Fracture, Metatarsal Stress

Indexing Metadata/Description

- **Title/condition:** Fracture, Metatarsal Stress
- **Synonyms:** Stress fracture, metatarsal; metatarsal stress fracture; metatarsal stress reaction; metatarsal stress injury; fatigue fracture, metatarsal; march fracture; march stress fracture; bone stress injury: metatarsal
- **Anatomical location/body part affected:** Forefoot/metatarsal bone (most often the 2nd or 3rd metatarsal)
- **Area(s) of specialty:** Orthopedic Rehabilitation, Pediatric Rehabilitation, Sports Rehabilitation
- **Description**
  - The metatarsals are common sites of stress fracture in athletes involved in high-impact activities (e.g., runners, jumpers, gymnasts), military recruits, and dancers(1,20)
  - Approximately 28% of all stress fractures reported in the literature are metatarsal stress fractures(24)
  - Stress fractures are most common in the 2nd and 3rd metatarsals, followed by the 4th and 5th metatarsals.(24) The majority of cases involve the distal diaphysis of the 2nd and/or 3rd metatarsal(2)
  - Undisplaced stress fractures of the metatarsal shafts typically heal well with conservative treatment, including relative rest, and usually do not require immobilization(3)

- **ICD-9 codes**
  - 733.94 stress fracture of the metatarsal

- **ICD-10 codes**
  - M84.37 stress fracture of metatarsal
  - S92.3 fracture of metatarsal bone

(IDC codes are provided for the reader’s reference, not for billing purposes)

- **G-Codes**
  - **Mobility G-code set**
    - G8978, Mobility: walking & moving around functional limitation, current status, at therapy episode outset and at reporting intervals
    - G8979, Mobility: walking & moving around functional limitation; projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
    - G8980, Mobility: walking & moving around functional limitation, discharge status, at discharge from therapy or to end reporting
  - **Changing & Maintaining Body Position G-code set**
    - G8981, Changing & maintaining body position functional limitation, current status, at therapy episode outset and at reporting intervals
    - G8982, Changing & maintaining body position functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
    - G8983, Changing & maintaining body position functional limitation, discharge status, at discharge from therapy or to end reporting
• **Carrying, Moving & Handling Objects G-code set**
  – G8984, Carrying, moving & handling objects functional limitation, current status, at therapy episode outset and at reporting intervals
  – G8985, Carrying, moving & handling objects functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
  – G8986, Carrying, moving & handling objects functional limitation, discharge status, at discharge from therapy or to end reporting

• **Self Care G-code set**
  – G8987, Self-care functional limitation, current status, at therapy episode outset and at reporting intervals
  – G8988, Self-care functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
  – G8989, Self-care functional limitation, discharge status, at discharge from therapy or to end reporting

• **Other PT/OT Primary G-code set**
  – G8990, Other physical or occupational primary functional limitation, current status, at therapy episode outset and at reporting intervals
  – G8991, Other physical or occupational primary functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
  – G8992, Other physical or occupational primary functional limitation, discharge status, at discharge from therapy or to end reporting

• **Other PT/OT Subsequent G-code set**
  – G8993, Other physical or occupational subsequent functional limitation, current status, at therapy episode outset and at reporting intervals
  – G8994, Other physical or occupational subsequent functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
  – G8995, Other physical or occupational subsequent functional limitation, discharge status, at discharge from therapy or to end reporting

<table>
<thead>
<tr>
<th>G-code Modifier</th>
<th>Impairment Limitation Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH</td>
<td>0 percent impaired, limited or restricted</td>
</tr>
<tr>
<td>CI</td>
<td>At least 1 percent but less than 20 percent impaired, limited or restricted</td>
</tr>
<tr>
<td>CJ</td>
<td>At least 20 percent but less than 40 percent impaired, limited or restricted</td>
</tr>
<tr>
<td>CK</td>
<td>At least 40 percent but less than 60 percent impaired, limited or restricted</td>
</tr>
<tr>
<td>CL</td>
<td>At least 60 percent but less than 80 percent impaired, limited or restricted</td>
</tr>
<tr>
<td>CM</td>
<td>At least 80 percent but less than 100 percent impaired, limited or restricted</td>
</tr>
<tr>
<td>CN</td>
<td>100 percent impaired, limited or restricted</td>
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</tbody>
</table>

