The Effect of Insoles in Reducing Plantar Pressure in Diabetic Patients

Saleh S. AL- Tayyar , Hassan AL- Fahel

Saleh AL-Tayyar Ph.D

Director General / Medical Devices . SFDA

Assistant Professor / Biomedical Technology Department

Biomechanics Consultant / Foot Care Unit

King Abdulaziz University hospital Diabetic Center

King Saud University

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)

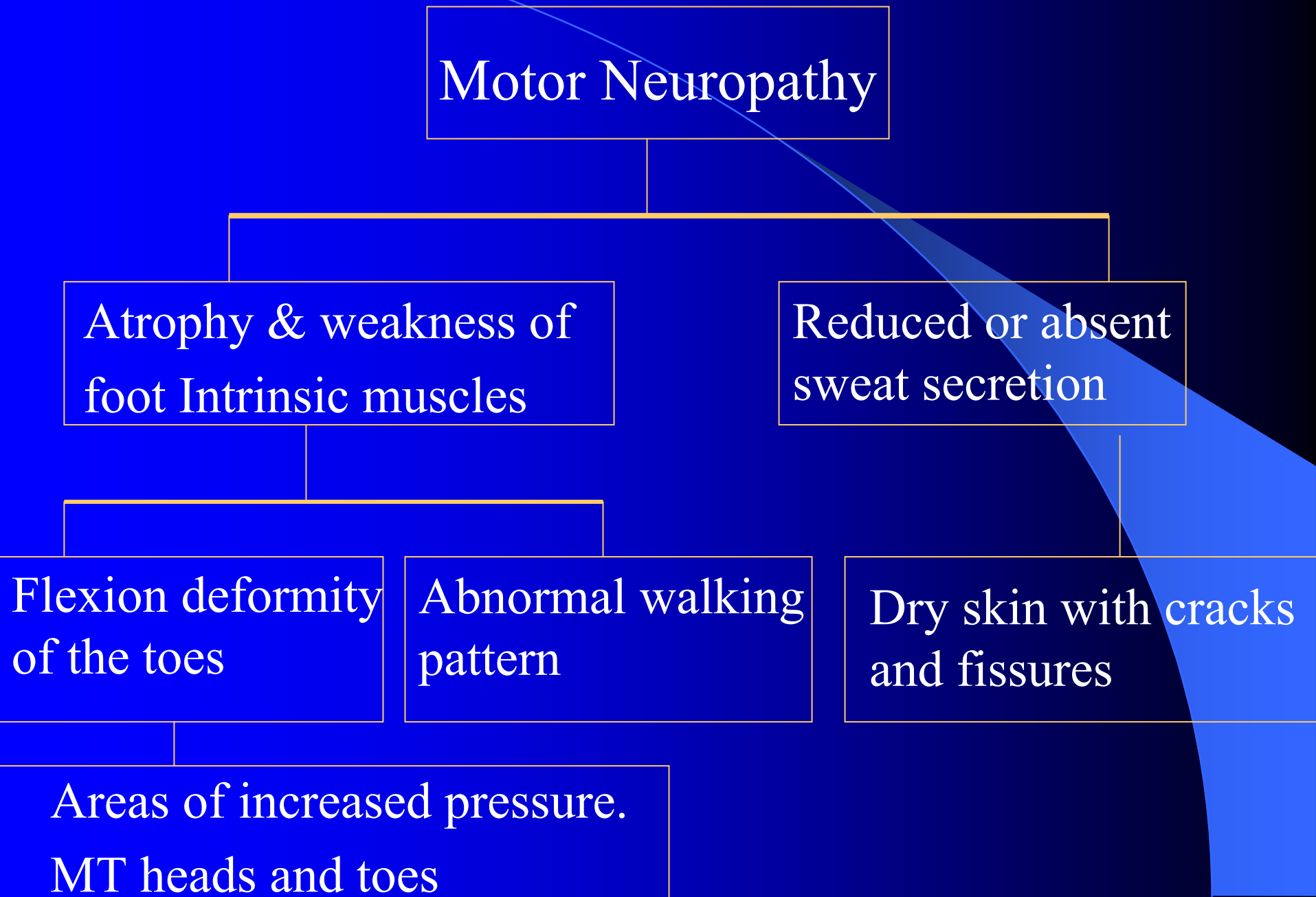
- Increased dynamic foot pressures is a major risk factor in the formation of diabetic foot ulcer.
- Foot related hospital admission constitutes 20% of all diabetic patients admission.
- Foot care and Patients footwear education are important initial treatment for diabetic feet at risk.

Background (Cont)

- Neuropathic ulcerations result from repetitive stress over areas of high pressure.
- Ulcers are predicted at a pressure greater than (500 Kpa)

Background (Cont)

- **50% of all amputation in diabetic patients are preceded by injury from footwear. Which is Rarely seen in non-diabetic people.**


Motor Neuropathy
Atrophy & weakness of foot Intrinsic muscles
Reduced or absent sweat secretion
Flexion deformity of the toes
Abnormal walking pattern
Dry skin with cracks 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)

Dr. Paul W Brand recognized in the late 50's the plantar foot ulceration to be a mechanical rather than medical.

