ORTHOTICS

Principles and Descriptions
Review Previous Lecture
Orthosis

- An orthopedic appliance used to support, align, prevent, or correct deformities of a body part, or
- To improve the function of moveable parts of the body
Terminology

- **Brace** – synonymous with orthosis
- **Splint** – temporary orthosis
- **Orthotic** – adjective relating to orthoses
  - commonly refers to a foot orthosis
Personnel

- Orthotists: CO or CPO
- Pedorthists: C. Ped.
- Physicians: MD, DO, DC
  - Physiatrists
  - Orthopedists
  - Psychologists
- Physical Therapists & PTAs
- Occupational Therapists
- Social Workers
Nomenclature

- FO = foot orthoses (regularly referred to as an orthotic)
- AFO = ankle-foot orthosis
- KAFO = knee-ankle-foot orthosis
- HKAFO = hip-knee-ankle-foot orthosis
- THKAFO = trunk-hip-knee-ankle-foot orthosis
- LSO = lumbosacral orthosis
- TLSO = thoracolumbosacral orthosis
Biomechanics

- **Therapeutic Benefits**
  - Resist motion
  - Assist motion
  - Transfer force
  - Protect body parts

- **Comfort**
  - Maximizing area
  - Snug fit
  - Leverage
Biomechanics: Pressure Systems

Pressure systems: **Three-point pressure system**

- One principal force acting in one direction and two counterforces acting in the opposite direction located proximal and distal to the principal force
Biomechanics

- Effectiveness (continued)
  - Floor reaction: *Ground reaction force*
    - The force exerted on the body in response to the force that a person exerts on the floor; the force is equal and opposite in direction.
Physical Characteristics of Orthotics

- The thicker the material, the more rigid, heavier, and bulkier the orthotic

Shape – The orthosis is made stronger if it is...

- Corrugated or curved
- Has rolled edges
- Is reinforced
Stresses

- **Compressive**
  - Force squeezes the material
  - An inflatable splint

- **Tensile**
  - Distraction or pulling apart a material
  - Dorsiflexion assist

- **Shear**
  - Horizontal sliding of one plane of material over another
  - Trunk brace to control scoliotic curve

- Material refers to body part
Properties of Materials

Properties of materials used in orthoses

1. **Elasticity** — ability to recover to original dimensions
2. **Plasticity** — changes shape without cracking
3. **Malleability** — ability to be reshaped
4. **Corrosion resistance** — deterioration when exposed to chemicals
Shoe Parts

- Height
- Material
- Heel
- Tongue
- Closure (lace stay)
- Throat
- Upper
- Sole
Shoe Throat Styles

Blucher

Balmoral (or Bal)
Reinforcements

- **Heel counter**
  - Stiffens the posterior portion of the upper

- **Shank**
  - Longitudinal reinforcement of the midportion of the shoe

- **Toe box**
  - Shields the toes from trauma
Shoe Reinforcements

- Heel
- Counter
- Shank
- Toe Box
Foot Orthoses – Shoe Modification

- **Inserts & Internal Modifications**
  - Heel pads
  - Metatarsal pads
    - Reduce stress over MTP joints.
  - Insoles
    - Shock absorption
    - Increase arches
Foot Orthotics –
external modifications

- Heel wedge
  - Medial heel wedge
- Metatarsal Bar
- Rocker Bar
ANKLE-FOOT ORTHOSES

- **Parts**
  - Foot Plate
  - Uprights / Shell
  - Posterior Calf Band
  - Brim
ANKLE-FOOT ORTHOSES

- **Types**
  - **Solid AFO**
    - Limits all foot and ankle motion
  - **Hinged solid AFO**
    - Allows slight sagittal motion
ANKLE-FOOT ORTHOSES

- Ankle Control
  - **ASSIST**
    - Posterior Leaf Spring: DF assist
    - Steel DF Spring
  - **STOP**
    - Posterior Stop: limits PF
    - Anterior Stop: limits DF
Pediatric Foot Orthosis

- **Denis Browne Splint**
  - a metal bar with attachments to the shoe soles
  - Resists adduct or IR of hips
  - To maintain correction of talipes equinovarus in infants
Other Supports

- Elastic straps
- Leather or canvas lace-up support
- Air cast
- Gel cast
- Cryocuff AFO
Knee-Ankle-Foot Orthosis

- For who?
- Consists of everything mentioned for the AFO with the addition of knee control
  - Hinge
  - Knee locks
    - Drop ring lock
    - Pawl lock with bail release
  - Anterior band or strap distal to the knee
  - Thigh band or weight bearing brim
Hip-Knee-Ankle-Foot Orthosis

- It is the addition of a pelvic band and hip joint that converts the KAFO to a HKAFO
- **Hip Joint**: metal hinge that connects the lateral upright of the KAFO to the pelvic band
- **Pelvic Band**: an upholstered metal band anchors the HKAFO to the trunk; it lodges between the greater trochanter and iliac crest on each side
TRUNK ORTHOSES

- Used to be called spinal orthoses
- But they don’t contact the spine!
TRUNK ORTHOSES

- **Corset:**
  - Goal: abdominal compression to increase intra-abdominal pressure
  - Fabric
  - Relieve LBP
  - Don’t want the patient to rely on corset long term

- **Rigid Orthoses:**
  - Most LSO (Knight) & TLSO (Taylor Brace) include a corset
  - Horizontal & vertical rigid plastic or metal components
TRUNK ORTHOSES

- **Cervical Orthoses**
  - Collars: minimal control
  - Four Post Orthoses: moderate control
  - Minerva Orthosis (non-invasive) or halo (fixed to skull by 4 screws): maximal control

- **Scoliosis Orthoses**
  - Prevents increase in curves
  - Milwaukee orthoses, Boston, Wilmington, Charleston (worn 16-23 hours/day)
Orthotic Considerations

- Do not overprescribe
- Cost
- Energy efficiency
- Cosmesis
- Temporary vs permanent
- Dynamic vs static
- Encourage normal movement
Orthoses are designed to provide the patient with maximum function with a minimum of discomfort and effort.

Performance depends on many factors: extent of skeletal and neuromuscular involvement; mobility, strength, coordination, etc.
ORTHOTIC TRAINING

- Includes: donning instruction, developing standing balance, walking safely, performing other ambulatory activities

- Standing balance: most difficult for the patient who wears bilateral KAFOs or more extensive bracing
  - balancing “act” between feet and UEs, as both are supporting weight
ORTHOTIC TRAINING

- prerequisite for ambulation is weight shifting, through LEs and UEs.
  - shift weight from hands to feet and back
  - lifting one, then the other hand, and eventually both
  - moving hands behind body
  - diagonal weight shifting
ORTHOTIC TRAINING

- Gait training: the patient should practice gait on different surfaces, speeds, etc.

- Gait selection depends on the patient’s:
  - step ability (can step with either or both limbs)
  - weight-bearing and balance ability
  - upper extremity power
ORTHOTIC TRAINING

- Reciprocal gaits: four-point and two-point
- Simultaneous gaits: drag-to, swing-to, and swing-through
ORTHOTIC TRAINING

- Activities:
  - curbs
  - ramps
  - stairs
  - transfers (chair, sit to stand, car)
ORTHOTIC TRAINING

- Not all patients achieve full range of ambulatory activity, but benefit from partial independence, especially psychologically and physiologically.
Goals

- Maximize functional mobility skills with the orthosis
- Maximize independence with donning/doffing
- Maximize independence with wearing schedule
- Maximize independence with skin inspection
- Maximize competence with care of the orthosis
Looking Ahead

- Muscle Tone
Questions???