Source: [https://www.cms.gov/](https://www.cms.gov/)

› **Reimbursement**: No specific issues or information regarding reimbursement have been identified

› **Presentation/signs and symptoms** \(^{(1,2,3,4)}\)
  • Recent history of increased physical activity, with unaccustomed intensity, duration, or frequency
  • Gradual onset of dorsal foot pain with weight-bearing
  • In a study of 5th metatarsal fractures in elite European footballers, researchers found that in 45% of cases the players had lateral foot pain prior to sustaining the fracture\(^{(25)}\)
  • Increased pain with continuation of precipitating activity
  • Point tenderness on dorsum of foot over affected metatarsal
• Mild swelling
• Little or no bruising

Causes, Pathogenesis, & Risk Factors

› Causes
• The mechanism of stress fracture depends on both the magnitude and frequency of unaccustomed mechanical loading on the bone
• Metatarsal stress fracture is associated with activities that involve fitness walking/running (e.g., soccer, military training, basketball) and/or jumping (e.g., dance, gymnastics and other high-impact activities)
  – Higher risk is associated with sports with increased forefoot loading (e.g., sprinters, jumpers)\(^{(27)}\)
• Strong evidence exists that sudden increases in training and excessive training intensity, duration, and frequency (i.e., high “training volume”) are the primary causes of stress fracture in runners and military recruits\(^{(4,5)}\)
• The navicular bone is under maximal compressive forces at the end of foot strike with increased forefoot loading. The area of increased force through the navicular is also an area of poor blood supply, leaving it more vulnerable to stress fracture. \(^{(27)}\)
  However, metatarsal stress fractures are more often related with repetitive use and mechanical stressors
  – See Clinical Review....Navicular Stress Fracture. Topic ID Number: T708500 for more information on navicular stress fractures

› Pathogenesis
• A metatarsal stress fracture begins as a partial (incomplete) break
• Unaccustomed mechanical loading can occur with a rapid increase in training volume. In theory, the time available for bone repair is reduced between workouts, such that bone resorption overwhelms adaptive bone formation\(^{(1)}\)
• Unaccustomed mechanical loading might also explain two cases of stress fracture of the 1st metatarsal after total knee arthroplasty that corrected severe valgus deformity of the knee. Correction of leg alignment may have increased weight-bearing on the 1st metatarsal during gait\(^{(19)}\)
• Stress fracture has also been reported to occur at the base of the 2nd metatarsal after proximal interphalangeal (PIP) joint fusion to surgically correct deformities (e.g., hammer or claw toe) due to tensile strain at the dorsal aspect of the bone\(^{(23)}\)
• Experimental models of stress fracture
  – High acceleration movements in sports appear to increase bending force on the 5th metatarsal more than jump take-off, jump landing, or cutting to the left or right\(^{(6)}\)
  – Tibial stress fracture is the most common stress fracture of the lower extremity in runners and is often associated with metatarsal stress fracture.\(^{(1-5)}\) The effect of running speed on tibial contact force was used to estimate the risk of tibial stress fracture in healthy runners who ran over a force platform at 3 different speeds.\(^{(2)}\) It was found that reducing running speed (from 10 mph to 7.8 mph, and then to 5.6 mph) produced significant reductions in the likelihood of stress fracture
• A change to barefoot running and very light shoes may increase the risk of metatarsal stress fracture by altering footstrike from the heel to the midfoot, and because of insufficient cushioning\(^{(5)}\)
• In a South Korean radiographic study of 50 male soccer players with 5th metatarsal stress fractures, cavus foot structure and increased curvature of the 5th metatarsal shaft were found to be possible predisposing factors\(^{(9)}\)
• Unlike the incidence of tibial and femoral stress fractures, which declined during 1 year of military training (n = 48 recruits), the incidence of metatarsal stress fractures remained unchanged, suggesting that the metatarsal bone is unable to adapt to repetitive strain\(^{(10)}\)
• Stress fracture of the 1st to 4th metatarsal shaft generally does not necessitate immobilization and will heal with restricted weight-bearing and relative rest for 4-8 weeks.\(^{(2,3,5)}\) Fifth metatarsal stress fractures may or may not need to be immobilized

