Ankle – Open Reduction Internal Fixation

Surgical Indications and Considerations

Anatomical Considerations: Damage to neurovascular and tendonous structures must be considered with ankle fractures. Medially, the posterior tibial artery, tibial nerve, posterior tibial and flexor tendons, and deltoid ligament are subject to trauma. Laterally, the peroneous longus/brevis tendons, lateral collateral ligaments, superficial peroneal nerve and sural nerve are potentially at risk.

Pathogenesis: Ankle fractures result from similar mechanisms as ankle sprains. For example, an inversion injury may result in a medial malleolus fracture as well as a sprain of the lateral collateral ligaments. In contrast, an eversion injury may fracture the lateral malleolus and sprain the medial deltoid ligament. Ankle fractures are based on the classification system developed by Lauge-Hansen in 1948. The classification system has five groups of ankle fractures and is dependent on the foot position and direction of force when the injury occurred. It also indicates the injured structures. Since the mechanism of injury for ankle sprains and fractures is virtually the same, ankle sprains that do not respond to conservative treatment after 4 to 5 weeks should be reevaluated for a fracture.

Lauge-Hansen Classification (Lesic & Bumbasirevic)

Type of Fracture	Stage	Injured Structures
Supination-adduction	1	Avulsion fracture of the lateral malleolus
Supination-adduction	2	Vertical fracture of the medial malleolus
Supination-eversion	1	Lesion of the anterior tibiofibular ligament
Supination-eversion	2	Oblique fracture of the lateral malleolus
Supination-eversion	3	Posterior malleolus fracture or rupture of the posterior tibiofibular ligament
Supination-eversion	4	Fracture of the medial malleolus or rupture of the deltoid ligament
Pronation-abduction	1	Transverse avulsion fracture of the medial malleolus
Pronation-abduction	2	Rupture of tibiofibular ligaments
Pronation-abduction	3	High transverse bending fracture of the lateral malleolus
Pronation-eversion	1	Rupture of deltoid ligament or avulsion fracture of the medial malleolus
Pronation-eversion	2	Failure of the anterior tibiofibular ligament
Pronation-eversion	3	Oblique or spiral fibular fracture
Pronation-eversion	4	Disruption of the posterior tibiofibular ligament or fracture of the third metatarsal
Pronation-dorsiflexion	5	Pilon fractures stages 1/3

Epidemiology: Ankle fractures are one of the most common injuries in the lower extremity occurring at a rate of 107 fractures per 100,000 persons per year. Young athletic males and middle age women are most commonly affected. Talus fractures represent 3% of foot fractures and tend to be associated with high-energy traumas such as a fall from a height or a motor vehicle accident. Eversion fractures are the most common whereas pronation-dorsiflexion (pilon) fractures are the rarest but more severe.

Diagnosis:

Physical Examination:

- Acute trauma
- Pain with weight bearing
- Local tenderness
- Instability
- Obvious swelling- Ankle effusion of 13 mm or more has been shown to be indicative of a fracture with an 82% predictive value.

Radiological Examination: Plain film radiographs using a minimum of three views (anterior-posterior, lateral and mortise view with the foot internally rotated 15^{o}) are used. Magnetic Resonance Imaging may be utilized if ligamentous, tendon or chondral lesions are suspected. Computed tomography is also used in complex fractures to better identify fracture comminution and displacement as well as soft tissue injury.
The following radiological criteria are used to assess ankle integrity:

- The medial joint space measures less than 4 mm.
- There is less than 5 mm of interosseous clear space.
- The anterior tibial tubercle and fibula overlap at least 10mm.
- Normal talcrural angle is $83^{o} \pm 4^{o}$
- 0^{o} of talar tilt allowing for 5^{o} of difference between the two joints.
- The tibiotalar line must pass through both the center of the tibia and the talus on anterior-posterior and lateral views.

Nonoperative Versus Operative Management: Nonoperative versus operative treatment depends on the type of fracture (displaced versus nondisplaced), skin integrity, circulation status as well as the patient's age and current health. Stable, nondisplaced fractures are typically treated conservatively with immobilization. Some displaced fractures may undergo closed reduction under general or spinal anesthesia if possible. Some indications for conservative treatment include: peripheral vascular disease, peripheral neuropathy, diabetes mellitus, poor health, age, sedentary lifestyle, open wounds, infections, paraplegia, and debilitated mental status (i.e. ability to maintain weight-bearing status post-operatively). The patient is typically nonweight-bearing in a cast for 3-4 weeks and may then be weight-bearing as tolerated or partial weight-bearing in a walking cast for another 8-12 weeks depending on the stability of the fracture.

Open reduction internal fixation is indicated in unstable, displaced fractures especially if the talus is subluxed. Pronation type fractures are typically treated with open reduction and internal fixation whereas supination/eversion type fractures can be treated either conservatively or surgically with about equal results.

Fractures and dislocations should be reduced as quickly as possible to prevent circulatory impairments and neuropraxia. Swelling and inflammation severely limit reduction. Depending on the extent of the fracture, pins, screws, plates and intramedullary nails and rods are used to secure the fracture site(s). The surgical approach depends on the location of the fracture.

POSTOPERATIVE REHABILITATION

Phase I: Weeks 1-4

Goals: Decrease pain and edema
Protect surgical repair
Maintain/improve general cardiovascular and muscular fitness

Intervention:

- Ice and elevation
- Gait train nonweight-bearing with crutches/front wheeled walker. Step/stair training as needed
- Immobilize with below-the-knee plaster cast with ankle in neutral
- General cardiovascular and total body strengthening program

Phase II: Weeks 5-10

Goals: Control pain and edema
Protect surgical repair
Gradually progress weight-bearing status
Increase ankle plantarflexion/dorsiflexion range of motion
Maintain/improve general cardiovascular and muscular fitness

Intervention:

- Ice and elevation
- Continue gait training as weight-bearing status changes (walking cast to short leg walking brace) with assistive device as needed
- Compression garments as needed to control edema
- Begin active and passive ankle dorsiflexion and plantarflexion
- General cardiovascular and total body strengthening program

Phase III: Weeks 10-14

Goals: Control edema
Full ankle range of motion
Normalize gait
Increase strength
Maintain/improve general cardiovascular and muscular fitness

Intervention:

- Ice and elevation
- Continue range of motion exercises adding ankle inversion/eversion
- Lower extremity stretching focusing on the gastrocnemius/soleus complex (may begin with passive seated towel stretch and progress to standing)
- Begin ankle/foot strengthening (begin with isometric progressing to isotonic with theraband to standing ankle dorsiflexion/plantarflexion)
- Scar mobilization and desensitization
- Joint mobilization to decrease capsular tightness
- General cardiovascular and strengthening program

Phase IV: Week 14-24

Goals: Increase ankle muscle strength/endurance
Increase balance/proprioception/neuromuscular control
Maintain/improve general cardiovascular and muscular fitness
Begin sport/job specific activities
Normalize gait/running on varied surfaces

Intervention:

- Continue to progress lower extremity stretching and strengthening
- Balance/proprioception exercises on varied surfaces/conditions (single leg stance/tandem, compliant/noncompliant surface, eyes open/closed)
- Gait training/running on varied surfaces and inclines
- General cardiovascular and strengthening program
- Sport/job specific skill training

Selected References:

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