A Team Approach to Wound Care on the Lower Limb
A Physical Therapist's Perspective

James G. Spahn, MD, FACS
Sharon Lucich, PT, CWS
Jaimee Haan, PT, CWS

FACTS

Pressure ulcers are the result of an ischemic event, and not a crush injury.

Soft tissue distortion leads to ischemic necrosis (pressure ulcer).

FACTS

Contact with a support surface causes either volumetric support of the body or distortion of the soft tissue trapped between the bony prominence and the support surface.

Since the body is three-dimensional, volumetric support (flotation) is needed to maintain proper tissue orientation.
FACTS

Nutritionally and mobility impaired patients are at risk for developing pressure ulcers.

FACTS

Pressure ulcers may start immediately, but often are not recognized until 3-7 days later.

High incidence of pressure ulcers may occur on bed, surgery, ER, transportation cart, and seating surfaces.

FACTS

Continuum of care is needed during the acute, sub-acute, and chronic levels of care.

Patients at risk are usually discharged to rehab, since they are not rehabilitated at time of discharge.
FACTS

- Protocols decrease incidence by 50%.

- Usage of pressure-reducing devices alone can cause an increase in incidence.


Clinical Protocols

Nutrition

Mobilization
- Ambulate
- Turn
- Passive Range of Motion

Support Surface
- Bed, Chair, Cart, Emergency Room, Operating Room

Incontinence Care

Wound Care

Continuum of Care

- Treatment of other general medical conditions

FACTS

- Heel ulcers constitute 30% of all pressure ulcers in hospital settings. (Dekeyser, Depoyster, Meyers and Everson, 1994)

- The heel consistently ranks as the second most common location for pressure ulcers. (Barczak, Barnett, Childs, Bisley, 1997)

- Acute care heel prevalence is between 8-17% (1992) and 15-23% (1997).
Heel ulcers constitute 30% of all pressure ulcers in hospital settings. (Dekeyser, Dejarger, Meyst and Evers, 1994)

The heel consistently ranks as the second most common location for pressure ulcers. (Barczak, Barnett, Childs, Bisley, 1997)

What’s Wrong With This Picture?

15-23% (1997)

Hospital Bed Simulation
Pressure = 19mmHg
(3” high density foam, air mattress and bed clothing)
Criteria for lower extremity protection in a horizontal position:

1. Provide volumetric support of calf (circulation)
2. Protect skin (address bony prominences)
3. Maintain skeletal integrity (footdrop & lateral rotation)
Remember!

No support surface by itself adequately protects the heel at all times.

Heel Elevation (Dewedge)

Heel Elevation (Dewedge)
The Effects of Extended Bedrest
(Microgravity)

- Blood volume
- In red cell mass
- In muscle strength and work capacity
- In maximum cardiac output
- Loss of calcium, phosphate, and mass from bones

"Most of these same effects also occur in people who lie in bed for an extended period of time."

11

Contouring Static Air (Flotation)
Contouring Solid (Distortion)

Maintain Skeletal Integrity
- Foot Drop
- Lateral Rotation
- Fractures
Foot Risk Awareness

<table>
<thead>
<tr>
<th>Condition</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral vascular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arterial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contracture of leg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deformity of foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin viability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape of heel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Arterial**
- Mobility of patient
- Ambulatory
- Ambulatory with assistance
- Non-ambulatory

**Foot Risk assessment scale**

Foot Risk awareness

**Clinical Protocols**
- Nutrition
- Mobilization
- Lower Extremity Protection
- Wound Care
- Continuum of Care
- Treatment of other general medical conditions
Product Should:

- Elevate heel (Dewedge)
- Protect sides of foot and ankle
- Neutralize weight of lower extremity (Delever)
- Maintain and promote circulation
- Address foot drop and lateral rotation of ankle
- Allow access to the foot for inspection/treatment
- Facilitate the musculoskeletal pump
- Fulfill regulatory requirements

Physical Therapy Perspective on Ankle Foot Orthosis (AFO’s)

Jaimee Haan, PT CWS  Sharon Lucich, PT CWS

Basic Anatomy of the Lower Extremity
**General Terminology**

- **Dorsal:** (Dorsum) — Top of the foot
- **Plantar:** — Bottom of the foot
- **Medial:** — Towards midline
- **Lateral:** — Away from midline
- **Proximal:** — Nearer to the trunk
- **Distal:** — Farther away from the trunk

**Bones of the Leg**

- **Hip**
  - Pelvis
  - Femur
- **Thigh**
  - Femur
- **Lower Leg**
  - Tibia
  - Fibula

**Bones of the Ankle and Foot**
Main Muscles of the Leg

ANTERIOR:
• Knee extensors  
  – Quadriceps Femoris
• Ankle Dorsiflexors  
  – Anterior Tibialis  
  – Extensor Hallucis Longus  
  – Extensor Digitorum Longus

