Standard of Care: Ankle Sprain

ICD 9 Codes: 845.00
Secondary supporting ICD 9 codes:

719.7 Difficulty walking
719.07 Effusion of ankle/ foot
Choose these or any additional secondary ICD 9 codes based upon individual's impairments.

Case Type / Diagnosis:

Practice Pattern 4E – Impaired joint mobility, motor function, muscle performance and ROM associated with localized inflammation

Practice Pattern 4D – Impaired joint mobility, motor function, muscle performance and ROM associated with connective tissue dysfunction

Ankle sprain is a common injury with a high rate of recurrence usually as a result of landing on a plantarflexed and inverted foot. Each day, an estimated 23 000 ankle sprains occur in the United States[1]. Ankle sprains account for 85% of ankle injuries and 85% of sprains involve lateral structures.[2] They account for 25% of all sports related injuries.[3] No significant female-male ratios were found. Risk can be increased in individuals that are overweight and less physically active.[4] Weekend type athletes also have an increased risk.

The lateral ligaments are most commonly involved, then the medial ligaments, then the syndesmosis. Ankle sprains are usually treated non-surgically.[3]
Careful evaluation determines prognosis, progression of treatment and may detect other injuries.

Forty percent of lateral sprains develop chronic ankle instability (CAI).[5]
This is defined as a combination of persistent symptoms and repetitive lateral ankle sprains.[6]

Ligaments involved and mechanism of injury[3]

- Laterally – The anterior talofibular ligament (ATFL), posterior talofibular ligament (PTFL), calcaneofibular ligament (CF) are responsible for resistance against inversion and internal rotation stress. The lateral ligaments are more commonly involved (ATFL more than CF, least PTFL). Examples of mechanism of injury: uneven terrain, stepping in a hole, stepping on another's foot during athletic play, landing from a jumping position.
- Medially – The superficial and deep deltoid ligaments are responsible for resistance against eversion and external rotation stress. The medial ligaments are less commonly injured than the lateral ligaments.

- Syndesmotic Injury: The ATFL, PTFL, transverse tibiofibular ligament, interosseus ligament, interosseus membrane are responsible for maintaining stability between the tibia and fibula. Syndesmotic injuries can occur with forced external rotation of the foot or during internal rotation of the fibula on a planted foot. This injury is common in skiing and contact sports.

Degree of Severity of Ankle Sprains[7]

- Grade I – mild stretch, no instability, single ligament involved (usually ATFL), minimal swelling, no point tenderness.
- Grade II – large spectrum of injury, mild to moderate instability, complete tearing of ATFL or partial tearing ATFL plus calcaneofibular ligaments, localized swelling.
- Grade III – significant instability, complete tear anterior capsule, ATFL and calcaneofibular ligaments, diffuse swelling both sides Achilles tendon, possible tenderness medially and laterally

With a ligamentous injury there may also be a disruption of the joint afferents. This would lead to a decrease in the proprioception and joint position sense and a decrease in ability to make postural adjustments of the foot before ground contact. The strength of the ankle evertors – peroneal longus and brevis- are important in supporting the lateral ankle after an inversion injury.[8]

The aim of rehabilitation is to restore normal function to the ankle and surrounding tissues. Immediate protected exercise promotes healing by the formation of dense connective tissue.[9]

Indications for Treatment:

Patients can be referred with an acute, sub-acute or chronic injury. Treatment will depend on duration and intensity of symptoms. Chronic problems can include pain, reoccurring sprains and ankle instability.

Contraindications / Precautions for Treatment:

- Fracture
- Tumor at ankle or foot
- Tendon tears or tendonitis – current or past
- Avoid positions which increase swelling or pain
- Refer to modality practice standards for other specific contraindications and precautions

Evaluation:

Medical History: Review medical history questionnaire (on an ambulatory evaluation), patient's medical record and medical history reported in the Hospital's Computerized Medical Record. Review any diagnostic imaging, tests, work up and operative report listed under LMR.

History of Present Illness: Interview patient at time of examination and include onset, acute, subacute, or chronic, duration of symptoms and mechanism of injury. Inquire and document if there was a deformity or locking at the time of injury and whether the patient was able to immediately weight bear on the extremity or continue the activity after the injury. Include any previous ankle sprains or fractures or past treatments for ankle pathology.

Social History: Review patient's home, work, recreational and social situation. Specifically ask about weight-bearing activities and types of independent exercise.