› Risk factors
• Training errors, such as rapid increases in training volume or poor sport-related biomechanics
• Long-distance running and military recruit training
• In runners\(^{(5)}\)
  – High weekly training mileage
  – Cavus feet
  – Leg length inequality/discrepancy, sacroiliac dysfunction
Menstrual issues (e.g., amenorrhea), decreased caloric intake and lower bone density; for more information, see Clinical Review…Female Athlete Triad; Topic ID Number: T708517

High-impact activities, particularly running, cheerleading, and gymnastics, were associated with increased risk of stress fracture (unspecified types) in adolescent girls(11)

A change to barefoot running and/or barefoot-simulating running shoes(8)

Obesity(20)

Pes cavus, decreased ankle dorsiflexion, limited subtalar mobility, short 1st metatarsal, long 2nd metatarsal and metatarsal adductus may be considered predisposing factors for MT stress fractures. However, there is no strong evidence to support or refute these factors(22)

Vitamin D deficiency has been proposed as a risk factor in fracture patients(27)

Overall Contraindications/Precautions
› In pediatric cases, obtain written referral from physician for specific treatment. Also obtain written consent from parent or legal caretaker and secure parental involvement/commitment to the treatment plan
› Clarify restrictions on weight-bearing with physician and obtain postoperative instructions if the patient had surgery
› Relative rest (i.e., patient should avoid the precipitating activity associated with the stress fracture but may continue with activities that do not aggravate the condition) is a necessary component of conservative treatment to provide time for bone healing and to avoid further injury
› See specific Contraindications/precautions to examination and Contraindications/precautions under Assessment/Plan of Care

Examination
› Contraindications/precautions to examination

Ensure that the patient is referred specifically for metatarsal stress fracture. If metatarsal stress fracture has not been diagnosed, refer back to the patient’s physician as indicated

Metatarsal stress fracture typically involves a history of gradual onset of dorsal foot pain with weight-bearing that increases as the patient engages in the precipitating activity. If the patient describes sudden onset of pain after direct trauma to the involved foot, referral back to the physician is indicated to rule out acute fracture

› History

History of present illness/injury: Was the diagnosis of metatarsal stress fracture based on results of a bone scan, clinical evaluation, or both?

– Mechanism of injury: When did pain begin? Did pain onset follow a sudden precipitating event or develop gradually for no apparent reason? Has there been any recent change in training? Change in shoe wear? How have symptoms progressed to this point? Any complications?

– Course of treatment

- Medical management: What interventions have been implemented to date? General recommendations include the following:
  - Decrease weight-bearing activity and consider using a surgical shoe to decrease weight-bearing on the fracture site
  - Short-leg walking cast is usually unnecessary but may provide symptomatic relief in some cases
  - Decreased or modified activity for 3-6 weeks (duration may vary depending on physician’s protocol)
  - As patient gradually returns to activity, avoid uneven ground, and correct any fault foot mechanics. Assess need for shoe orthotics
  - If patient is a runner – must discontinue running until pain and tenderness are gone; upon resuming running, avoid hills, reduce shock (avoid downhills/hard surfaces, reduce speed, ensure adequate cushioning/padding, adjust running style, emphasize warm-up and stretching), correct gait/running mechanics

- Surgical management: Has the patient had surgery? Patient may have had internal fixation(12,13)

- Medications for current illness/injury

- Determine what medications clinician has prescribed, if any; are they being taken? Are they effective?

