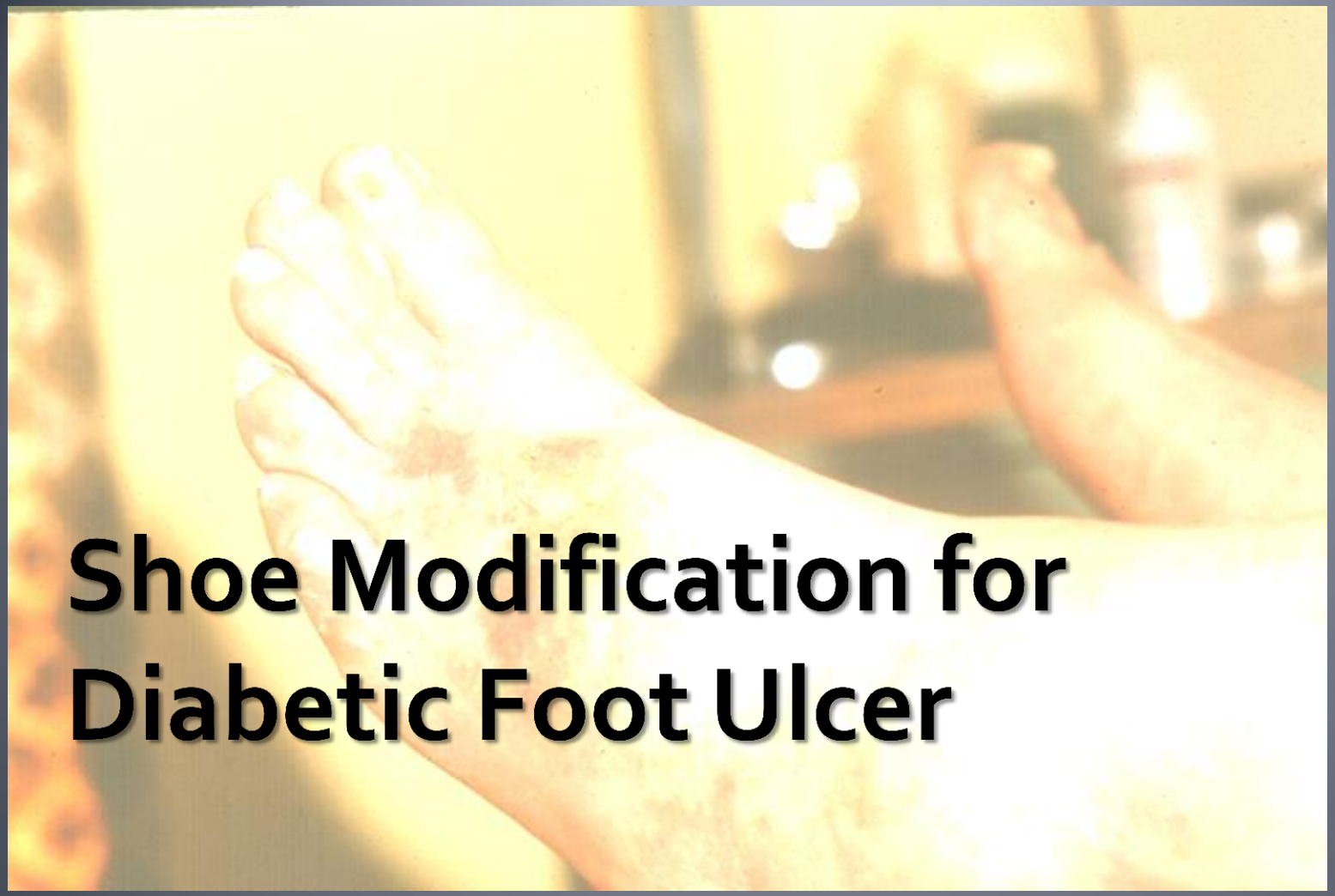


Shoe Modification for Diabetic Foot Ulcer

Jong Moon Kim M.D., Ph.D.
Department of Rehabilitation Medicine,
School of Medicine, Konkuk University

DM foot ulcer

- DM: 7% of the adult population.
  - 333 M in 2011 → 552 M by 2030

- DM foot: 15 - 25 % of DM patients
- 20% of DM patients admitted for foot problem

- 50 % of non TA Lex Amputation caused by diabetes.

