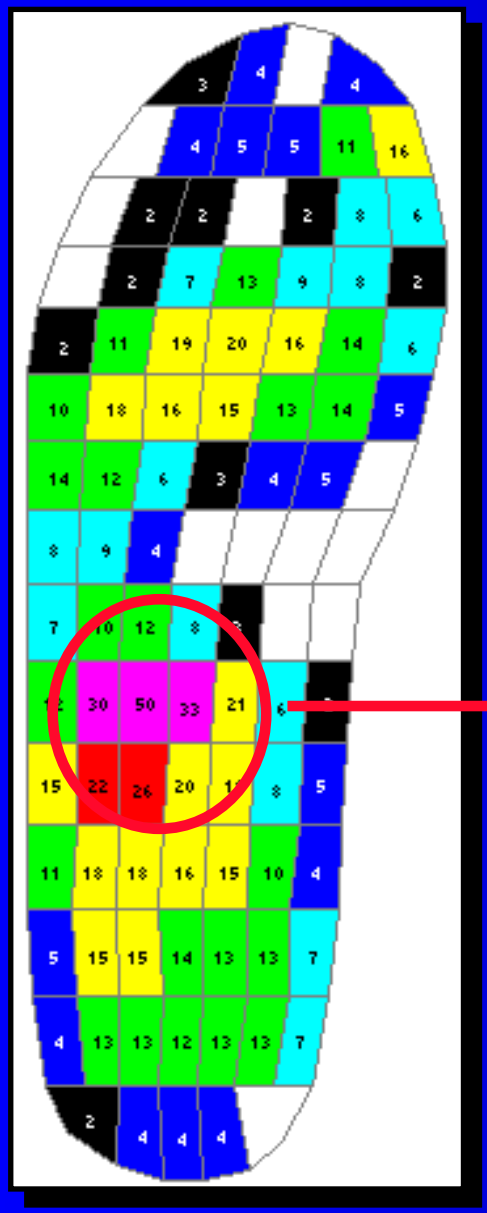
pedar in-shoe system

Measurement online

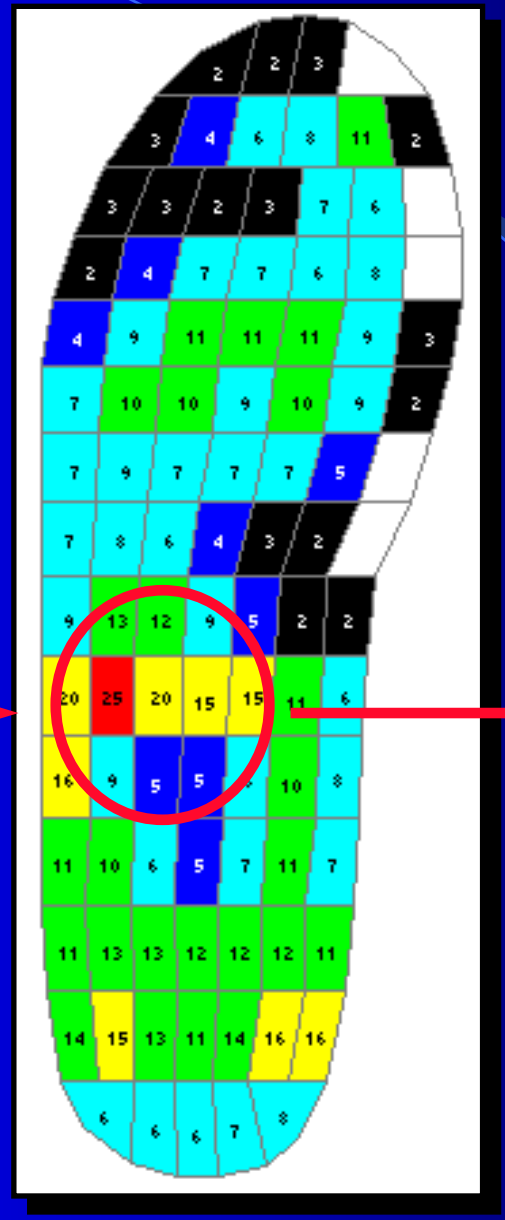
- 2 x 99 sensors
- 10.000 sen./s
  = 50 frames/s
- 2 - 60 N/cm²
- < 5%