- Analgesics are often recommended, but as reduced pain may increase weight-bearing activity, avoiding analgesics should be considered(1)

- Nonsteroidal anti-inflammatory drugs (NSAIDs)(21)
- **Diagnostic tests completed:** In most cases, diagnosis is based on a careful history and clinical evaluation. Bone scans have been the gold standard for diagnosing stress fractures. For many practitioners, magnetic resonance imaging (MRI) has become the study of choice in acute cases. (It should be pointed out the many insurers will not approve MRI for this diagnosis unless conservative treatment has also been tried for a specified period of time.) However, CT scan can often determine fracture lines prior to MRI and is suggested to be used prior to MRI.\(^\text{27}\) Plain X-rays may show characteristic changes (periosteal callus formation\(^\text{20}\)) in 2 to 4 weeks after onset of symptoms\(^\text{14}\)

- Use of the Ottawa Rules for the foot is appropriate for any patient over the age of 6 years. The rules state that a series of X-rays are required if there is pain in the midfoot and any one of the following:\(^\text{22}\)
  - Point bone tenderness of the navicular
  - Point bone tenderness of the base of the 5th metatarsal
  - Inability to bear weight

- **Home remedies/alternative therapies:** Document any use of home remedies (e.g., ice or heating pack) or alternative therapies (e.g., acupuncture) and whether or not they help

- **Previous therapy:** Document whether patient has had occupational or physical therapy for this or other conditions and what specific treatments were helpful or not helpful

  - **Aggravating/easing factors** (and length of time each item is performed before symptoms come on or are eased). Ask about any current changes in footwear. Typically, increased activity will aggravate symptoms and rest will relieve symptoms. Patient will often describe dorsal foot pain that occurred with running and then eventually with walking as well

  - **Body chart:** Use body chart to document location and nature of symptoms. Patient will often describe dorsal foot pain

  - **Nature of symptoms:** What increases or decreases pain? Document nature of symptoms (e.g., constant vs. intermittent, sharp, dull, aching, burning, numbness, tingling)

  - **Rating of symptoms:** Use a visual analog scale (VAS) or 0-10 scale to assess symptoms at their best, at their worst, and at the moment (specifically address if pain is present now and how much); can use Oucher scale for children

  - **Pattern of symptoms:** Document changes in symptoms throughout the day and night, if any (A.M., mid-day, P.M., night); also document changes in symptoms due to weather or other external variables

  - **Sleep disturbance:** Document number of wakings/night, if any

  - **Other symptoms:** Document other symptoms patient may be experiencing that could exacerbate the condition and/or symptoms that could be indicative of a need to refer to physician (e.g., dizziness, bowel/bladder/sexual dysfunction, saddle anesthesia)

  - **Barriers to learning**
    - Are there any barriers to learning? Yes__ No__
    - If Yes, describe _________________________

- **Medical history**
  - **Past medical history**
    - **Previous history of same/similar diagnosis:** History of stress fracture elsewhere? History of other lower-extremity dysfunction?
    - **Comorbid diagnoses:** Ask patient about other problems, including diabetes, cancer, heart disease, complications of pregnancy, psychiatric disorders, eating disorders, orthopedic disorders, etc. Also, does the patient have a history of osteopenia, osteoporosis, or other significant medical history such as gout?
    - **Medications previously prescribed:** Obtain a comprehensive list of medications prescribed and/or being taken (including over-the-counter drugs)
    - **Other symptoms:** Ask patient about other symptoms he or she may be experiencing

- **Social/occupational history**
  - **Patient’s goals:** Document what the patient hopes to accomplish with therapy and in general
  - **Vocation/avocation and associated repetitive behaviors, if any:** Does the patient participate in running or sports with repetitive running? Is the patient in the military, or does he or she engage in activities that include prolonged walking or high impact? If patient is employed, what activities does his or her job require? What activities that the patient enjoys have been limited by his or her current symptoms?
  - **Functional limitations/assistance with ADLs/adaptive equipment:** How has this injury affected function?
  - **Living environment:** Stairs, number of floors in home, with whom patient lives (e.g., caregivers, family members). Identify if there are barriers to independence in the home; any modifications necessary?
Relevant tests and measures: (While tests and measures are listed in alphabetical order, sequencing should be appropriate to patient medical condition, functional status, and setting)