Tragic "Rule of 50"

- 50% of amputations → Transfemoral/ transtibial level
- 50% of patients → 2nd amputation in ≤ 5 years
- 50% of patients → Die in ≤ 5 years

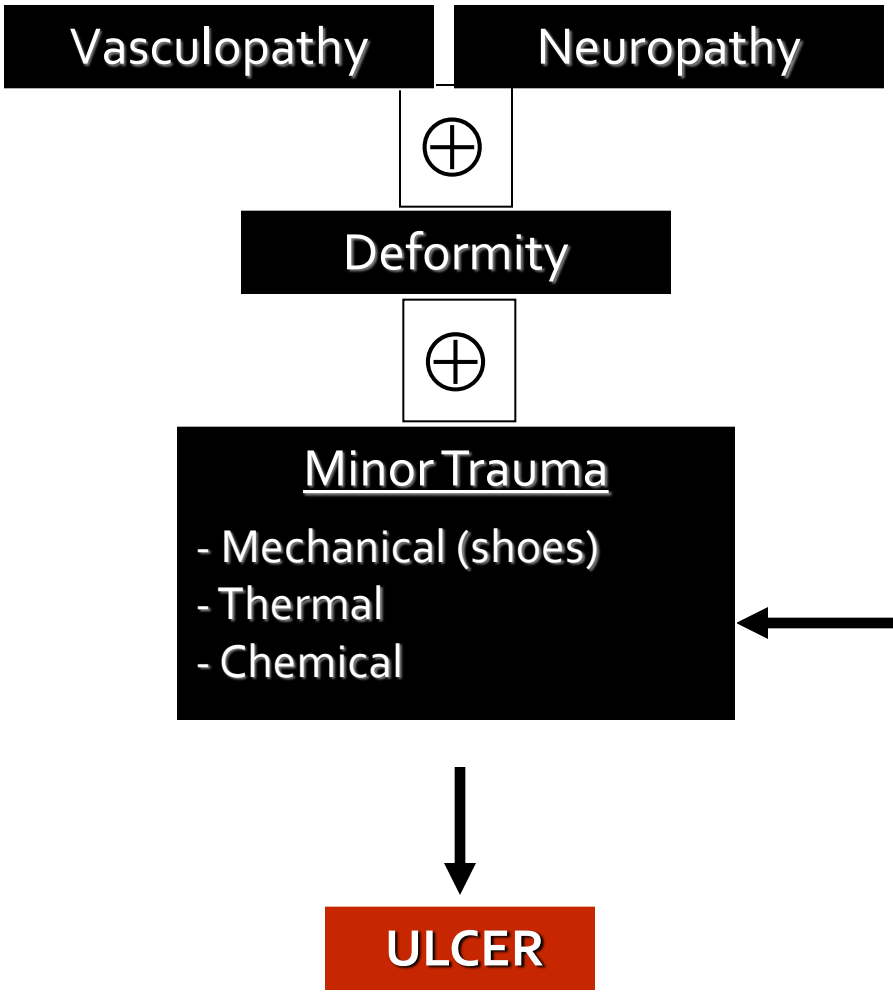
Clinical Care of the Diabetic Foot, 2005

Tragic "Rule of 15"

- 15% of diabetes patients → Foot ulcer in lifetime
- 15% of foot ulcers → Osteomyelitis
- 15% of foot ulcers → Amputation

Clinical Care of the Diabetic Foot, 2005

Causal Pathways for Foot Ulcers



% Causal Pathways

Neuropathy:	78%
Minor trauma:	79%
Deformity:	63%
Behavioral	?

Diabetes Care. 1999; 22:157

Causes of DM foot

1. **Peripheral neuropathy**
2. **Peripheral vascular disease**
3. **Poor immune system & slow wound healing**
4. **Trauma**
    1. **Acute:** any injury such as burns or cuts

    2. **Chronic:** due to foot **deformities**

        : changes of foot shape

        → ill-fitting shoes

        → ulceration

Pathophysiology

Trauma

Acute trauma

absence of nociception
→ abrasions and burns occur
→ Poor wound healing
→ ulcerations

Chronic trauma

reduced motor function
→ results in a high arch
+ decreased proprioception
→ classical deformed foot shapes.
→ bony prominences
+ high mechanical pressure
→ ulceration.

