Learning Outcomes

• Describe the design principles of sport orthoses
• Compare and contrast the indications and contraindications for prefabricated, custom-fit and custom designed sport orthoses
• Identify various components and materials used in the fabrication of sport orthoses
• Explain the process of proper orthotic device delivery, fitting and regular follow-up for maintenance of proper device functioning

Orthotic Treatment Programs

• Definition of an orthosis
• Support and align
• Prevent or correct deformity
• Substitute or enhance function
• Decrease pain or discomfort

Introduction

• Contributors to injury - intrinsic factors
  • Malalignment
  • Limb-length discrepancy
  • Decreased flexibility
  • Muscle imbalance
  • Muscle weakness
  • Kinetic chain dysfunction

Orthotic Treatment Programs

• Goals
  • Return to prior activities and activity levels
  • Prevent further injury
  • Protection of involved joints
  • “Reminder” of previous injury

The Foot/Ankle

• Biomechanics
  • Approximately 30 joints of foot and ankle
  • Primary: Midtarsal, subtalar and talocrural
  • Joints of the foot/ankle function in synchrony
  • Compressive forces of the ankle
The Foot/Ankle

- Common injuries
  - Plantar fasciitis
  - Fractures
  - Rearfoot varus
  - Pes cavus
  - Pes planus
  - Forefoot valgus
  - Forefoot varus
  - Rearfoot valgus
  - Hallux valgus
  - Ankle sprains
  - Equinus
  - Morton's neuroma
  - Tarsal tunnel syndrome
  - Shin splints
  - Reflex sympathetic dystrophy
  - Metatarsalgia
  - Tendinitis
  - Stress fractures
  - First MP joint sprain

Patient evaluation
- History: Description of current problem, mechanism of injury, area of discomfort, previous injuries...
- Observational data: Global assessment of standing and walking postures
- Active and passive range of motion

Orthotic design considerations
- Height, weight, anticipated activity level, degree of deformity, degree of correction, diagnosis, prognosis, mobility requirements, stability requirements
- Designing an appropriate orthosis to meet the patient's structural and functional needs.

Prescription Criteria
- Foot alignment and function
- Supination
- Pronation
- Skeletal deviations (i.e. hallux valgus)

Prefabricated, Custom-Fit and Custom
- Prefabricated orthoses
  - Mild involvements
  - Temporary uses
  - Diagnostic procedures
  - Limited fit and function
- Custom orthoses
  - Moderate to severe involvements
  - Extended or permanent use
  - Individual fit and maximum function

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Sports Medicine
Orthotic Applications & Design Criteria

The Foot/Ankle

• Custom designs
  • Morton’s neuroma (interdigital nerve entrapment)
  • Forefoot and rearfoot disorders
  • Plantar forefoot neuritis (cyclists / stair climbers)

Prefabricated, Custom-Fit and Custom

• Custom orthoses
  • Casting
  • Measurement
  • Negative mold
  • Positive model
  • Modification process
  • Fabrication process

Components and Materials

• AFOs
  • Made of various materials
  • Different biomechanical functions
  • Adjustability

Motion: When and Why?

Components and Materials

• Thermoplastics
  • Chosen for specific materials characteristics
  • Rigidity or flexibility
  • Durability

• Laminates
  • Chosen for durability and rigidity
  • Reinforcement materials

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### The Knee

**Biomechanics**
- Tibiofemoral joint is loaded at 3x body weight in stance phase of gait and 4x body weight during stair climbing.
- Patellofemoral joint is loaded at .5x body weight during walking, 3.3x during stair climbing, and 7.6x during squatting.
- Range of 10° extension to 140° flexion.

**Common injuries**
- Patellofemoral pain
- Iliotibial band syndrome
- Femoral condyle fractures
- Epiphyseal plate fractures
- Patella fractures
- Anterior cruciate rupture/tear
- Posterior cruciate rupture/tear
- Ligament sprains
- Meniscal injury
- Collateral ligaments
- Bursitis
- Muscle strains
- Muscle contusions
- Osgood-Schlatter disease
- Patellar instability
- Reflex sympathetic dystrophy

**Prefabricated designs**
- Acute injuries

**Custom-fit designs**
- Subacute and chronic injuries

**Custom designs**
- Posterior cruciate ligament
  - Common injury mechanism involves anteriormedial blow to flexed knee
  - Posteriorly directed force at the proximal tibia
  - Often accompanied by tears of the MCL and arcuate ligament complex

- Anterior cruciate ligament
  - Common injury mechanisms involves a combination of valgus and external rotation forces
  - Usually non-contact injuries

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Orthotic Fracture Management

- Protection of the injured area
- Immobilization of the injured area
  - Compression – Reduction
  - Mobilization of the patient
  - ROM
  - Wolfe's Law

Wrist Hand Orthoses

- Immobilization of effected joint
- Water Resistant

Lower Extremity Fracture Orthoses

Humeral Fractures

Distal Radial or Ulnar Fractures

Metacarpal Fractures

- Wrist hand orthosis
- Wrist hand finger orthosis
- Post-operative management
- Post-operative and post-cast rehabilitation

Humeral Fracture Orthoses

- Shoulder Cap
- Standard
- Circumferential Compression
- Water Resistant

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The Elbow

- Prefabricated designs

Orthotic Fitting and Follow-Up

- Adjustments and repairs
  - Ongoing process
  - Mechanical device needs mechanical maintenance
  - Changes in patient model (atrophy or hypertrophy)
  - Re-evaluation of functional abilities and needs

The Elbow

- Custom designs
  - Volkmann’s ischemic contracture:
    - Incapacitating complication to follow a fracture or dislocation
    - Inflammatory reaction can lead to arterial ischemia or contracture
    - Often associated with supracondylar fractures
    - If impaired circulation is unrecognized, muscular fibrosis and atrophy develop

Questions?

The Shoulder

- Custom designs
  - Unique circumstances requiring custom design due to desired function or difficulty in fitting
  - Can also encourage or allow available joint motion in a controlled manner