

# Orthotic Management for Diabetic Foot

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## Case 1

- ✓ F74
- ✓ DM for about 40 years
- ✓ Frequent foot ulceration for 7 years



## Case 2

- ✓ F78
- ✓ DM for about 20 years, RA
- ✓ Foot deformity
- ✓ Loss of protective sensation



## Risk Categorization

| Category | Loss of Protective Sensation | Deformity, Callus, Weakness | History of Ulceration or Ischemia | Follow-up  |
|----------|------------------------------|-----------------------------|-----------------------------------|------------|
| 0        | No                           | No                          | No                                | Annually   |
| 1        | Yes                          | No                          | No                                | 6 Months   |
| 2        | Yes                          | Yes                         | No                                | 2-3 Months |
| 3        | Yes                          | Yes                         | Yes                               | 1-2 Months |

## Treatment Recommendations

### Category 0

- ✓ instruct in basic foot care
- ✓ regular footwear

### Category 2

- ✓ daily foot self-examination
- ✓ diabetic foot patient education
- ✓ in-depth shoes or sneakers
- ✓ custom-molded foot orthoses
- ✓ external shoe modifications

### Category 1

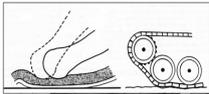
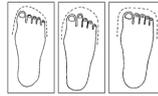
- ✓ daily foot self-examination
- ✓ diabetic foot patient education
- ✓ in-depth shoes or sneakers
- ✓ nonmolded soft inlays
- ✓ possible total contact orthoses

### Category 3

- ✓ daily foot self-examination
- ✓ patient-at-risk diabetic foot education
- ✓ custom-fabricated, pressure-dissipating accommodative foot orthoses
- ✓ inlay-depth, soft-leather, adjustable-lacing shoes
- ✓ external shoe modifications

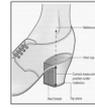
### General Principles of Footwear Prescription

- ✓ Shoe should match the shape of the foot
- ✓ Roomy and in-depth shoes (+1/4 – 3/8")
- ✓ Triple depth-inlay(removable insole)
- ✓ Minimizing shear/friction
  - : high instep, non-leather insole
- ✓ 1/2 to 5/8 inch longer than the longest toe



### General Principles of Footwear Prescription

- ✓ Heel heights: < 2 inches
- ✓ Rigid rocker or roller sole
- ✓ Shoes should be fitted at the end of the day
- ✓ Change shoes at midday and again in the evening
- ✓ Never be purchased just by asking for a specific numbered size



The role of therapeutic footwear in diabetic patients is mainly prevention of initial or recurrent ulceration rather than actual healing of ulcers

### In-depth shoes

- ✓ Blucher-style oxford or athletic shoe
- ✓ Additional ¼ to ½ inch of depth throughout the shoe
  - provides the extra volume needed to accommodate both the foot and a TCO
- ✓ Light-weight, shock-absorbing soles
- ✓ Strong counters
- ✓ Upper materials
  - soft, seam-free full leather linings with a firmer upper material
  - deer skin, cowhide
- ✓ Charcot foot
  - shaped wider in the midfoot area to accommodate deformity

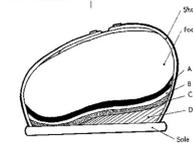
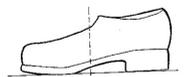


### Shoe Inserts

- ✓ Redistribute plantar forces
  1. Pressure under one part of the foot can be relieved by increasing the pressure on an adjacent part
  2. Exactly molding an insole to the plantar shape
  3. Soft material take time to compress
- ✓ Insole design
  - lamination of different materials
  - a single firm material
- ✓ Softer component next to the skin (for shear relief) and firmer materials underneath for structural support

### Shoe Inserts

- A: Nylon-covered PPT or Spenco
  - nylon covering reduces shear stress and the underlying foam allow for cushioning
- B: Pelite
  - molds well to the shape of the positive model
- C: Suborthalene
  - reinforced by the rigid material
- D: Neoprene crepe
  - firm support for the other materials