Medications: NSAID's and/or analgesics (OTC, prescription), oral and/or injections

Examination:

This section is intended to capture the most commonly used assessment tools for this case type/diagnosis. It is not intended to be either inclusive or exclusive of assessment tools.

Appearance: Note presence of effusion and document figure 8 measurement. Note discoloration, rubor, ecchymosis, symmetry in contour, presence of scars/incisions, blisters, calluses, corns and toe deformities. Note alignment of calcaneous, and of subtalar joint. Note dorsalis pedis and posterior tibialis pulses.

Pain: As described using VAS. Note location, description and activities that increase or decrease symptoms. Pain is often located at area of ATFL for lateral and syndesmotic injuries.

Palpation: Palpate anterior and posterior talofibular, calcanealfibular and deltoid ligaments, Achilles tendon, anterior, medial and lateral musculature, medial and lateral malleoli, and the 5th metatarsal base. (Note which sites are tender to touch; rate tenderness as mild, moderate, severe).

Range of motion (ROM): Measure active and passive dorsiflexion, plantarflexion, eversion, inversion, toe flexion and extension. Document measurements, end-feel, and evidence of capsular pattern. The capsular pattern of the ankle is PF more limited than DF and subtalar varus more limited than valgus. Check functional and symmetric hip and knee ROM bilaterally and back flexibility (lower quarter screen).

Accessory Joint Motion:

- Talocrural: distraction, anterior and posterior glide

- Subtalar: distraction, medial and lateral tilt and glide, tilt medially and laterally
- Cuboid: passive physiological motion and accessory joint glide[10]
- Tarsometatarsal, MTP

Strength: Manual Muscle Test hip, knee and ankle motions. If the patient is unable to tolerate MMT due to acute sprain or ability to weight-bear resistive isometrics can be used to test plantarflexion, dorsiflexion, eversion, inversion, toe flexion and extension in neutral. May see proximal muscle function changes (gluteus maximus) associated with severe ankle sprain.[11]

Posture/alignment: Particularly note lumbar, hip, knee, ankle and foot alignment

Neurological Testing: check for loss of sensation or motor weakness. Determine if any nerve damage from injury or past history is present.

- **Motor** - Tibial nerve (L4-S3) or peroneal nerve (L4-S2) injury is sometimes seen in severe injuries.[3]
  -Peroneal nerve motor (AT, EHL, EDL, peroneals)
  -Tibial nerve motor (gastrocnemius, plantaris, soleus, popliteus, tibialis posterior, FDL, FHL)

- **Sensation:** Changes in sensation affect ankle stability and ability to balance. Local sensory changes can be associated with severe ankle sprain.[11] Tension neuropathy of the superficial peroneal nerve can lead to chronic pain localized to the dorsum of the foot where the nerve exits the fascia of the anterior compartment. Pain is located anterolaterally and reproduced with plantarflexion and decreased with dorsiflexion.[12]

Functional Outcomes and activities: Squat, stand on toes, stand on heels, stand on one foot or other with eyes open, stand on one foot or other with eyes closed, (single leg stance or Romberg) stand on toes on one foot or other, walk on toes, run, jump, jump and squat.[7] Choose a functional outcome measure that most appropriately matches patient's abilities at the time of examination.

Timed Get Up and Go test may be indicated for elderly population and may give a reflection of functional compromise.[13]

LE Functional Scale (LEFS) [14] -a patient self report scale
Patient may not be able to perform all functional tests depending on acuity of injury and prior status such as chronic instability. Tests include information on balance and proprioception.

Special Tests [3,4,7,15]:

- Neutral position of talus[7]
- Anterior drawer sign (tests anterior talofibular ligament, with inversion also tests calcaneofibular ligament)[4, 7]
- Talar Tilt (tests calcaneofibular ligament)[4, 7]
- Squeeze Test of leg or Distal Tibia-Fibula Compression Test (tests if syndesmosis injury. Fracture, contusion or compression syndrome need to be ruled out)[4, 7]

- External Rotation Stress Test (tests for syndesmosis injury) [4, 7,15]
- Kleiger Test (tests deltoid ligament) [7]
- Thompson Test (tests for Achilles tendon rupture) [7]
- Inversion Stress Test (in dorsiflexion to test calcaneofibular, in plantarflexion to test anterior talofibular [3, 7]

Differential Diagnosis:

- Fracture - check for tenderness over medial and lateral malleoli, navicular and 5th metatarsal head and ability to weight bear (Ottawa ankle rules). [3]
- Tendon injuries – Achilles injury or rupture, Peroneal tendon rupture, subluxation or dislocation, AT tendon rupture, FHL tendon rupture.
- Osteochondral or chondral injuries of talar dome [3, 4]
  (pain with weight-bearing, locking or clicking if fragment displaces, tenderness over the lateral aspect of talar dome, radiographs may show small flake of bone from lateral dome of the talus, if negative, a MRI can establish the diagnosis [16]
- Peroneal or sural nerve irritation

Assessment:

Establish diagnosis by onset, history and clinical examination. Establish need for skilled PT services to reduce/relieve pain and swelling, restore function and decrease risk of recurrence.