Plantar Pressure (Cont)

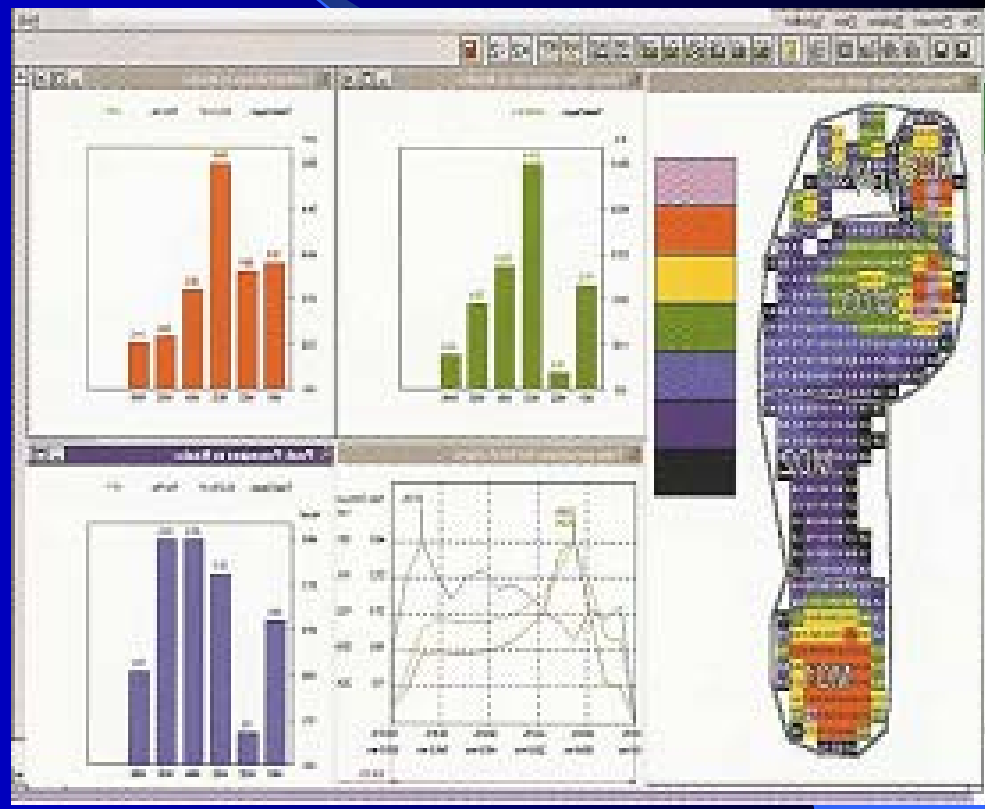
Researchers at the National Hansen's Disease Programs have done extensive rsearch on prevention of amputation by removing/reducing the mechanical foot stresses through footwear and/or footwear modification

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

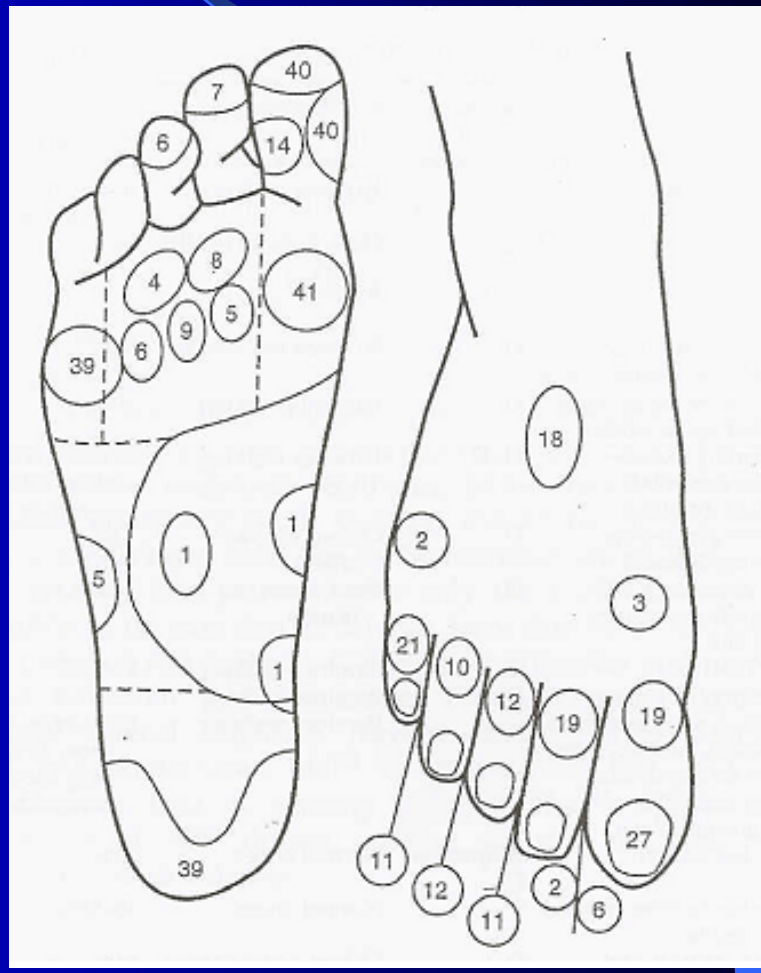
Plantar Pressure (Cont)

high risk of injuries as a result of Diabetic feet mismatch between footwear and foot due to pressure and shear Stresses resulting from both foot deformity and Improper footwear,



Plantar Pressure (Cont)

- **Localization of foot ulcers**



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)

Types of pressure distribution measurement:

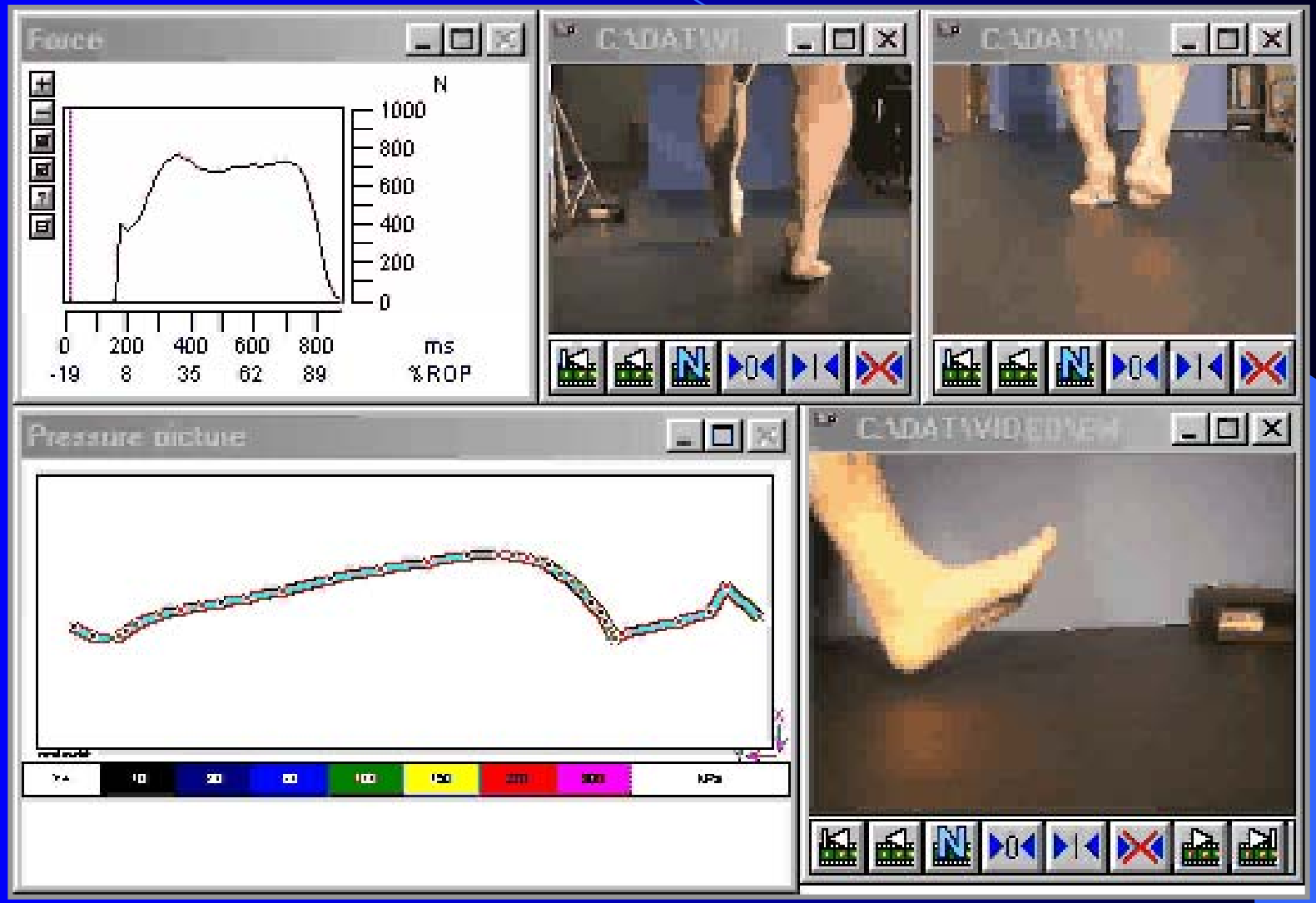
I. Diagnostics: barefoot measurement

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

- Protocols:
  - first step,
  - free walking

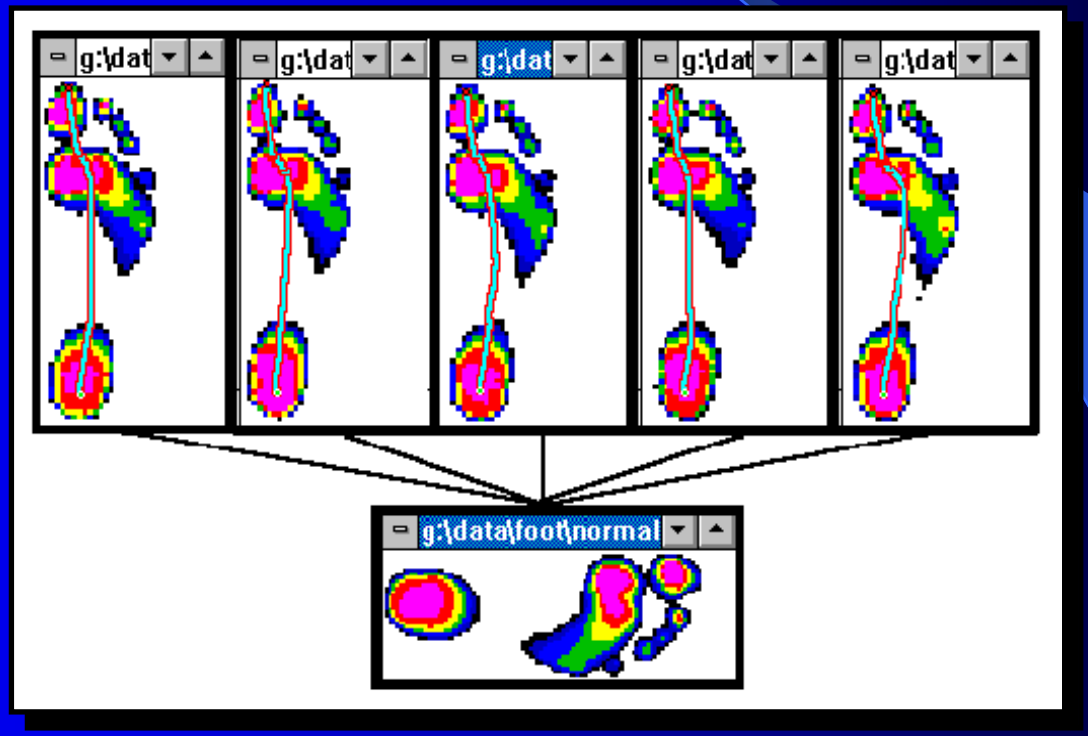
Only the dynamic barefoot measurement on the platform can be used for functional diagnostics!