- Anthropometric characteristics: Document height, weight, and body mass index (BMI). There is an increased fracture risk in obese patients. Is there a leg-length discrepancy? Take circumferential measurements if there is edema.
- Assistive and adaptive devices: Does patient use orthotics? If so, what type, and are they being worn? If applicable, is the proper ambulatory assistive device (AD) being used correctly and is it in good condition? Did patient require casting or a boot?
- Balance: Dynamic balance may be impaired due to pain on weight-bearing; assess balance as indicated. The Berg Balance Scale (BBS) can be used for objective assessment for lower level patients; for higher level patients, assess single limb stance (SLS) and compare to the unaffected side for time and quality of postural control.
- Circulation: Assess peripheral pulses and for cyanosis and refer to physician or emergency services if inadequate circulation is suspected.
- Functional mobility (including transfers, etc.): Assess whether patient maintains weight-bearing status in transfers and mobility. The FIM or Timed Up and Go (TUG) test can be used as an outcome measure.
- Gait/locomotion: Initially, ensure the patient is following weight-bearing precautions and is using AD appropriately. When full weight-bearing, assess for symmetrical gait, hyperpronation, toeing-in or toeing-out gait, and increased toe extensor activity. Assess for limited dorsiflexion at heel strike, as it can decrease heel strike which increases the loading of the metatarsals. Pain may decrease plantar flexion (push-off) and hallux extension during toe-off. Use Functional Gait Assessment (FGA) or Dynamic Gait Index (DGI), as indicated. If patient is a runner, assess running form outside and on a treadmill prior to the return to sport.
- Joint integrity and mobility: Assess mobility at the involved metatarsophalangeal (MTP) and tarsometatarsal joints. Assess the hallux MTP joint for valgus, rigidity, and overall motion. Also assess ankle joint integrity, although it is typically not compromised.
- Muscle strength: Assess strength of foot and ankle with manual muscle testing (MMT) and scan entire lower extremity for functional strength.
- Observation/inspection/palpation (including skin assessment)
- Palpate for tenderness along the metatarsals and throughout the foot
- Palpate and inspect hallux for deformity, rigidity, or adhesions in comparison with the unininvolved side
- Document any discoloration, bruising, or ecchymosis
- Inspect foot for callus formation; patterns may suggest where the patient tends to excessively load
- Inspect footwear – note localized wear, poor fit, unusual shape and use of orthotics
- Document any swelling, point tenderness over fracture site, or pain with percussion
- Note site of tenderness – localized dorsally over affected metatarsal shaft
- Inspect for signs and symptoms of complex regional pain syndrome (CRPS), such as shiny skin, abnormal sweating, and changes in nail or hair growth. For more information, see Clinical Review…Complex Regional Pain Syndrome; Topic ID Number: T708498
- Pain: Assess for pain in weight-bearing, during gait, and with palpation.
- Posture: Assess the foot for pes planus or pes cavus, noting position of calcaneus, height of longitudinal arch, toeing in, or other malalignment of the foot during weight-bearing. Also, assess rearfoot, forefoot, and first ray alignment in subtalar neutral in weight-bearing and non-weight-bearing.
- Range of motion: Assess forefoot ROM, noting any pain restriction. Also, assess ROM and flexibility of ankle and entire lower extremity.
- Sensory testing: Assess sensation, including proprioception, of the involved foot and ankle.
- Special tests
  - Foot Function Index (FFI), a 23-item, self-administered questionnaire with 3 subscales that assess foot function in terms of pain, disability, and activity.
  - Lower Extremity Functional Scale (LEFS)

Assessment/Plan of Care

- Contraindications and precautions
  - In the acute phase of healing, treatment should be limited to protection and control of pain/edema
  - Initiate therapeutic exercise for the affected foot after 4-8 weeks of healing, as guided by X-ray findings.
• Patients with this diagnosis are at risk for falls due to restricted weight-bearing status and/or pain. Follow facility protocols for fall prevention and post fall-prevention instructions, if inpatient. Ensure that patient and family/caregivers are aware of the potential for falls and educated about fall-prevention strategies. Discharge criteria should include independence with fall-prevention strategies