Shoe modification for DM foot

RENALAN'S VISUAL GUIDE TO DRESS SHOES

SHOES


Saddle/Spectator


Longwing Blucher


Shortwing Blucher


Split Toe Blucher


Plain Toe Blucher


Medallion Cap Toe Balmoral


Perf Toe Balmoral


Cap Toe Balmoral


Medallion Toe Wholecut


Wholecut


Opera Pump

BOOTS


Jodhpur Boot


Chelsea Boot


Chukka Boot


Wingtip Boot


Split Toe Boot


Plain Toe Boot


Cap Toe Boot


Balmoral Boot

LOAFERS


Moc Toe Penny Loafer


Horsebit Loafer


Tassel Loafer


Fullstrap Loafer


Double Monkstrap


Single Monkstrap

LEATHERS


Suede


Chromexcel


Pebble/Scotch Grain


Shell Cordovan


Calfskin


Patent Leather

SOLES


Wedge


Commando


Dainite


Leather Dress

FORMALITY ⟶

NOTE

TAKE THIS AS A GENERAL GUIDELINE ONLY. THERE ARE HUNDREDS OF STYLES OF SHOES, I'VE ONLY LISTED SOME OF THE MOST COMMON STYLES. MANY DIFFERENT FEATURES CONTRIBUTE TO A SHOE'S FORMALITY AND HOW FORMAL A SHOE IS, IS EASILY DEBATABLE.

Why do we wear shoes?

Why do we wear shoes?

- Protection
- Fashion
- Functioning
- Correction (?)

Why do we wear shoes?

Traditionally…

- Protection

Why do we wear shoes?

But now….

- Fashion

Why do we wear shoes?

But now….

- Fashion

Why do we wear shoes?

But now….

- Fashion

Management

The Normal Foot

"If a patient with diabetes has normal feet, do we need to worry ?"