Problem List: identify impairment(s) and/or dysfunction(s)

- Pain
- Impaired ROM
- Impaired Strength
- Impaired Gait
- Impaired Joint Play
- Impaired balance/proprioception
- Edema
- Impaired Knowledge
- Impaired Functional Mobility

Prognosis: A history of previous sprains, fractures or ankle instability will affect the prognosis. Dynamic muscle strength can compensate for ligamentous laxity due to ankle sprain. [17-20,22] Proprioceptors can also be damaged with this injury and patients often require proprioception training. The type and level of sports activity can affect outcome. Complete recovery from Grade III injuries may be prolonged. Surgical treatment may be needed if continued problems with instability and mechanical problems are documented by stress radiographs even with full course of physical therapy and trial of bracing.

Goals:

- Pain Relief/Reduction
- Protect injured ligaments against re-injury

- Increased ROM
- Increased Strength
- Maximize Gait
- Maximize Functional Independence
- Increased balance and proprioception
- Independent home exercise program
- Maximize ability to return to previous vocational, avocational and recreational activities

Age Specific Considerations:

- Patients with osteoporosis may be more likely to fracture than sprain
- Decreased proprioception with age

Treatment Planning / Interventions

Established Pathway	___ Yes, see attached.	_X_ No
Established Protocol	___ Yes, see attached.	_X_ No

Interventions most commonly used for this case type/diagnosis.

This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

Timing of phases varies with severity of sprain[3] and individual healing process.[22]

Acute Phase – Days 1-3:

The goals of this phase are decreasing effusion and pain, protecting from further injury [3] and allowing protected gait as tolerated. Early mobilization can lead to earlier return to work and patient comfort. [23]
Also, early mobilization of joints following ligamentous injury actually stimulates collagen bundle orientation and promotes healing although full ligamentous strength is not re-established for several months.[3]

- Pain and Swelling Management: RICE (rest, ice, compression, elevation)

  Evidence found for elevation and cold therapy in minimizing edema.[24, 25] Can also consider electrical stimulation (high volt or interferential). No strong evidence for ace wrap, compression pneumatic device, ultrasound, elastoplast.\[24-26] One study stated contrast bath contraindicated to reduce edema in posterior ankle sprains. [24]

- Protection of injured ligaments from further injury: (taping, splints, pneumatic walking boot, semi-rigid ankle stirrup orthotic**,** lace up brace, cast for severe injuries).

Pneumatic walking boot or even a cast may be needed for severe injuries or fracture. Boot may also be indicated if patient cannot normalize gait with a splint.

A device such as a pneumatic walking boot which restricts motion and protects healing ligamentous tissues but allows weightbearing may help recovery and return to activity. It also allows non weight-bearing exercise such as ROM out of the boot. [27]

Taping can be open basketweave for acute injuries in athletes. Taping does not provide same degree of protection as strong evertor muscles but muscles may fail to protect against inversion injury due to muscle onset latency therefore external devices may provide protection by doubling resistance to inversion. [22]
However, the patient may experience problems with loosening of the tape.

- Gait : weight-bearing as tolerated
  The higher the grade of sprain the longer period of time required for pain-free weight-bearing.[3] The patient may need assistive devices to normalize pain free gait.