• Cryotherapy contraindications
  – Cold urticaria
  – Cold intolerance
  – Paroxysmal cold hemoglobinuria
  – Cryoglobulinemia
  – Raynaud’s disease or phenomenon
  – Over a regenerating peripheral nerve
  – Over a circulatory compromise
  – Over an area of peripheral vascular disease

• Cryotherapy precautions
  – Hypertension
  – Thermoregulatory disorders
  – Over a superficial peripheral nerve
  – Over an open wound
  – Over an area of poor sensation
  – With individuals with poor cognition
  – In the very young and the very old
  – Persons with an aversion to cold

• Superficial heat contraindications
  – Over areas with a lack of intact thermal sensation
  – Over areas of vascular insufficiency or vascular disease
  – Over areas of recent hemorrhage or potential hemorrhage
  – Over areas of known malignancy
  – Over areas of acute inflammation
  – Over infected areas where infection may spread
  – Over areas where liniments or heat rubs have recently been applied
  – In any situation deemed unreliable by the practitioner

› Diagnosis/need for treatment: Metatarsal stress fracture/pain; management during healing phase (e.g., gait and functional mobility training with AD and weight-bearing precautions, safe exercises to maintain fitness); reduced foot mobility, strength, balance, proprioception, and ROM following restricted weight-bearing status; rehabilitation needed for return to participation in usual physical activities

› Rule out
  – Proximal stress fracture (at the base) – presents with increased risk of nonunion when treated with conservative measures, whereas shaft or neck fractures respond well
  – Interdigital (Morton’s) neuroma – pain between metatarsal heads on lateral compression
  – Extensor tendonitis – pain precipitated by passive stretch and resistance against involved tendon
  – Metatarsalgia (i.e., tenderness located on plantar side of 2nd [and/or 3rd] metatarsal)
  – Sesamoiditis
  – Gout
  – Arthritis
  – Lisfranc injury
  – Soft tissue or bone tumor
  – CRPS of the foot
  – Osteochondritis dissecans
  – Navicular stress reaction
Prognosis

- Prognosis is good when the fracture is protected and allowed to repair.\(^{(20)}\) Most patients can return to functional activities and sports after rehabilitation/reconditioning of foot.
- Stress fracture of the 1st to 4th metatarsal shaft is usually benign, generally does not necessitate immobilization, and heals with relative rest for 4-8 weeks. Stress fracture of the 5th metatarsal may require immobilization to heal\(^{(2,5,20)}\).
- Stress fracture of the 2nd metatarsal base is associated with risk of nonunion and requires close diagnostic follow-up\(^{(11)}\)
  - Based on a retrospective chart review conducted in the United States
  - 12 stress fractures reported in 9 patients
  - 6 patients with fractures (50%) developed nonunion; 5/6 fractures required surgery
- A high rate of healing problems has been reported in 4th\(^{(24)}\) and 5th\(^{(25)}\) metatarsal stress fractures. Surgical repair of 4th and 5th metatarsal stress fractures is associated with faster healing time and return to sports in athletic populations\(^{(24,25)}\).
  - In a retrospective review of 67 5th metatarsal fractures in elite European footballers, the majority were stress fractures. Rate of union was significantly lower in patients treated conservatively (33%) than in patients treated surgically (75%)\(^{(25)}\).
  - Results of a retrospective review conducted in the United States of 4th metatarsal fractures in an athletic population desiring early return to sport showed that all patients treated with operative open reduction and internal plate fixation had evidence of radiographic healing before return to activity, and patients returned to sports at an average of 12 weeks post-surgery\(^{(24)}\).

Referral to other disciplines: Orthopedic physician and/or orthotist, as indicated; aquatic therapist for pool exercise program; dietitian for eating disorder; psychologist for exercise addiction; orthotist for orthotics.