➔*...YES !*

➔ wearing the correct footwear

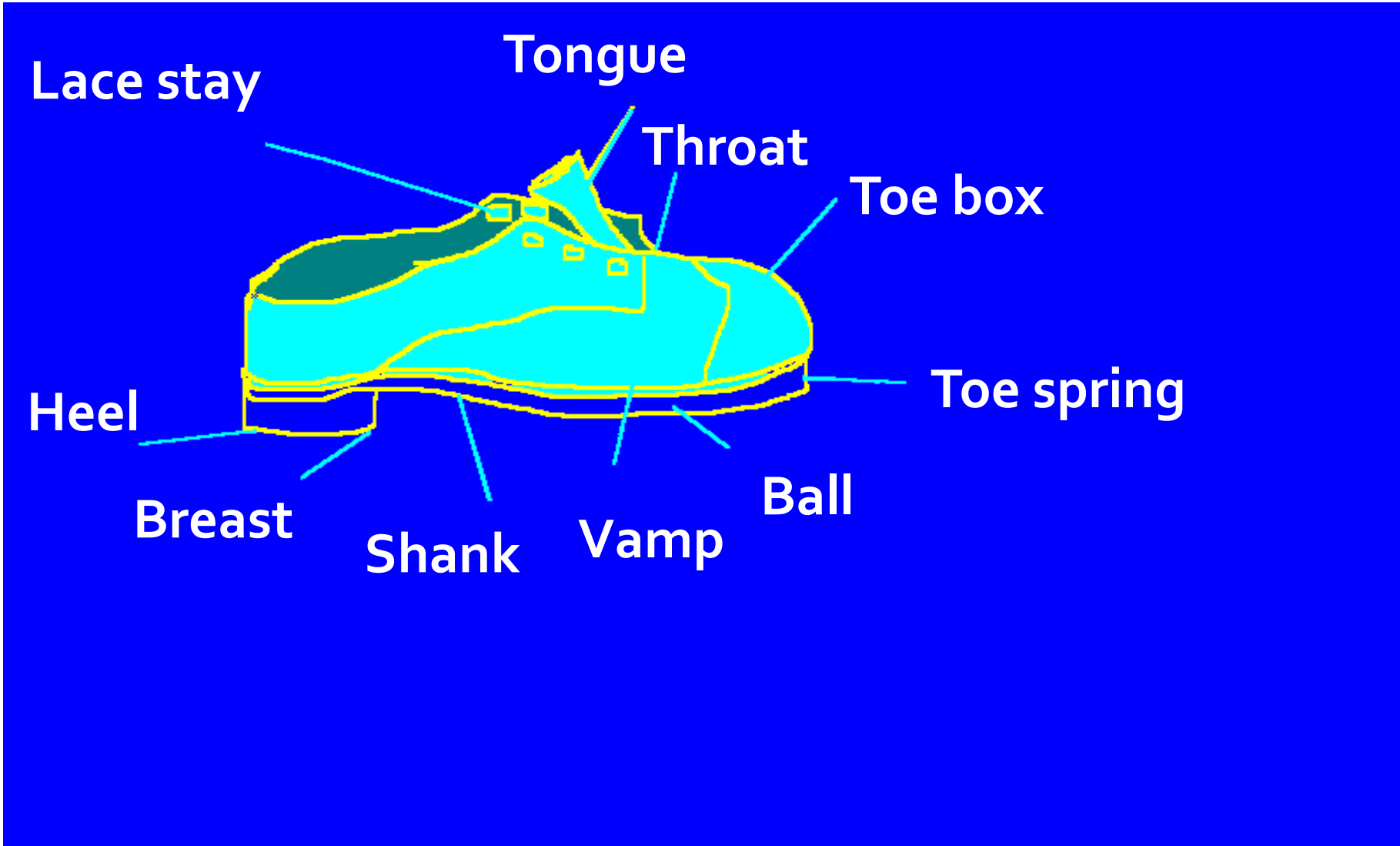
Good pairs of shoes for men and women

Bad shoe type

Shoe Components

- Common type of shoe

Shoe Components



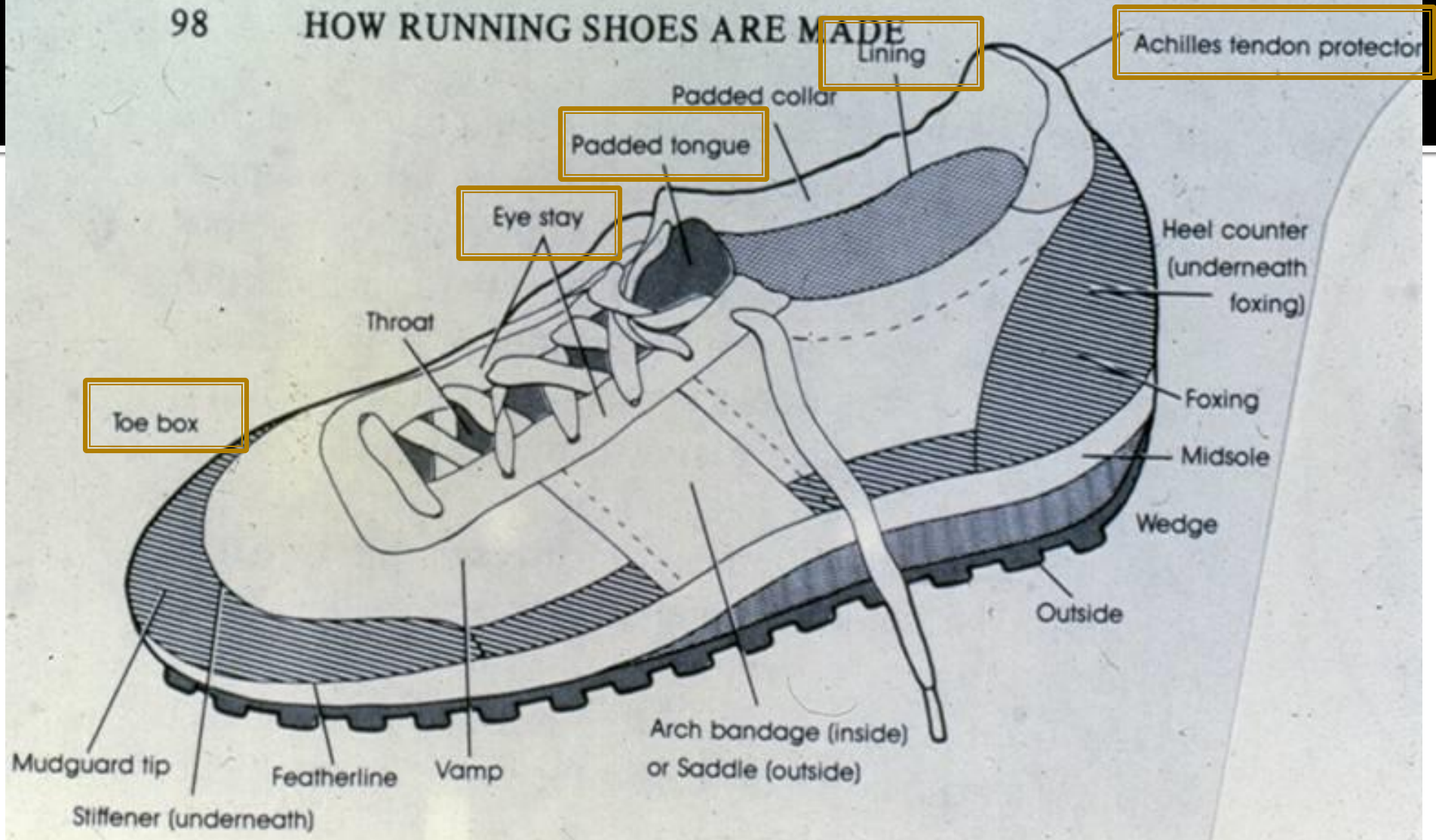


Fig. 5.1a The various parts of a typical running shoe.