POSTERIOR:
• Hip extensors  
  – Gluteus Maximus (Buttock)
• Knee flexors (Hamstrings)  
  – Biceps Femoris  
  – Semitendinosus  
  – Semimembranosus
• Ankle Plantarflexors  
  – Gastrocnemius  
  – Soleus  
  – Achilles Tendon

Biomechanics of the Lower Extremity
Joint Motion

- **Range of Motion (ROM):**
  - The amount of motion available at a joint

- **Active Range of Motion (AROM):**
  - Amount of motion available at a joint by a subject during unassisted voluntary movement

- **Passive Range of Motion (PROM):**
  - Amount of motion available at a joint attained by an examiner without the assistance of the subject

---

Goniometry:

- Measurement of joint angles created by the bones of the body

- **Goniometer:**
  - Tool used for goniometry

---

ROM of the Hip

- **Flexion:**
  - Bending of the hip joint

- **Extension:**
  - Straightening of the hip joint
ROM of the Hip

- **Abduction:**
  - Movement of the femur away from midline

- **Adduction:**
  - Movement of the femur towards midline

- **External (or Lateral) Rotation:**
  - Rotation of the femur away from midline

- **Internal (or Medial) Rotation:**
  - Rotation of the femur toward midline

- **Neutral Position:**
  - No internal or external rotation

ROM of the Knee

- **Flexion:**
  - Bending of the knee

- **Extension:**
  - Straightening of the knee

**Hyperextension:**
Knee extension beyond neutral

Hoppenfeld, Stanley: Physical Examination of the Spine and Extremities, 1976

Hyperextension:
Knee extension beyond neutral
Common Types of Knee Deformity

• **Genu Varum:**

• **Genu Valgum:**

• **Genu Recurvatum:**

ROM of the Foot and Ankle

• **Plantarflexion:**
  – Ankle joint flexion
  – Movement of the bottom of the foot in the caudal (tail) and posterior direction

• **Dorsiflexion:**
  – Ankle joint extension
  – Movement of the top of the foot in the cranial (head) and anterior direction

ROM of the Foot and Ankle

• **Abduction:**
  – Movement in a sideways direction away from midline of the foot

• **Adduction:**
  – Movement in a sideways direction towards midline
**ROM of the Foot and Ankle**

- **Pronation:**
  - Rotation of the foot so that the sole of the foot faces a lateral (away from midline of the body) direction

- **Supination:**
  - Rotation of the foot so that the sole of the foot faces a medial (toward midline of the body) direction

**Ankle Alignment**

- **Neutral Position:**
  - The ankle is considered to be "in neutral" when the foot is at a right angle with the tibia

- **Subtalar Neutral:**
  - The point at which the subtalar joint is fully supinated and then carried two-thirds of the way through maximum pronation

Relevance: when positioning a foot in a splint, the goal is to achieve neutral alignment of the ankle and the subtalar joint
Gait Cycle

Standing Alignment and Balance
Phases of Gait Cycle

- **STANCE PHASE**
- **SWING PHASE**

Abnormal Gait Patterns

- **Foot slap**
  - Weak dorsiflexors cause foot to slap down
  - Occurs at the beginning of heel strike

- **Toe scuff**
  - Lack of dorsiflexion
  - Occurs during midswing
Abnormal Gait Patterns

• High steppage gait
  – Loss of dorsiflexion
  – Inability to decelerate dorsiflexors
  – Knee lifts higher than normal to allow foot to clear the floor
  – Occurs during midswing

• Leg Length discrepancy?

Abnormal Gait Patterns

• Hip hike

• Leg Length discrepancy?

Abnormal Gait Patterns

• Balance issues
Common Foot/Ankle Impairments Requiring the Use of an AFO

Foot Drop

- An abnormal neuromuscular condition of the lower leg and foot characterized by an inability to dorsiflex or evert the foot.
- May be due to damage to the Common Peroneal Nerve or dorsiflexors.
- AFO can be used for treatment if surgery not an option.

Foot Drop (cont)

- Splinting Philosophy:
  - Stabilize ankle in neutral position to maintain functional ankle range of motion to allow standing and ambulation (walking).
  - Provide medial and lateral stabilization of the hip joint (Use stabilization bar if available on the AFO).
Plantarflexion Contracture

- Abnormal, usually permanent, condition of the ankle joint characterized by plantarflexion and fixation; caused by atrophy and shortening of muscle fibers ("heel cord")
- Goal: Maintenance of current ROM to enable adequate skin care and functional use

Spasticity

- A state of increased muscular tone with exaggeration of tendon reflexes
- Common in patients with closed head injuries, spinal cord injuries, cerebral palsy or stroke
- Can cause deformity and limit functional movement

Splinting Philosophy (cont)