Example of a dynamic pressure distribution measurement



Calculation of averaged pressure distribution

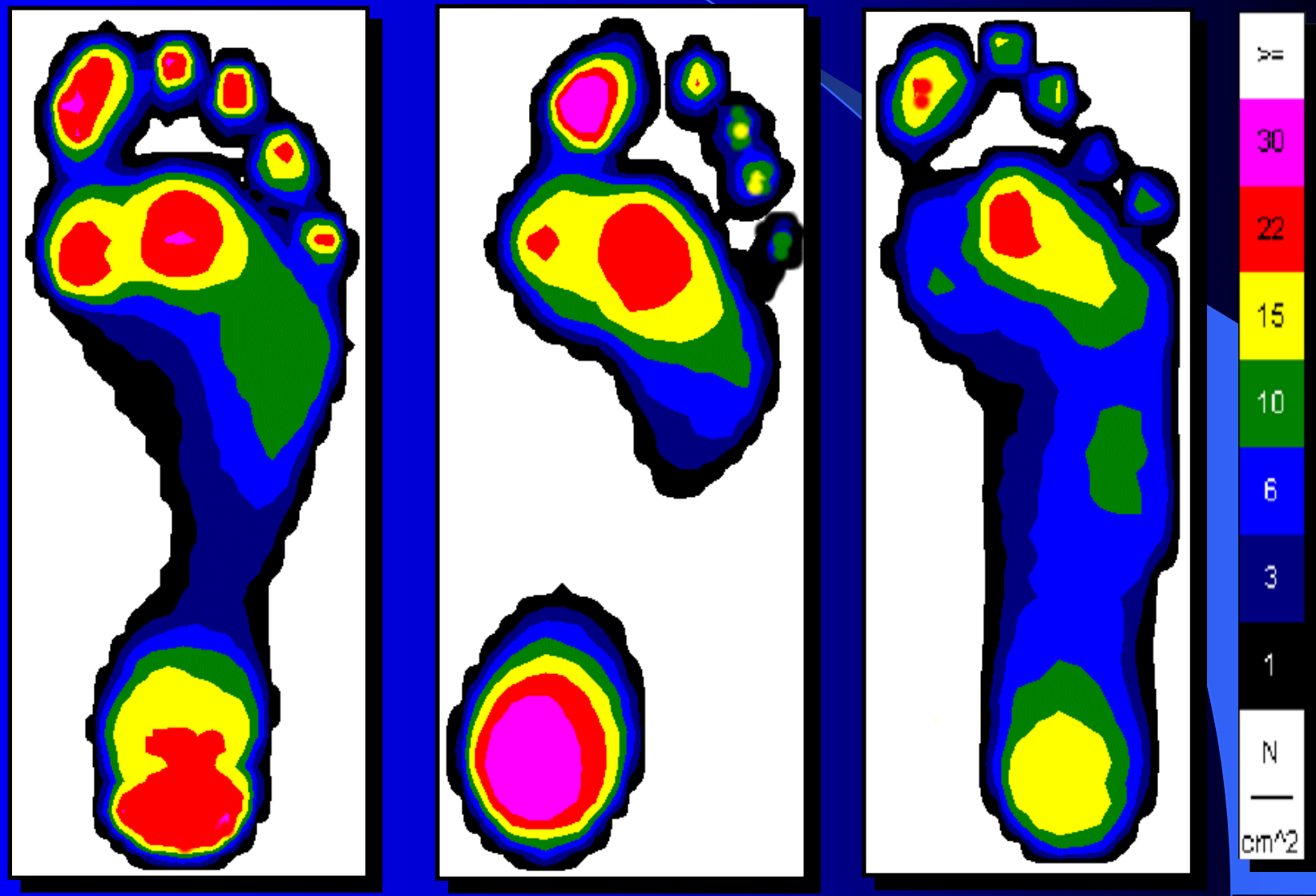
5 trials



Averaged pressure distribution for whole roll over process

Maximum pressure picture (MPP) for:

common roll over high arch type flat foot

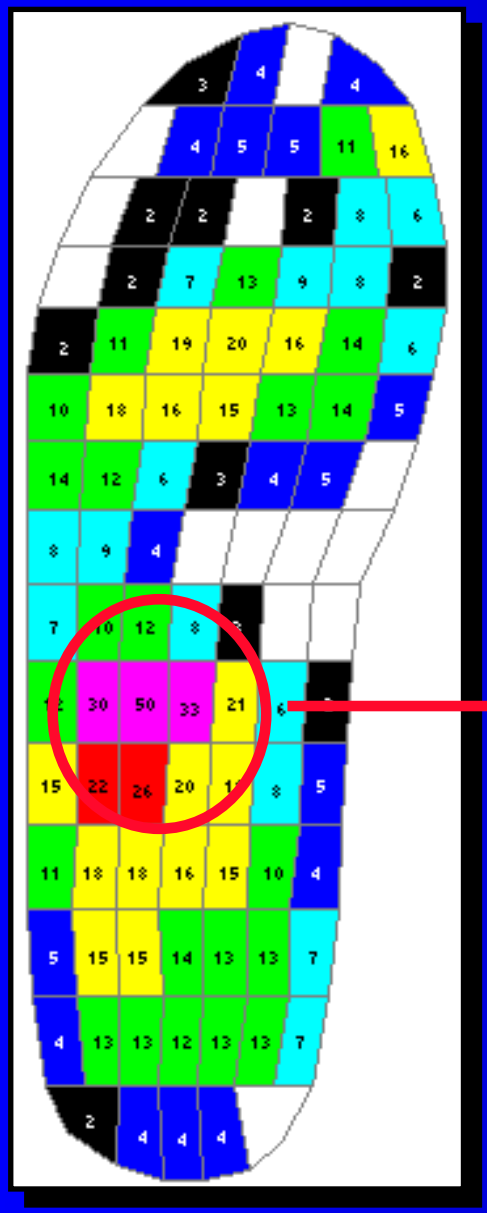


pedar in-shoe system

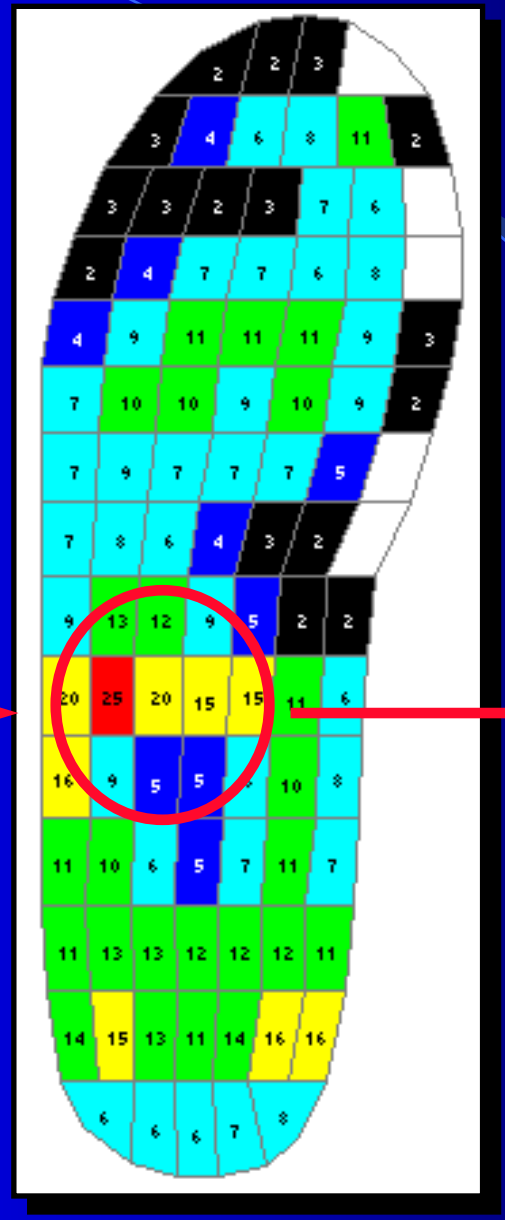
- 2 x 99 sensors
- 10.000 sen./s
  = 50 frames/s
- 2 - 60 N/cm²
- < 5%

Optimization of insole

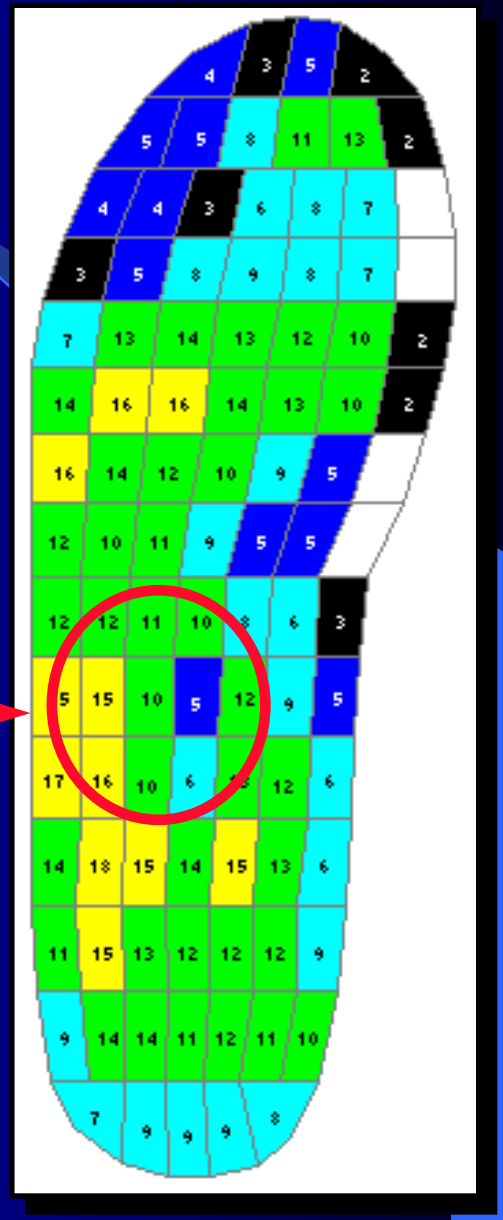
without insole



with insole



with optimized one



Insoles

- Insoles are very important in 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

Objective

The objective of this study is to look at the effect of insoles in reducing plantar pressure in diabetic patients.

Methods

- 32 Subjects with type 2 diabetes (16 females and 16 males).

Females

mean age = 54.4 + 14.2 years

mean mass = 76.4 + 13.9 Kg.

Males

mean age = 51.8 + 9.9 years

mean mass = 90.1 + 19.6 Kg.