Other considerations

- Results of a double-blind, placebo-controlled trial conducted in Australia indicate that low-intensity pulsed ultrasound (US) is not an effective treatment for lower-limb bone stress injuries\(^{(26)}\).
  - 23 patients with a bone stress injury of the tibia, fibula, or 2nd, 3rd, or 4th metatarsal participated
  - Patients were randomized to receive either US treatment or placebo for 20 minutes daily for 4 weeks
  - There were no significant differences in outcomes between the groups. Outcomes included MRI grading, bone marrow edema size, and 6 clinical parameters (night pain, pain at rest, pain on walking, pain with running, tenderness, and pain with single-leg hop)
  - Although research has suggested that low-intensity pulsed US is effective in the treatment of acute fractures and nonunions, its use in stress fractures is not supported.

Treatment summary: \(^{(3,4,14)}\) Treatment may begin once fracture is healed, as indicated by callus formation on x-rays. Comprehensive foot rehabilitation will likely be needed if foot has been immobilized for healing\(^{(16)}\).

<table>
<thead>
<tr>
<th>Problem</th>
<th>Goal</th>
<th>Intervention</th>
<th>Expected Progression</th>
<th>Home Program</th>
</tr>
</thead>
</table>
| Tenderness on palpation. Pain and swelling with normal ambulation | Relief of symptoms | **Physical agents and electrotherapeutic modalities**
  - Trial of cryotherapeutic agents and modalities for pain/edema management; RICE\(^{(20)}\) | Gradual resolution of symptoms | Encourage self-management of pain/edema using ice pack/ice massage, RICE |
| Reduced foot and ankle mobility and ROM | Normal mobility and ROM of foot and ankle | **Therapeutic exercises**  
Once fracture is healed, passive foot and ankle stretching and mobilization to improve ROM and mobility, especially if the hallux is rigid  

**Physical agents**  
Superficial heat may be used prior to joint or tissue mobilization with hypomobility  
Assisted stretching in ankle plantarflexion, extension, inversion, eversion; supination/pronation, forefoot abduction/adduction  

**Manual therapy**  
Once fracture is healed, joint mobilization may be trialed if forefoot is rigid. Joint traction/distraction, lateral gliding, and anterior/posterior mobilizations can be used to increase overall hallux ROM  
Progress each patient as appropriate and indicated by symptoms  
Provide patient with home exercise plan for restoring normal ROM of the entire ankle and foot |

| Foot/ankle muscle weakness | Normal foot/ankle strength | **Therapeutic and manual exercises**  
Once fracture is healed, begin general foot and ankle strengthening activities, including dorsiflexion, plantar flexion, inversion and eversion, toe flexion and extension. Begin with isometrics and progress to resistance with manual therapy or resistance bands and weights, as tolerated  
Progress each patient as appropriate and indicated by symptoms  
Provide patient with home exercise plan for restoring normal strength |
<table>
<thead>
<tr>
<th>Impaired use of the foot during dynamic balance and gait</th>
<th>Normal gait mechanics, improved dynamic balance; restored balance strategies</th>
<th><strong>Functional training</strong></th>
<th>Progress to dynamic activities in weight bearing such as a balance board, SLS, compliant surfaces (e.g., foam), altering visual input (e.g., eyes closed) and adding cognitive activity; ensure proper foot mechanics during these activities</th>
<th>Provide oral and written instruction on functional exercises and prevention of reinjury and falls</th>
</tr>
</thead>
<tbody>
<tr>
<td>At risk for reinjury and falls</td>
<td>Reduced risk for reinjury and falls</td>
<td>Proprioception exercises, as needed</td>
<td>Independent exercise program, including avoidance of overuse/training errors and adherence to correct footwear and biomechanical alignment with walking</td>
<td></td>
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<tr>
<td>Normal strength of all muscles of affected lower extremity, especially hip, for dynamic balance</td>
<td>Normal gait mechanics, improved dynamic balance; restored balance strategies</td>
<td>Balance training</td>
<td>Normal strength of all muscles of affected lower extremity, especially hip, for dynamic balance</td>
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<td>ROM activities should be completed to increase dorsiflexion at heel strike, which is needed to attain correct distribution of force through the forefoot during gait. This should decrease abnormal loading of the metatarsals (8)</td>
<td>Normal strength of all muscles of affected lower extremity, especially hip, for dynamic balance</td>
<td></td>
</tr>
<tr>
<td>Functional training</td>
<td>Once fracture is healed, begin gait training with a focus on correct biomechanical alignment and function of the foot during heel-strike and toe-off</td>
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<tr>
<td>Cavus feet and leg-length inequality and/or sacroiliac dysfunction if applicable</td>
<td>Patient fitted with heel lift and/or orthotics</td>
<td><strong>Prescription, application of devices and equipment</strong></td>
<td>Instruct patient in a wearing schedule</td>
<td>N/A</td>
</tr>
<tr>
<td>Inability to return to sport or previous work/recreational activities</td>
<td>Correct sacroiliac dysfunction</td>
<td>Trial of corrective heel lift. Referral for trial of orthotics</td>
<td>Progress as appropriate</td>
<td>Complementary home program</td>
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<tr>
<td></td>
<td>Return to sport/prior activities</td>
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</tbody>
</table>
Normal balance and functional mobility
- Berg Balance Scale
- SLS
- TUG Test
- FFI
- LEFS