Good shoe guide

- Toe box
  - sufficiently long, broad and deep → toes without pressing
  - a clear space between the apices of the toe
- Shoes
  - fasten with adjustable lace, strap or Velcro
- The inner lining: smooth
- The heel < 5 cm
  - to avoid weight being thrown forward into metatarsal heads

- Stocking or socks
  - always be worn to avoid blisters
  - Not much slippery
  - High in order to hold foot firmly inside
  - reduce frictional forces when the patient walks

Management

The At-Risk Foot

- Deformities

→ properly fitting footwear. Special footwear will be needed if the deformity is severe.

→ Some specific deformities need special management;

- Clawed toes: a wide, deep, soft toe box.

Extra depth shoes to protect the apices of the toes

- Prominent metatarsal heads

Extra depth stock shoe with cushioning insole (metatarsal pad)

Dry skin and fissure: moisturizing with cream, reduce fissure margins with scalpel

CALLUSES

CAUSE → PRESSURE

Usually a bony prominence

most important pre-ulcerative lesion
→ regularly and sufficiently remove

Callus removal


SUPPORTIVE DEVICES

THERAPEUTIC FOOTWEAR: GOALS

- **Inappropriate footwear:**
  - Contributes to 21-76% of ulcers/amputations
- **Optimal footwear should:**
  - Protect feet from external injury
  - Reduce plantar pressure, shock and shear forces
  - Accommodate, stabilize, support deformities
  - Suitable for occupation, home, leisure

Diabetes Care 2004; 27:1832 Diab Metab Res Rev 2004; 20(Suppl1):S51

Shoe modification for DM patients 1.

- **Shape & Design**
  - Dr.'s first consideration, but few well designed clinical study
  - Based by plantar pressure measurement
- **Functional Insole**
  - 50% reduction of peak pressure on the forefoot
  - In therapeutic purposes, the most effective method for DM foot

Shoe modification for DM patients 2.

- **Custom-made insole**
  - Reducing pressure where the ulceration occurred
  - Effectiveness for reducing peak plantar pressure in DM patients
- **Center of gravity**
  - pressure distribution
- **Medial arch support/ Met Pad**
  - Reducing max pressure as much as 36~39% at metatarsal head

THERAPEUTIC FOOTWEAR: COMPONENTS

- **Padded socks** (eg. CoolMax, Duraspun, others)
  - Cushion metatarsal heads & heels
  - decrease plantar pressure
  - White, seamless, absorbent acrylic fibers

- **Shoe inserts/insoles** (closed-cell foam, viscoelastic)
  - Off-the-shelf
  - Custom-molded

