Rehabilitation of Ankle Injuries

- Functional Anatomy and Biomechanics
- Biomechanics of Normal Gait
- Ankle Sprains
- Ankle Fractures & Dislocations
- Pronation & Supination
- Plantar Fasciitis
- Chapter 24

Functional Anatomy and Biomechanics

Talocrural Joint
  - Articulation of tibia, fibula and trochlea of talus
    - Motion consisting of plantarflexion and dorsiflexion
  - Ligamentous support
    - Articular capsule
    - Anterior talofibular, posterior talofibular, calcaneofibular ligaments
    - Deltoid ligament

![Diagram of Talocrural Joint](image-url)
### Tarsometatarsal Joint
- Comprised of cuboid; 1st 2nd 3rd cuneiforms; bases of metatarsal bones
- Bones allow rotational force during weight-bearing activity
- Dependent on midtarsal and subtalar joint position

### Metatarsal Joints
- Foot stabilization is dependent on relationship metatarsal joints and other joints of foot
- Independent movement of first row with respect to rest of foot
  - Body propulsion – reliant on peroneus longus stabilization
Biomechanics of Normal Gait

- Two phases
  - Stance (support)
    1. Heel contact to toe off
    2. Absorb shock, transfer weight and provide propulsion
    3. Lateral-medial-lateral movement
    4. Movement medially – pronation – allows for shock absorption and distribution of forces during stance phase
    5. Obligatory internal rotation of tibia with pronation
    6. Propulsion (lateral movement) – supination – "re-locks" the foot in order to form a rigid lever
    7. Tibial external rotation at push-off
  - Swing (recovery)

Rehabilitation Techniques

1. Stretching exercises
   - PROM
   - AROM
2. Strengthening exercises
   - Isometric
   - Isotonic
   - CKC
3. NM Control exercises
   - BAPS
4. Cardiorespiratory exercises
   - Stationary cycle
   - Upper-body ergometer
   - Pool running

Ankle Sprains

Pathomechanics and Injury Mechanism

- Inversion sprain
  - Ankle inversion, plantarflexion and internal rotation
  - Injures lateral ligaments of ankle

- Eversion sprain
  - Less common due to bony structure of ankle and str of deltoid ligament

- Syndesmotic sprain
  - Occur due to excessive dorsiflexion or external rotation
  - Involve tibiofibular ligaments, possibly interosseous membrane
Inversion Sprain

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Eversion Sprain

- Occur due to excessive dorsiflexion or external rotation
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Syndesmotic Sprain

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Clinical grades

- Grade I (mild)
  - injury involves little swelling and tenderness
  - minimal or no functional loss
  - no mechanical joint instability

- Grade II (moderate)
  - moderate pain, swelling, tenderness over involved structures;
  - some joint motion is lost
  - joint instability is mild to moderate

- Grade III (severe)
  - complete ligament rupture, marked swelling, hemorrhage, tenderness;
  - function is lost,
  - joint motion and instability are markedly abnormal

Rehabilitation Concerns

1. Swelling and pain control
   - Compression
   - Ice
   - Elevation
   - Rest
   - Protection

2. Immobilization
   - depending on severity

3. Chronic ankle instability
   - Mechanical insufficiencies
   - Functional insufficiencies
   - Recurrent ankle sprain


Prehabilitation


Program

Rehabilitation Progression

– Adequate rest/healing time for ligaments prior to exercise initiation
– Retardation of atrophy
  • maintenance of proprioception
– Weight bearing vs. Non-weight bearing
  • Aquatic therapy
  • Enhanced ligament healing with stress application
– Swelling and pain management
– Range of Motion
  • Focus on plantar and dorsiflexion through towel ex; joint mobilizations
  • Decreasing pain inversion and eversion ex initiated (BAPS board)

1. Strengthening

• Peroneal muscle weakness (need for strengthening reported as a potential concern in management of CAI)
• Isometrics can begin early in the rehabilitation process
• Pain will serve as a guideline
• Tubing, multidirectional Elgin ankle exerciser manual resistance and ankle weights can be utilized
• Ultimately isokinetics and PNF exercises should be introduced
3. Proprioception and NM Control
- Role of proprioception and repeated ankle trauma
- Progress from both feet to one, eyes open and closed
- Advance to balance training on BAPS board
- Other CKC can also used to enhance proprioceptive feedback