Normal foot biomechanics during gait
- FGA
- DGI

Return to ADLs, including recreational activities or sport
- Sport-specific testing

Maintenance or Prevention
- Custom-made or prefabricated insoles might reduce lower-limb injuries

  - Systematic review of 5 published randomized or quasi-randomized trials (6 comparisons) of different insoles used in an effort to reduce lower-extremity injuries compared to no insoles with 2,446 participants
  - All trials had methodological limitations
  - In 4 of the trials, the risk reduction was at least 50%
  - Shock-absorbing insoles do not appear to reduce lower-limb injuries in military recruits as compared to non-shock-absorbing insoles

    - 1,205 military recruits in basic training in the United Kingdom were randomized to non-shock-absorbing insoles (Saran) vs. shock-absorbing insoles (Sorbothane) vs. shock-absorbing insoles (Poron)
    - Removal from training due to lower-limb injury occurred in 18% of Saran group, 17.3% of Sorbothane group, and 19.8% of Poron group
    - There were no statistically significant differences in the incidence of lower-limb injuries among the groups

- Avoid/modify risk factors associated with increased fracture risk (see Risk Factors, above)

Patient Education
- Ankle Pain Info/Foot Pain Info: http://footpaininfo.com/stressfractures.html

Note
- Recent review of the literature has found no updated research evidence on this topic since previous publication on March 11, 2016

Coding Matrix

References are rated using the following codes, listed in order of strength:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Published meta-analysis</td>
</tr>
<tr>
<td>SR</td>
<td>Published systematic or integrative literature review</td>
</tr>
<tr>
<td>RCT</td>
<td>Published research (randomized controlled trial)</td>
</tr>
<tr>
<td>R</td>
<td>Published research (not randomized controlled trial)</td>
</tr>
<tr>
<td>C</td>
<td>Case histories, case studies</td>
</tr>
<tr>
<td>G</td>
<td>Published guidelines</td>
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<tr>
<td>RV</td>
<td>Published review of the literature</td>
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<tr>
<td>RU</td>
<td>Published research utilization report</td>
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<tr>
<td>QI</td>
<td>Published quality improvement report</td>
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<tr>
<td>L</td>
<td>Legislation</td>
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<tr>
<td>PGR</td>
<td>Published government report</td>
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<tr>
<td>PFR</td>
<td>Published funded report</td>
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<tr>
<td>PP</td>
<td>Policies, procedures, protocols</td>
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<tr>
<td>X</td>
<td>Practice exemplars, stories, opinions</td>
</tr>
<tr>
<td>GI</td>
<td>General or background information/texts/reports</td>
</tr>
<tr>
<td>U</td>
<td>Unpublished research, reviews, poster presentations or other such materials</td>
</tr>
<tr>
<td>CP</td>
<td>Conference proceedings, abstracts, presentation</td>
</tr>
</tbody>
</table>

References