### Shoe Sole Modifications

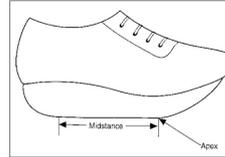
- ✓ Rigid rocker sole
- ✓ Extended steel shank
- ✓ Stabilization: Flare, Stabilizer
- ✓ Cushion heel
- ✓ Wedge

## Rigid Rocker Sole

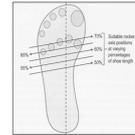
As much as 50% of the pressure can be reduced by use of a rigid rocker sole

- ✓ **Rigid shoe sole**
  - reduce shear stress on the foot
  - limit the damage to toes: limited motion at MTP joint
- ✓ **Rocker sole**
  - restoring lost motion in the foot, ankle, or both
    - overall improvement of gait
  - relieving pressure of a specific area of the plantar surface

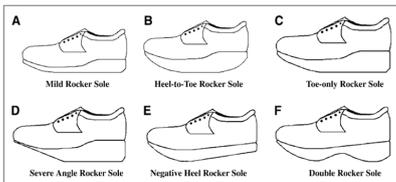
## Midstance and Apex of Rocker Sole



- ✓ **Midstance**
  - contact with the floor when in a standing position
- ✓ **Apex**
  - located at the distal end of the midstance
  - must be placed behind any area for which pressure relief is desired
  - reducing MTH pressure: 55%-60%
  - reducing toe pressure: 65%



## Six Types of Rocker Soles



- A. **Mild:** the most widely used, relieve mild metatarsal pressure, assist in gait
- B. **Heel-to-Toe:** ankle or subtalar joint fusion, fixed claw or hammer toe deformity
- C. **Toe-only:** forefoot ulcerations with stability or proprioception problems
- D. **Severe Angle:** extreme relief of MTH or toe-tip ulcerations
- E. **Negative Heel:** accommodate a foot fixed in dorsiflexion, relieve forefoot pr.
- F. **Double Rocker:** midfoot pathology

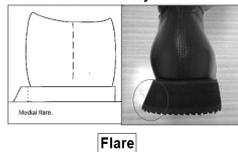
## Extended Steel Shank

- Strip of spring steel or carbon graphite composite inserted between the layers of the sole, extending from the heel to the toe of the shoe
- most commonly use in combination with a rocker sole and helps maintain the shape and effectiveness of the rocker sole
- prevent the shoe from bending
- limit toe and midfoot motion
- propulsion on toe-off
- strengthen the entire sole and shoe and maintains the continuity of the rocker sole
- hallux limitus or rigidus, limited ankle motion, more proximal partial foot amputations



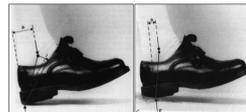
## Stabilization: Flare, Stabilizer

- ✓ ¼-inch-wide medial or lateral extensions of the sole or heel
- ✓ Acts as an outrigger
- ✓ Provides a wider base of support for the foot
- ✓ Partial foot amputation
  - Fixed varus or valgus ankle deformity
  - Stabilize a hindfoot, midfoot, or forefoot instability



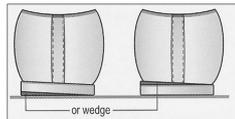
## Cushion Heel

- ✓ Simulate ankle plantar flexion
- ✓ Reduce stress on ankle dorsiflexors
- ✓ Decrease flexion momentum at the knee
- ✓ Provide a maximum amount of shock absorption under the heel
- ✓ Calcaneal ulcers, rigid ankle

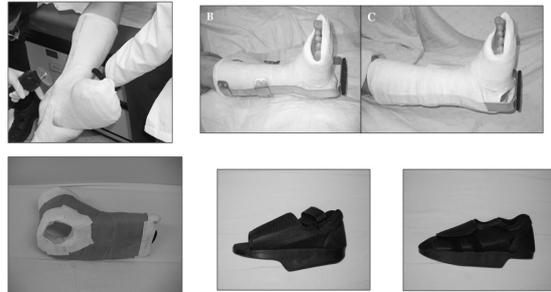


### Wedge

- ✓ Medially or laterally to the heel of the sole or to both the heel and sole
- ✓ Stabilizing a flexible deformity in a corrected position or in accommodating a fixed deformity
- ✓ Medial wedge: extreme pronation
- ✓ Lateral wedge: ankle instability, varus heel deformity