3. Cardiorespiratory Endurance
- Must be maintained during the rehabilitation process
- Pedaling stationary bike or UBE can be used
- Pool running/aquatic therapy can be substituted as well

4. Functional Progression
- Should begin as ambulation resumed, without limitations/deficits in gait
- Running progression
- Hopping and jumping
- Sports-related activity

Table 1: Principal components of a functional ankle rehabilitation programme (reproduced from Osborne.7 with permission)

<table>
<thead>
<tr>
<th>Rehabilitation mode</th>
<th>Goal</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRICE</td>
<td>Reduce swelling, inflammation and pain</td>
<td>Use of ice massage, taping, ankle circumferential elastic bandages, and short-term use of braces</td>
</tr>
<tr>
<td>ROM</td>
<td>Primary emphasis is on early ROM restoring ankle dorsi/planter flexion and extension</td>
<td>Heel cord stretching with the knee straight (to stretch the gastrocnemius and soleus) and foot DP (to stretch the soleus), as well as extensor (posterior tibialis) stretching. Alphabet ROM exercises</td>
</tr>
<tr>
<td>Strengthening</td>
<td>Primary emphasis on ankle extensor strengthening and begins with low-level strengthening such as submaximal concentric exercises and progress in a parallel fashion to isometric strengthening. Use a combination of open and closed kinetic chain strengthening</td>
<td></td>
</tr>
<tr>
<td>Proprioceptive exercises</td>
<td>Restore dynamic ankle balance and stability</td>
<td>Use of ankle dorsiflexion braces, single leg stance on even surface or with eyes closed</td>
</tr>
<tr>
<td>Functional exercises</td>
<td>Restore dynamic strength, balance and power</td>
<td>Jogging, running, straight leg jumping, single leg hopping, skipping rope, figure-eight drills, balance, cutting skills, and agility exercises</td>
</tr>
</tbody>
</table>

Criteria for Return to Play
1. Gradual completion of functional progression
2. Ankle support – provide stabilizing effect
3. Complete ROM, 80-90% of pre-injury strength
4. Practice tolerated without insult to injured part

Ankle Fractures and Dislocations

Pathomechanics and Injury Mechanism
– Must be cautious (sprain vs. fracture)
– Multiple mechanism of injury
– Malleolar fractures, osteochondral fractures of talus
– Non-displaced or compression fractures
– Dislocations rarely occur
  • Occurrences are generally combined with fracture

Rehabilitation Concerns
– Rest, protection and immobilization
– Surgical intervention

Rehabilitation Progression
– Following surgery non-weight bearing for 2wks
  • Work to limit swelling and pain
– At 2-3wks a walking boot may be applied (on for 6wks)
– ROM ex should begin as directed by physician (2-3 x d)
– At 6 wks weight bearing can occur
– A gradual strengthening program should also be initiated
– Joint mobilizations and stretching may be necessary to aid in restoration of motion
– As strength and NM control are regained more functional CKC ex can be added
Criteria for Return to Play

1. Strength, flexibility and neuromuscular control must return to “normal” levels
2. Following completion of functional progression full activity can be resumed

Excessive Pronation and Supination

A. Forefoot Varus  B. Forefoot Valgus  C. Rearfoot Varus

Rehabilitation Concerns

– Goal of treatment is to correct faulty biomechanics
– Must perform an accurate biomechanical analysis
– Orthotic fabrication
– Examination
  • Determine subtalar neutral
Plantar Fasciitis

Pathomechanics
- Attributed to heel spurs, plantar fascia irritation, bursitis
- Tension increases in fascia with weight bearing and extension of toes
- Pes cavus feet are subject to fascial strain
- Changes in footwear
- Lordosis → increasing anterior pelvic tilt and altering foot-strike angle

Rehabilitation Concerns
- Orthotic use (with extra deep heel cup)
- Heel cup for additional cushioning
- Taping for symptom relief
- Night splints to maintain static stretch
- Flexibility – vigorous heel cord stretching
- NSAID’s recommended
- Steroidal injections may be warranted if symptoms fail to resolve
Criteria for Full Return

1. Will require extensive treatment
2. Symptoms may persist for 8-12wks
3. Must remain persistent with rehabilitation
4. In some instances the athlete is able to continue if symptoms and pain are not prohibitive