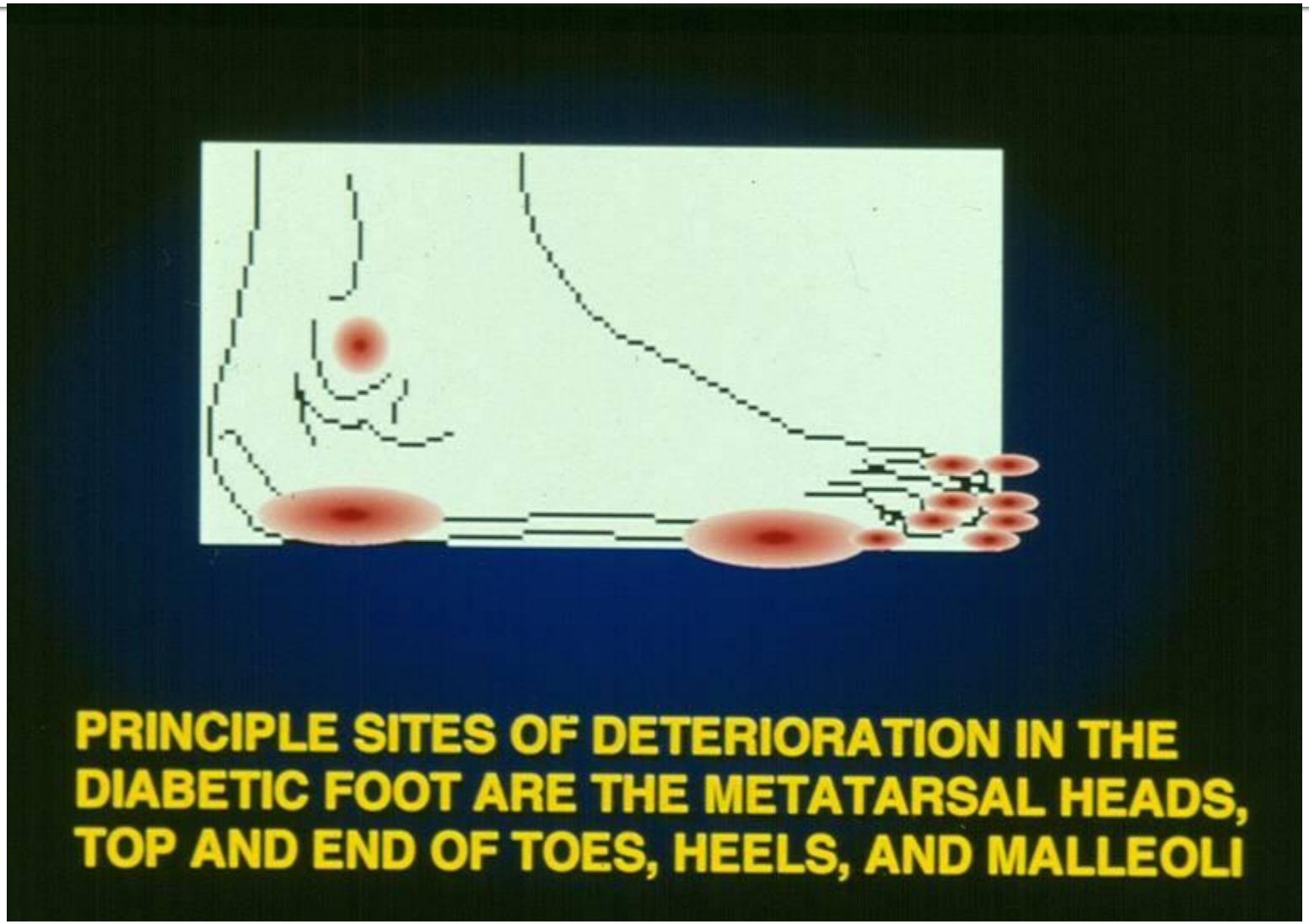
- **Therapeutic shoes**
  - Extra-depth ± extra-width
  - Rigid rocker outsoles
  - Custom-molded