- Apply mechanical force to correct or prevent contractures
  - Shortened muscles cause increased muscle tone; splinting at the ankle puts the gastroc/achilles on a prolonged stretch allowing lengthening to occur in the collagen of the soft tissue and re-form to the appropriate length
- Provides sensory stimulation which alters muscle tone to promote normal movement patterns
Spasticity (cont)

- Splinting Philosophy
  - Precautions

Plantar Fasciitis

- Repetitive micro-trauma to Plantar Fascia (fibrous band that supports the arch of the foot)
- Causes pain on plantar surface of heel and medial aspect of foot with weight bearing

Heel Pressure Ulcer

- Development of a wound due to mechanical stresses: pressure, shear
- Prevention/Treatment
  - Supports the ankle while a patient is confined to bed for prolonged periods of time decreases the risk of heel breakdown
  - Prevents prolonged pressure and shear forces of the heel moving across the bed
General Splinting Terminology and Techniques

Common Terminology

- **Splint:**
  - An orthopedic device for immobilization, restraint, or support of any part of the body
- **Orthosis:**
  - A force system designed to control, correct, or compensate for a bone deformity, deforming forces, or forces absent from the body

Traditional Orthotics

- Posterior leaf spring AFO
- Patellar-tibia bearing AFO
- Floor reaction AFO
- Conventional AFO
Traditional Orthotics

- Foot or Shoe Orthotic (Insole)
  - Diabetics
  - Pronated/Supinated foot
- Hinged ankle foot orthosis
- Rigid ankle foot orthosis

Rigid Ankle Foot Orthosis (AFO)

- Static Splints
  - Immobilize
  - Help prevent further deformity
  - Help prevent contractures

Heel Pressure Relieving Ankle Foot Orthosis (AFO)
Splinting (AFO) Precautions

- **Fit**
  - An ill-fitting ankle-foot orthosis can cause harm to the patient.
  - The ankle joint should be positioned in the splint at the correct therapeutic angle.
  - When a patient wears an AFO with padding in supine (lying on their back), the distal tibia is elevated relative to the proximal tibia and femur; This encourages knee hyperextension.
  - Signs of improper fit: skin redness, edema (swelling), joint stiffness, pain, skin rash, decreased circulation.

- **Skin Assessment**
  - The clinician should don the AFO properly and leave in place for 20-30 minutes.
  - Red areas should not be present 20 minutes after removal of AFO.
  - Educate patient/family to report any rashes or other skin reactions.

- **Edema Assessment**
  - If AFO straps are applied too tight, issues with edema above and below straps may result and can cause skin breakdown.
Splinting (AFO) Precautions

• Timing
  – Splint schedules should be provided and patient, family and education regarding splint schedule should be provided

• Compliance
  – Education of all parties involved in the patient’s care is key to increasing patient compliance
  – Education should include explanation of the goal of wearing the splint, and should be repetitive and consistent

Splint Schedule

Please wear the splint according to the following schedule:

Day: 2 hours on, 2 hours off
Night: On all night

Special Instructions:

Contact Name/Number:

Precautions: redness, pain, swelling, rash or reduced sensation

HCPCS Code: L4398
Foot Drop Splint/Recumbent Positioning Device

• A prefabricated ankle-foot orthosis which has all of the following characteristics:
  – Designed to maintain the foot at a fixed position of 0 degrees; and,
  – Not designed to accommodate an ankle with a plantarflexion contracture; and,
  – Used by a patient who is nonambulatory; and,
  – Has a soft interface
HCPCS Code: L4396
Static AFO

• Prefabricated ankle-foot orthosis which has all of the following characteristics:
  – Designed to accommodate either plantar fasciitis or an ankle with a plantarflexion contracture up to 45 degrees; and
  – Applies a dorsiflexion force to the ankle; and,
  – Used by a patient who is minimally ambulatory, or nonambulatory; and,
  – Has a soft interface

Medicare Reimbursement for HCPCS code L4396 (Static AFO)

• Covered if all criteria 1-4 met or if criterion 5 is met
  1. Plantarflexion contracture (718.47) with passive dorsiflexion of at least 10 degrees (non-fixed); and,
  2. Reasonable expectation of ability to correct contracture; and,
  3. Contracture interfering with functional abilities; and,
  4. Used as component of therapy program which includes active stretching
  5. Plantar fasciitis (728.71)

Evaluation of patient, measurement and fitting of orthosis are included in the allowance for the orthosis. There is no separate payment for these services.

Other Medicare Reimbursement Codes

- L1930 Plastic Splint
- L2820 Soft interface
- L4360, L4386 Walking boot
- L4396 Static AFO
- L4398 Foot drop splint/recumbent positioning device
- L4392 Replacement interface

• GY modifier must be added if AFO used solely for treatment of edema and/or for prevention or treatment of a pressure ulcer
• Must indicate why e.g. “used to treat pressure ulcer”
Questions??

Thank You!

Jaimee Haan, PT, CWS jaimeehaan@sbcglobal.net
Sharon Lucich, PT, CWS shlucich@sbcglobal.net