Methods (cont)

- Subjects were asked to walk bare foot across the e-med platform, and their plantar pressure was measured.
- Insoles were designed and manufactured according to subjects conditions.
- In shoe plantar pressure measurements were performed using pedar system with subjects wearing their insoles.

Results

The maximum and minimum Bare foot vs Inshoe plantar pressure for both females and males subjects were tabulated and are shown in the following tables.

Results (cont)

Bare Foot vs Inshoe Plantar Pressure (Kpa) Females Subject (Right Feet)		
	Bare Foot	Inshoe
Maximum	٨٩٠	231.4
Minimum	395	80
Average	635	163.4

Results (cont)

Bare Foot vs Inshoe Plantar Pressure (Kpa) Females Subject (Left Feet)		
	Bare Foot	Inshoe
Maximum	1195	341.8
Minimum	395	90
Average	708.8	175.6

Results (cont)

Bare Foot vs Inshoe Plantar Pressure (Kpa) Males Subject (Right Feet)		
	Bare Foot	Inshoe
Maximum	1265	450
Minimum	270	150
Average	651.6	237.2

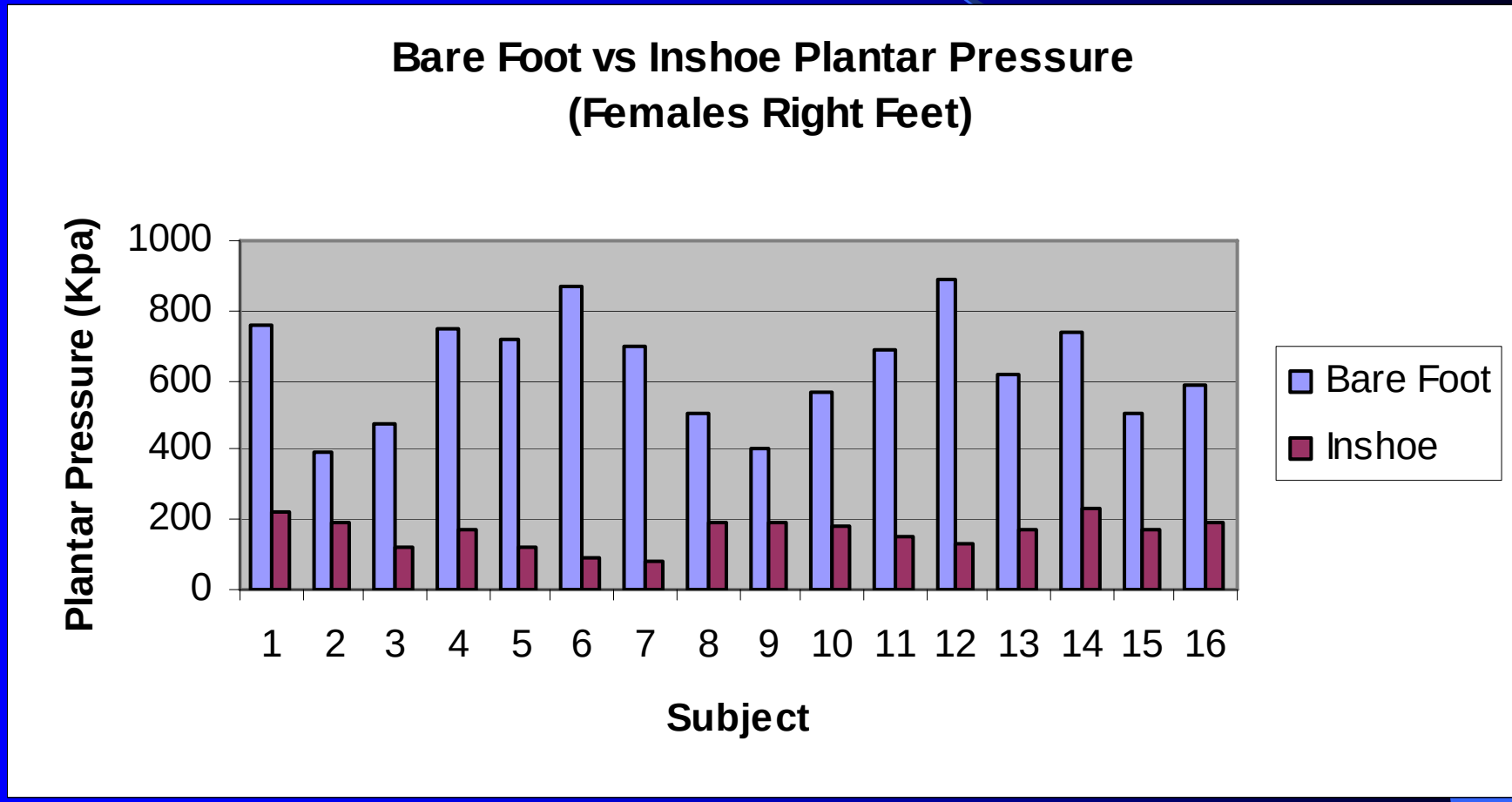
Results (cont)

Bare Foot vs Inshoe Plantar Pressure (Kpa) Males Subject (Left Feet)		
	Bare Foot	Inshoe
Maximum	1020	٦٩٠
Minimum	245	120
Average	594.1	224.9