Optimization of insole

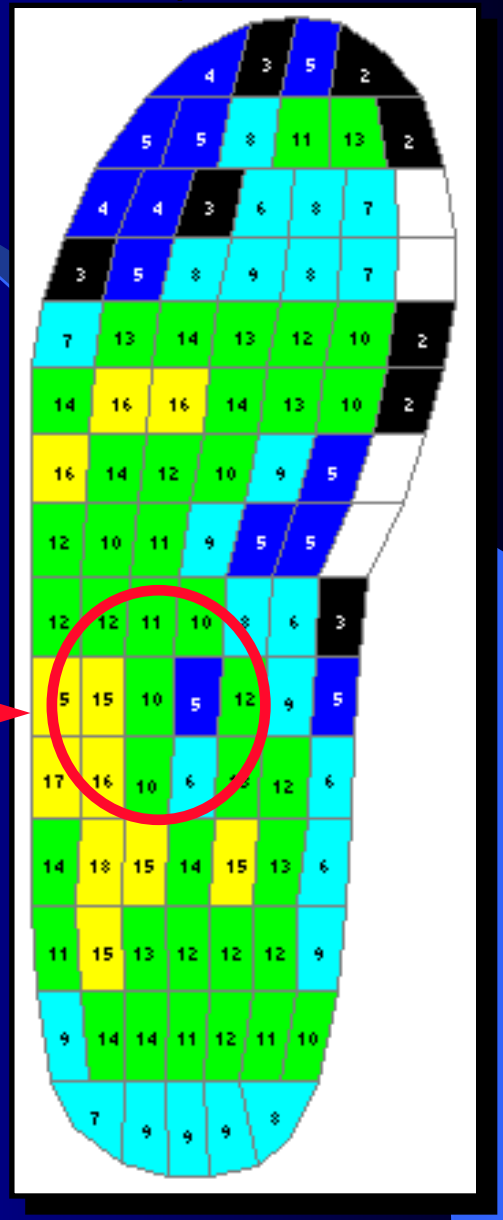
without insole



with insole



with optimized one



Foot wear

Shoes construction and materials are used to reduce the load on the foot during the roll-over process. (cushioning to decrease impact during heel strike).

Foot wear (Cont)

Individuals with reduced plantar fat thickness are at greater risk of overloading their feet during locomotion.

Foot wear (Cont)

- Feet come in all sizes.
- Shoes differ in type and style.
- Foot problems are the result of improperly fitting shoes.

Footwear (Cont)

- The 26 bones in each foot do not fully set until age 18.
- The shoes we wear as children are vital to our future foot health.
- We can still do damage to our adult feet by wearing the wrong shoes.

Footwear (Cont)

Diabetes must get the right fit for their footwear. A proper shoe must be:

- Well fitting.
- Made of soft leather.
- Must have lace-up or velcro to prevent slipping forward causing pressure on the toes

Footwear (Cont)

- Wide and deep enough to accommodate the foot comfortably with out putting pressure on any part of it.
- The entire bottom of the shoe should be flat with a gentle slope upward under the toes.
- The main part of the shoe (upper) must be made of natural material, e.g leather.

Footwear (Cont)

- The lining (inside the shoe) must be smooth and without seems.
- More flexible sole shoes were found to have more decreased plantar pressure then less flexible sole shoes.
- Extra depth shoes alone must be used with insoles to to reduce foot plantar pressure.

- Off the shelf” shoes designed to customize to the feet for comfort and protection. Recommended by foot health professionals for diabetes, arthritis, and forefoot disorders such as bunions and hammer toes. With plastazote foam lining and removable plastazote orthotics.

- Urban walkers are a versatile, “off the shelf) shoe. Designed to ensure proper biomechanical support, They reduce shear force.

Footwear (cont)

Footwear (cont)

Footwear (cont)

Footwear (Cont)

Footwear tested	Mean peak Pressure (Kpa)
• Barefoot.	1194.4
• Extra depth (no insole).	985.5
• Sandal (hand made) with insole.	840.7
• Extra depth shoes with poron insole.	645.2
• Commercial sandal with rubber insole.	594.3
(Jonathan Scarlet & Mark Blais) 1989	

Footwear (Cont)

Footwear tested	Mean peak Pressure (Kpa)
• Commercial tennis shoe with two rubber insole	549.2
• Commercial sandal with rubber insole and metal stave for rigidity.	508.5
• Patients prescribed.	359.5
(Jonathan Scarlet & Mark Blais) 1989	

Insoles

- Insoles are very important is restoring foot shape and function.
- Insoles help reduce plantar pressure.
- Rigid insoles help reduce areas of increased plantar pressure and increase total contact area.

Insoles (Cont)

- Insoles are designed using soft elastic materials.
- Thick insoles help reduce plantar pressure.

Insoles (Cont)

- Components of Proper Insoles.

1. Highly Durable Leatherette Covering
2. Shock Absorbant Impact Foam
3. Medical Grade Polypropylene Support Base
4. Shock Absorbant Crepe Heel
5. Deep Heel Cup to Support & Hold Heel
6. Plastic Protective Base

Improper Footwear

The following type of shoes must be avoided.

- Slip on shoes. (constrict the foot and cause it to slide forward)
- Court shoes. (low fronted with no support to the foot and narrow at toe box)
- Sandals (leave the toe exposed)

Things you should not do

- Never walk barefoot.
- Women should try to limit the use of fashion shoes and use more “foot friendly” shoe for everyday wear.

Conclusion

- Studies showed 19% recurrence rate of healed ulcer in patients with modified shoes Compared to 90% recurrence rate in patients with normal foot wear.

Conclusion (Cont)

- Patients prescribed (custom designed) Shoes were shown to reduce pressure tremendously.

Conclusion (Cont)

The shoes we wear are very important for health feet. However, they very critical for diabetic patients health.

Thank You