Sub-Acute Phase - 2-4 days to 2 weeks:

The subacute phase focuses on decreasing and eliminating pain, increasing pain free ROM, protecting from re-injury with bracing or splints, limiting loss of strength and using modalities to decrease effusion. [3]

- Pain and Swelling Management:
  Modalities can be used to decrease pain and swelling: ice, electrical stimulation (Interferential, HVGS). There is limited evidence for ultrasound.[21] *Refer also to acute phase above.*

- Joint mobilization: Talocrural and subtalar joints
  Adding talocrural joint mobilization to RICE protocol to treat ankle inversion injuries can lead to fewer treatments to regain pain free dorsiflexion and improve stride speed. [28]

The patient may have a restricted posterior glide of the talocrural joint even with restoration of dorsiflexion. If restricted, patient may have residual joint dysfunction. [29] Reid et al[30] found that the talocrural Mulligan Mobilizations with Movement technique[31] improves dorsiflexion range immediately following treatment in patients with lateral ankle sprains. Vincenzino et al [32] suggest that that further randomized-controlled trials are needed to evaluate the efficacy of the treatment intervention in mobilizations with movement. They have found that there are trends in the data that support the clinical claim of the rapid decrease in pain and increased function during and after one treatment and subsequently a course of treatment. This rapid pain relief appears to be based on the correction of positional faults with mobilizations with movement.[32]

One needs to determine if the tarsal cuboid is subluxed in a plantar or dorsal direction. This subluxation could be caused by plantar flexion and inversion stresses at the ankle and could result in pain and impaired joint function. Refer to article Mooney article for procedure. [10]

- ROM within pain-free range:
    - Start with dorsiflexion and plantarflexion
    - Add inversion and eversion as pain and tenderness over ligaments decrease
    - Stretch gastroc/soleus complex – start with non weight bearing and then progress to weight bearing positions
    - Toe curls
    - Ankle alphabet
    - Stationary bike

- Progress gait training: increase weight bearing and decrease need for assistive device as tolerated (as pain decreases and balance allows)

- Strengthening: isometrics to limit loss of strength

- Protection: wean from splints or braces as tolerated and as pain and swelling decrease or provide external support if needed for support or protection (refer to section on protection under Acute Stage).

Rehabilitative Phase – 2-6 weeks post-injury:

The focus of this phase is on regaining ROM and strength, increasing endurance and neuromuscular performance.

As patient is able to tolerate full weight-bearing:

- Joint Mobilization: continue as needed
- Stretching: Achilles tendon, gastrocnemius, soleus (may also need to stretch into plantarflexion, eversion and inversion)
- Strengthening Exercises: Progression of dorsiflexion, plantarflexion, eversion and inversion from active range of motion exercises to resistive exercises (concentric and eccentric) as pain decreases and ROM increases. Use free weights and exercise bands. Progress to closed chain as ability to weight-bear increases, such as bilateral toe raises progressing to single leg, bilateral squats progressing to single leg squats, step-ups and step-down exercises (preparation for stairs if necessary)

  Study showed improvements in dorsiflexor and evertor strength and in joint position sense for inversion, dorsiflexion and plantar flexion after ankle strengthening exercises in subjects with functionally unstable ankles. Joint position sense changes thought to be due to muscle spindle sensitivity changes in central mechanisms related to spindles and not mechanoreceptor sensitivity. [17]

- Proprioception Training: Progress from sitting to standing on both and then single leg, eyes open to eyes closed, and reaching with dynamic challenge on level and progressing to uneven surfaces
    - Wobble Board
    - BAPS
    - Foam pad
    - Pillow
    - Star Excursion Balance Activities[33, 34]

  Studies show effectiveness of wobble board training in preventing functional instability[19], balance training in improving ankle joint proprioception and single leg standing[18] and of combined ankle disk training and non-elastic tape on decreasing postural sway[22]. In another study, proprioception training and peroneal muscle strengthening are affirmed as important in the rehabilitation after ankle injury.[20] Verhagen[35] reported a significant reduction in the ankle sprain risk for volleyball players with a history of ankle sprains when balance board training was used as a regular part of the daily warm-up. Han et al[6] noted that a standing elastic resistance balance program (front pull, back pull, crossover and reverse crossover) elicited meaningful improvements in balance that were retained 4 weeks after training.

- Gait Training: wean from assistive devices as tolerated

- Endurance Activities: swimming, biking, walking, etc.

Functional Phase – 6 weeks post-injury:

The goal of this phase is preparing the patient for return to full activity and function; adding sports specific exercises with goal of returning to sports and recreational activity. Return to sports should be based on patient's ability to perform sports-specific activities when patient has full ankle ROM, normal ankle strength especially of peroneals and dorsiflexors, and no pain or tenderness.