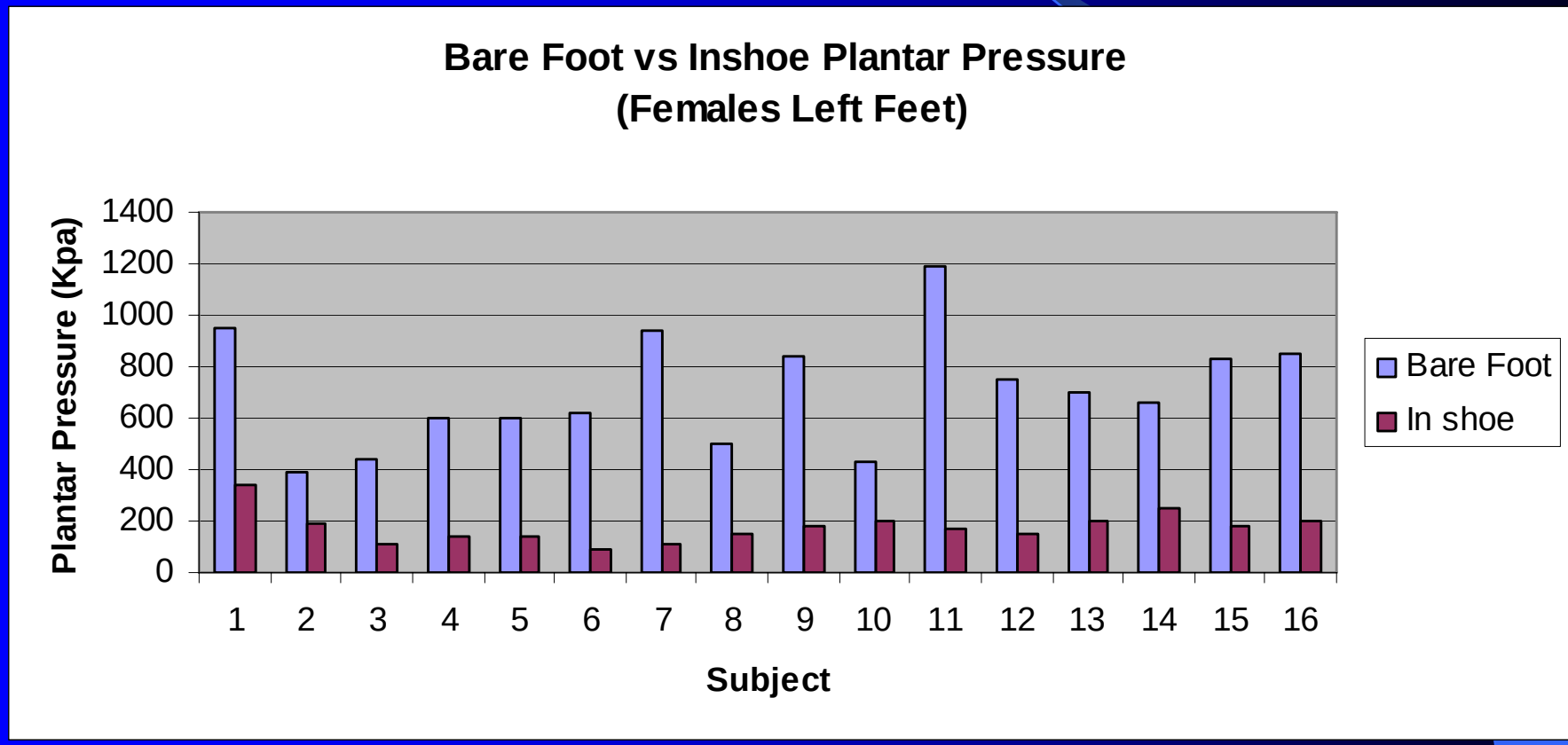
Results (cont)

Percent Reduction in Plantar Pressure		
	Right Foot	Left Foot
Females	74.4%	75.2%
Males	63.6%	62.1%

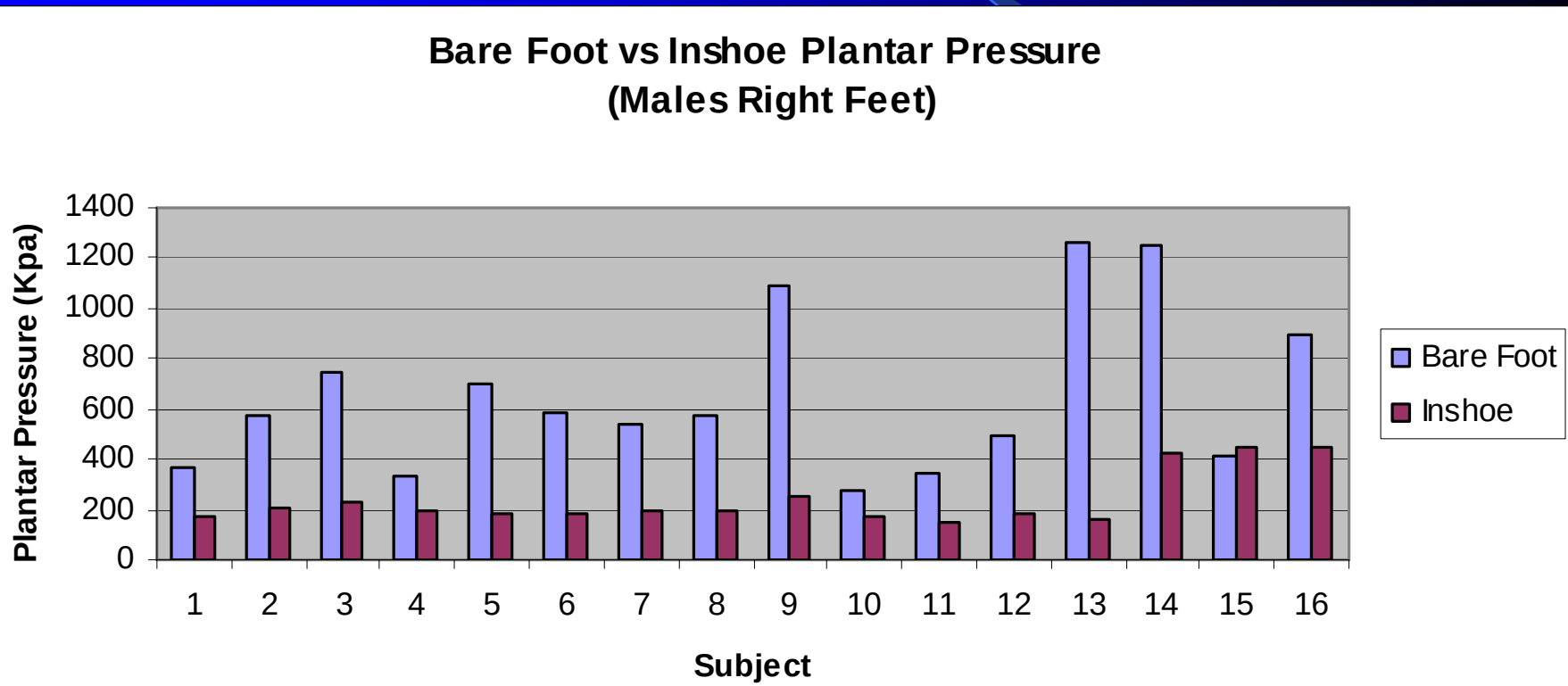
Results (cont)



