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Two-View Gravity Stress Imaging Protocol for Nondisplaced Type II Supination External Rotation Ankle Fractures: Introducing the Gravity Stress Cross-Table Lateral View

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ABSTRACT

Assessing ankle stability in nondisplaced Lauge-Hansen supination external rotation type II injuries requires stress imaging. Gravity stress mortise imaging is routinely used as an alternative to manual stress imaging to assess deltoid integrity with the goal of differentiating type II from type IV injuries in cases without a posterior or medial fracture. A type II injury with a nondisplaced fibula fracture is typically treated with cast immobilization, and a type IV injury is considered unstable and often requires operative repair. The present case series (two patients) highlights a standardized 2-view gravity stress imaging protocol and introduces the gravity stress cross-table lateral view. The gravity stress cross-table lateral view provides a more thorough evaluation of the posterior malleolus owing to the slight external rotation and posteriorly directed stress. External rotation also creates less bony overlap between the tibia and fibula, allowing for better visualization of the fibula fracture. Gravity stress imaging confirmed medial-sided injury in both cases, confirming the presence of supination external rotation type IV or bimalleolar equivalent fractures. Open reduction and internal fixation was performed, and both patients achieved radiographic union. No further treatment was required at 21 and 33 months postoperatively.

Ankle fractures account for 9% of fractures overall and approximately 56% of fractures occurring in the foot and ankle (1,2). Supination external rotation (SER) injuries are the most common indirect ankle fractures according to the Lauge-Hansen classification system (3). Generally, SER fractures follow a predictable progression of injuries to the soft tissue and osseous structures of the ankle. Frequently, SER injuries present as a seemingly isolated distal fibular fracture. SER-II fractures involve an isolated fibula fracture; however, stability of the ankle joint is maintained by intact medial soft tissue structures. In SER-IV fracture patterns, disruption of the deltoid ligament or fracture of the medial malleolus can occur, resulting in ankle joint instability by allowing lateral subluxation of the talus. Fracture of the medial malleolus is generally apparent on radiographs; however, the integrity of the deltoid ligament is difficult to identify on nonstress radiographs in minimally displaced fractures.

Assessing the stability of the ankle joint in nondisplaced SER-II injuries requires the use of specific imaging techniques. External rotation manual stress and gravity stress plain radiographs have both been described as reliable studies to predict medial-sided injury in SER fractures (4–7). The historical standard for assessing deltoid insufficiency is manual stress radiographs; however, recent studies have demonstrated that gravity stress is equally efficacious (4,5). Both examinations involve a mortise view, which allows assessment of the medial clear space (MCS) between the medial malleolus and the body of the talus. Widening of the MCS indicates lateral shift of the talus, which is only possible with disruption of the deltoid ligament. Gravity stress radiographs have the advantage of being less painful for the patient, reduces radiation exposure to the physician, and does not require the physician to be present (4,5).

We instituted a 2-view gravity stress imaging protocol several years ago for all patients presenting with seemingly SER-II nondisplaced fibula fractures. In addition to the traditional gravity stress mortise view (Fig. 1), a gravity stress cross-table lateral view (GSCTLV) is obtained (Fig. 2). To the best of our knowledge, the GSCTLV has not previously been described in reported studies. This 2-view protocol obviates the need to repeat 3 standard ankle views when the patient presents days later to the specialty clinic. It also provides a more

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Fig. 1. The traditional gravity stress mortise view is performed with the patient lying in the lateral position with the affected limb down. A foam block is placed proximal to the fibula fracture. The foot is allowed to relax or dangle in an externally rotated position, which produces gravitational stress through the ankle fracture.

complete assessment of the distal fibula and posterior malleolus (PM) while under gravity stress.

Case Series

A case series (two patients) is presented to highlight the clinical utility of the 2-view gravity stress imaging protocol in SER ankle fractures. These cases also demonstrate the ease of implementation of an electronic medical record (EMR)-based fracture triage protocol, including assessment of the immobilization strategy, appropriate timing of follow-up examinations in specialty care, optimal imaging studies on arrival to specialty care, venous thromboembolism (VTE) risk assessment during immobilization, and bone health assessment.

Case 1

A 35-year-old nondiabetic, otherwise healthy, female presented with right ankle pain after a fall down 1 stair. She was initially evaluated in the emergency department on the day of injury, and standard non-weightbearing ankle radiographs were obtained, demonstrating a nondisplaced oblique distal fibula fracture with a symmetric ankle mortise (Fig. 3). Her ankle was splinted, and she was referred to the foot and ankle surgery department for definitive care.

A preliminary diagnosis of a nondisplaced SER-II fracture was made on fracture triage, which was determined by specialty review of the EMR. Two gravity stress ankle views were ordered to be obtained on arrival to the specialty clinic, which was scheduled for 1 week after injury. Fracture triage also allowed for the VTE risk assessment, because the patient was immobilized in a splint. No history of inherited clotting disorders, active systemic cancer, or history of VTE was identified.

The physical examination during the clinic visit 1 week after injury revealed edema and ecchymosis present to the medial and lateral aspects of the ankle without the presence of fracture blisters. The compartments were soft and easily compressible, with pedal pulses present and sensation intact to all nerve distributions to the foot. Further physical examination was deferred, given the known fibular fracture. Widening of the MCS from 3.3 mm on the initial standard mortise view to 5.7 mm was appreciated on the gravity stress ankle mortise view, indicating loss of deltoid ligament integrity and resultant instability of the ankle. Displacement of the fibula fracture was demonstrated on both gravity stress views (Fig. 4). No PM fracture was identified. A bone health assessment was also performed, as is standard protocol for patients presenting with fractures. Serum 25-hydroxyvitamin D levels were obtained because of her lack of oral supplementation history and no previous testing and was noted to be

Fig. 2. The gravity stress cross-table lateral view is obtained with the patient lying supine on the table. A foam block *(blue)* is used to support the limb just proximal to the fibula fracture. The leg is slightly externally rotated, and the foot is allowed to relax in a slightly plantarflexed and externally rotated position. The x-ray cassette is placed on the medial side on the ankle, and a cross-table lateral image is taken.