- Progressive strengthening
- Coordination and Agility training - Activities to consider depending on patient's ability, recovery and type of vocational/and/or recreational activity the patient will return to:
    - Lunges
    - Hopping (progress bilateral, to injured leg only, whole foot to toes only)
    - Step exercises – forward, side to side
    - Running should be progressed when the patient can walk at a face pace without pain, starting on smooth surfaces and progressing to uneven surfaces

- Cutting exercises
- Figure 8's, zig-zags
- Jump rope
- Stairmaster, treadmill, exercise biking

Prophylactic Phase - Prevention of Re-Injury: [3, 36]

- Strengthening including dorsiflexion and peroneals
- Functional proprioceptive drills – speed, balance, coordination and agility
- Cardiovascular endurance training
- Proper footwear
- Prophylactic External Support – determine if there is a need (chronic instability and/or decreased proprioception) for brace, splint, orthotics[37] or taping and obtain physician order as needed. Consider lace-up ankle brace or ankle taping especially for sports with high incidence of ankle injuries (basketball, volleyball, soccer, tennis, and other sports which involve high frequency of stopping, starting and twisting).

  Molded orthotics helped to improve balance scores in the ankle sprain group and to decrease ankle pain during jogging for those with an ankle sprain. Control of the subtalar joint may decrease stress on the injured ligaments (ATFL stressed with excessive pronation) and lead to decreased pain and increased function.[38]

  Orthotics may be useful in reducing increased postural sway seen in patients with ankle injury and facilitating recovery and return to activity.[39]

Frequency & Duration: 2x/week for 4-8 weeks (3x/week for first 2 weeks may be indicated for severe pain, swelling or functional impairment)

Patient / family education: during each phase include instruction in:

- Pain and swelling management
- Re-injury prevention
- Home exercises
- Use of assistive device, brace or splint
- Footwear

Recommendations and referrals to other providers:

- Orthopedist
- Orthotist
- Rheumatologist
- Podiatrist

Re-evaluation

Standard Time Frame- 30 days or less as appropriate

Other Possible Triggers: significant change in symptoms, re-injury, or chronic instability and or pain after 8-12 weeks of intervention.

Factors which may limit progress or present as complications [3, 4]

Include but not limited to and may require referral back to MD or other specialist:

- Chronic ankle instability- feeling of being unstable, swelling with activity (see surgical management below)
- Impingement – scarring of ATFL and joint capsule can lead to intra-articular meniscoid tissue
- Peroneal tendon subluxation –detachment of peroneal retinaculum at insertion on fibula
- Talar dome fracture
- Anterior process fracture of calcaneous – bony rather than ligament point tenderness
- Chronic Regional Pain Syndrome

Also refer to differential diagnosis section on page 5.

Surgical Management of chronic lateral ankle instability:

Different surgical procedures have been described in the treatment of lateral ankle instability. The surgical procedures may be described as anatomical or nonanatomical.

Anatomical Reconstruction:

In 1966, Brostrom developed a surgical technique in which the anterior talofibular ligament (ATFL) and calcaneofibular ligament (CFL) were attenuated and shortened[40, 41] . However, this procedure was found to create instability at the subtalar joint, and in 1980, Gould developed the modified Brostrom procedure, addressing this instability by suturing the extensor retinaculum to the anterior aspect of the fibula[42]. This aspect of the procedure reinforces the repair but also limits active inversion. The lack of inversion is a known limitation of the procedure but is considered an acceptable outcome given that the purpose of the surgery is to correct the initial instability [42, 44]

Nonanatomical Reconstruction:

This surgical procedure involves tenodesis with the peroneal brevis to reconstruct and stabilize the lateral ankle. This procedure is chosen in cases where the patient has general ligamentous laxity, has failed a modified Gould-Brostrom procedure, is obese or if a direct repair isn't indicated because of chronic, repetitive trauma [44-46] .

Krips and colleagues[47] compared the modified Brostrom technique against the Watson-Jones and Cataing tenodesis procedures with a mean follow-up in both groups of over 12 years. They

found that the tenodesis procedures lead to inferior results with regards to functional and mechanical stability and with overall satisfaction in the long term.

Discharge Planning

Commonly expected outcomes at discharge:

- Independent functional mobility
- Minimal to no pain or swelling
- Functional ROM and strength
- Independent home exercise program
- Return to work and/or previous avocational and recreational activities

Transfer of Care: if applicable

- Patients who are a fall risk, have transportation issues, or significant difficulty walking may benefit from home physical therapy until the patient is safely able to attend outpatient physical therapy.
- Patient will be referred back to physician if worsening symptoms or symptoms do not change.

Patient's Discharge Instructions: continue home exercise program as directed. Contact clinic or physician if patient experiences increased symptoms or re-injury.

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