THERAPEUTIC FOOTWEAR: EFFICACY

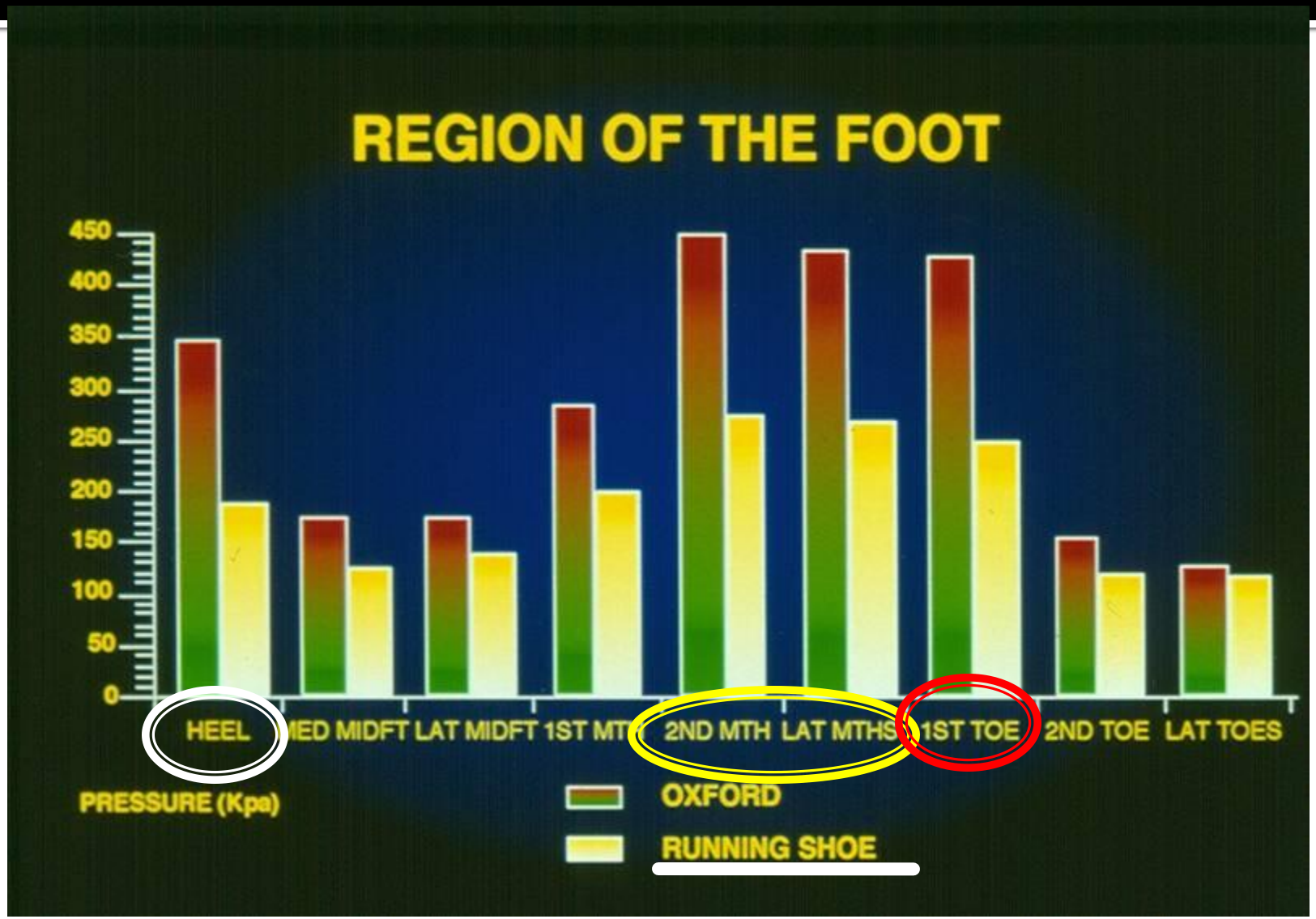
- **Decreases plantar pressure 50-70%**
- **Uncertain reduction in ulcer rate:**
  - *1° prevention: no data*
  - 2° prevention: controversial reduction of ulcer recurrence
    - Analytic/descriptive studies: **decreases ulcers 50-75%**
    - *2 RCTs: no benefit*
- **Benefits vary with footwear use, risk level?**
  - Severe foot deformity, prior toe/ray amputation?

Diabetes Care 2004; 27:1774

Common spots of DM Foot ulcer



Pressure during running



FOOTWEAR RECOMMENDATIONS BY RISK LEVEL

Low Risk (0)	Proper style/fit, cushioned stock shoes
↓ Sensation (1)	Deep toe box shoes, cushioned insoles
Callosities, ulcer Hx	Extra-depth stock shoes custom-molded insole
Severe deformities	Custom-molded extra-depth shoes and insoles, rigid rocker outsoles

Modified from The Foot in Diabetes, 2000, p136

Gait-Related Strategies for the Prevention of Plantar Ulcer Development in the High Risk Foot

Frank L. Bowling, Neil D. Reeves and
Andrew J. Boulton

- Diabetic foot ulcer by High plantar pressures
  - Particularly in the forefoot region around the metatarsal heads
- High plantar pressures persist during gait
  - peripheral neuropathy
  - foot deformities
  - limited ankle dorsi-flexion range of motion
  - Loss of subcutaneous fat tissue in the diabetic foot
    - bony prominences and predisposes to high-pressure areas

    ➔ injectable silicone: to augment tissue thickness and prevent the development of ulceration

- Shoes adapted with external rocker profiles
  - reduce pressures in the metatarsal heads
  - facilitate plantar flexion
  - restrict sagital plane motion of the MPJ
- Insoles custom-molded
  - reduce plantar pressures
  - minimize the risk of ulceration in the forefoot region

A comparison of customized and prefabricated insoles to reduce risk factors for neuropathic diabetic foot ulceration : a participant-blinded randomised controlled trial

Joanne S Paton1*, Elizabeth A Stenhouse1, Graham Bruce2, Daniel Zahra3 and Ray B Jones1