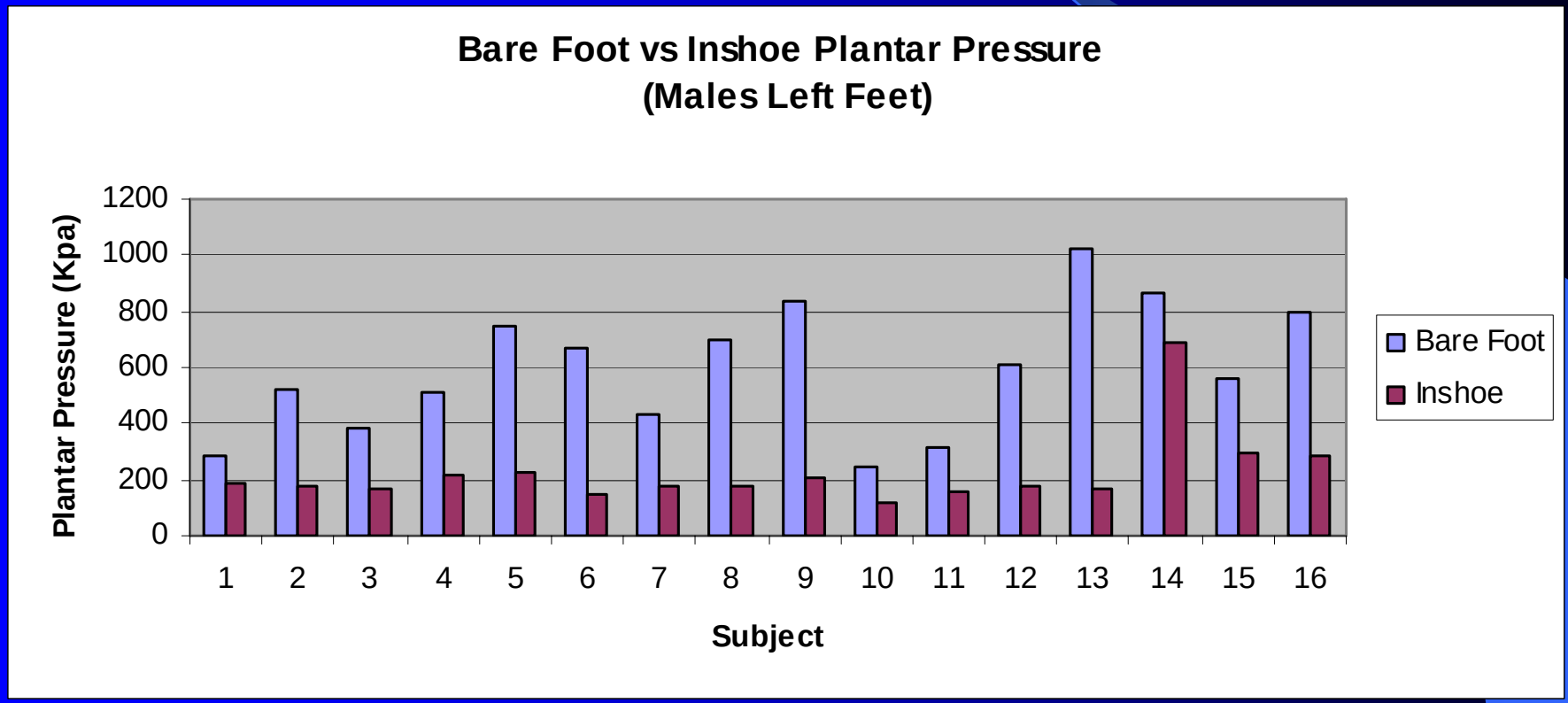
Results (cont)



Results (cont)



Results (cont)



Conclusion

- A significant reduction in the plantar pressure was achieved by fitting patients with custom made insoles.
- The maximum in shoe plantar pressure was 237.2 Kpa and was seen in males right feet, and the minimum was 163.4 Kpa and was seen in females right feet.

Conclusion (cont)

- Females were shown to have greater reduction than males (i.e 75.2% compared to 63.6% in males).

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