### Temporary Pressure Relief Methods



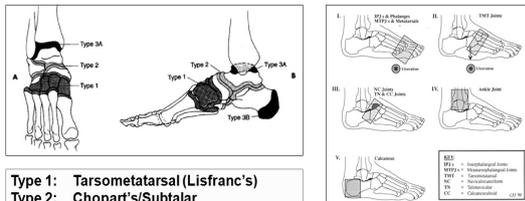
### Charcot Foot



### Radiological & Clinical Staging

- ✓ **Schon & Marks (1995)**  
Prodromal Stage 0: Trauma/Fracture (at risk)
- ✓ **Eichenholtz (1966)**  
Stage I: Bone & Joint Destruction (Development)  
Stage II: Fracture Healing (Coalescence)  
Stage III: Remodeling (Reconstruction)

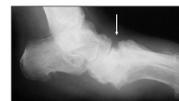
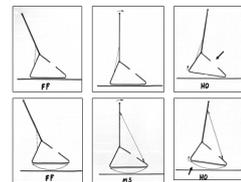
### Anatomic Classification



- Type 1: Tarsometatarsal (Lisfranc's)
- Type 2: Chopart's/Subtalar
- Type 3A: Ankle
- Type 3B: Calcaneus
- Type 4: Multiple regions
- Type 5: Forefoot

### Pathomechanics of Midfoot Collapse "Nut Cracking"

- ✓ Effect of tight Achilles on DM foot
  - promoting further collapse of midfoot in Charcot arthropathy
  - stress fracture of distal tibia
  - increased forefoot pressure: callus, ulcer formation
  - partial foot amputation: distal tip ulceration



### Conservative Treatment of Charcot Foot

- ✓ **Off-loading:** Nonweightbearing and Protected Weightbearing
  - minimize mechanical stresses
  - allow progression through the Eichenholtz stages with minimal displacement or deformity

Stage I: Total contact cast or Alternatives  
 Stage II: Total contact cast or Orthoses  
 Stage III: Orthoses and/or Therapeutic footwear

- ✓ **Edema Control**

### Prefabricated Removable Walking Braces

- ✓ Rigid rocker sole
- ✓ Padded with a protective insole
  - Plastazote or PPT®
- ✓ May be removed for bathing, skin checks, and dressing changes

- ✓ CAM Walker
- ✓ Pneumatic Walker
- ✓ Diabetic Conformer



### Calf Corset Brace



### PTB (Patellar Tendon-Bearing) Orthosis

- ✓ PTB brace with custom-molded footwear
- ✓ Saltzman et al. at the Mayo Clinic (*Foot Ankle*. 1992;13:14-21)
  - Reduce the mean vertical peak force by only 15% compared with vertical force in a shoe
  - Adding extra padding to the brace may decrease mean vertical peak force by only 32% compared with shoe
  - limited benefit in the acute stage
  - helpful adjunct for management of the stage of consolidation
- ✓ Tapering PTB brace may be considered after 6 to 24 months in the foot remains stable

### CROW (Charcot Restraint Orthotic Walker)

- ✓ **Some similarity to a bivalved TCC**
  - better hygiene and comfort
- ✓ **Custom, bivalved, total-contact, full-foot enclosure AFO consisting of a polypropylene outer shell, rocker sole, and well-padded inner lining**
- ✓ **Benefit**
  - edema control
  - effective ankle and foot immobilization
  - near normal ambulation
  - excellent patient satisfaction
- ✓ **Disadvantage**
  - high costs of fabrication and maintenance

### Alignment Control Strap



### **Edema Control**

- ✓ Tubigrip
- ✓ Profore
- ✓ **Unna Boot Bandages**
- ✓ Compression Stockings
- ✓ CircAid