Journal of Foot and Ankle Research 2012, 5:31

Background

- Custom-made functional insoles Vs Prefabricated insoles

- To reduce risk factors for ulceration of neuropathic diabetic feet

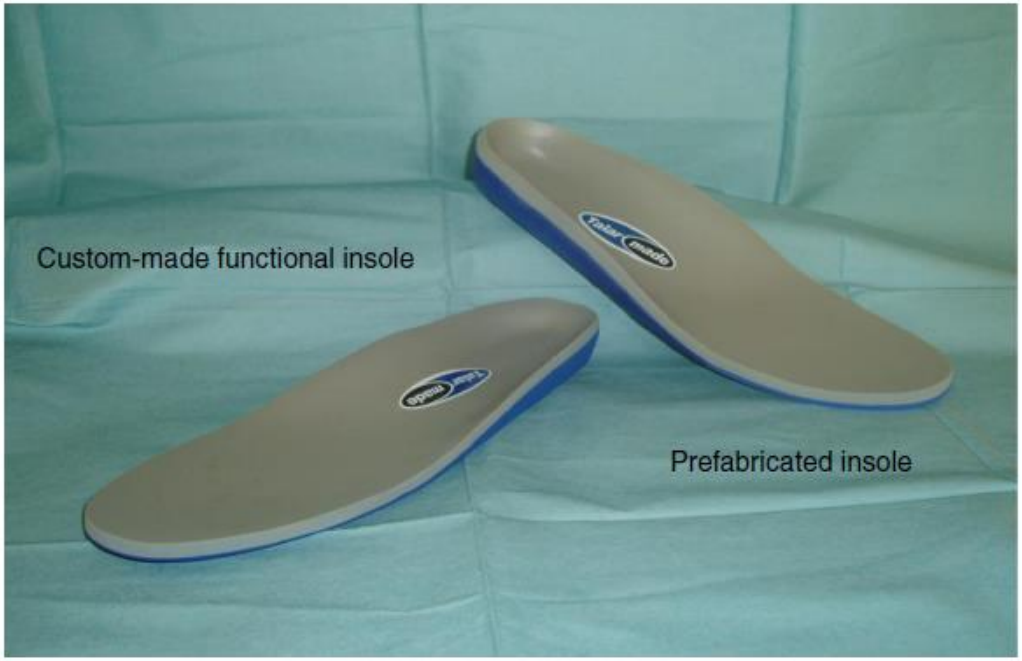


Figure 1 Example of the insoles used within the trial.

Outcome measurements

- Primary outcome measures
  - Peak pressure
  - Total contact area
  - Forefoot pressure time integral
  - Rate of forefoot loading
- Secondary outcome measures
  - Two self-report questionnaires
  - Bristol Foot Score
  - Audit of Diabetes Dependent Quality of Life
- Cost

Results

- Peak pressure, total contact area, rate of forefoot loading, duration of load
  - no difference between custom-made functional and prefabricated insoles
- Forefoot pressure time integral
  - greater percent reduction for the custom made functional insole
- Bristol Foot Score or Audit of Diabetes Dependent Quality of Life
  - no differences between custom-made functional insoles and prefabricated insoles

- Blind testing
  - participants were asked at completion of the study to guess their intervention group assignment

- 45 respondents receiving the prefabricated insole
  - 25 (56%): the custom-made functional insole
  - 4 (8%): prefabricated insole
  - 16 (36%): not know
- 46 respondents receiving the custom-made functional insole
  - 30 (65%): custom-made functional insole
  - 4 (9%): prefabricated insole
  - 12 (26%): did not know
- Correct Vs. Incorrect
  - 34 (37%) – guessed correctly
  - 29 (32%) - guessed incorrectly
  - 28 (31%) - unable to decide

- Cost
  - Prefabricated(£31.73)
  - custom made functional insoles(£137.65)
    - About 4 times expensive than prefabricated

Conclusion

- Custom-made insoles are more expensive than prefabricated insoles, but no better in reducing risk.
- No benefit was found in high cost custom-made insole than well designed prefabricated insole.

Take Home Message

BASIC FOOTWEAR EDUCATION

AVOID	FAVOR
Pointed-toes	Broad-round toes
Slip-ons	Adjustable (eg Velcro)
Open-toes	Toe box for protection
High heels	Athletics or walking shoes
Plastic	Leather, Canvas
Black color	White/ light
Too small	½ inch longer than longest toe

Diabetes Self-Management 2005; 22:33

The goals of insole in DM

- Pros
  - For reducing & redistributing plantar pressure (50-70%)
  - Reducing recurrence of ulceration upto 8~59%

  ➔ Good for the prevention from recurrence of foot ulceration of the patients suffered from previous DM foot

- Cons
  - Not enough evidence for preventing from foot ulcer by DM shoes
  - Especially, no difference between custom made insole and prefabricated insole

  ➔ systemic approach is required

Enjoy Korea

Thank you for listening