RadioGraphics

Simplified Diagnostic Algorithm for Lauge-Hansen Classification of Ankle Injuries[1]

TEACHING POINTS
See last page

Heitor Okanobo, MD • Bharti Khurana, MD • Scott Sheehan, MD Alejandra Duran-Mendicuti, MD • Afshin Arianjam, MD • Stephen Ledbetter, MD, MPH

Ankle injuries occur in a predictable sequence, allowing a logical understanding of their classification once the injury mechanism is recognized. The Lauge-Hansen classification system was developed on the basis of the mechanism of trauma and is useful for guiding treatment. Three radiographic views of the ankle (anteroposterior, mortise, and lateral) are necessary to classify an injury with the Lauge-Hansen system. Two additional criteria are also necessary: the position of the foot at the time of injury and the direction of the deforming force. Because understanding the mechanism of trauma is fundamental to classifying the injury, three-dimensional movies were assembled for each classification, showing the sequence of ligament rupture and bone fractures that occurs with each type of traumatic mechanism. Supplemental material available at *http://radiographics.rsna.org/lookup/suppl/doi:10.1148/rg.322115017/-/DC1*.

Introduction

Ankle fractures are common among both the general population and those who play contact sports. Knowing the precise mechanism of ankle fractures is important because it helps surgeons assess the fracture pattern and soft tissues to determine the sequence of the injury (1). Identifying a fracture and classifying the type of injury enables diagnosis of otherwise occult ligament injuries (2). Magnetic resonance (MR) imaging provides more detailed information about the soft-tissue damage associated with ankle fractures; however, the Lauge-Hansen system is useful as an initial assessment tool and treatment guide because it helps determine which forces to apply to obtain and maintain closed or open reduction of an ankle fracture, subluxation, or dislocation (3–6). The Lauge-Hansen classification system was developed on the basis of the mechanism of trauma, and the criteria to determine the appropriate classification consist of two points: the position of the foot (supination or

Teaching Point

Abbreviations: AITFL = anterior-inferior tibiofibular ligament, ATFL = anterior talofibular ligament, MCL = medial collateral ligament, PITFL = posteroinferior tibiofibular ligament, PTFL = posterior talofibular ligament

RadioGraphics 2012; 32:E71–E84 • **Published online** 10.1148/rg.322115017 • **Content Codes:** ER MK

[1]From the Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, 75 Francis St, Boston, MA 02115 (H.O., B.K., S.S., A.D.M., S.L.); and San Francisco Orthopaedic Residency Program, St Mary's Medical Center, San Francisco, Calif (A.A.). Presented as an education exhibit at the 2009 RSNA Annual Meeting. Received February 3, 2011; revision requested April 29 and received November 21; accepted November 23. S.L. has disclosed various financial relationships (see p E83); all other authors, the editor, and reviewers have no relevant relationships to disclose. **Address correspondence to** H.O. (e-mail: *hokanobo@partners.org*).

pronation) at the time of the traumatic event and the direction of the deforming force (abduction, adduction, or external rotation) (7–10). Unfortunately, patients with an ankle fracture are generally unable to give the position of the foot at the time of the injury; nevertheless, a specific location or appearance of the fracture and soft-tissue injuries at imaging allows radiologists to translate imaging information into a traumatic mechanism.

The Lauge-Hansen classification system may be cumbersome and complex, a possible reason why many radiologists prefer to describe fractures instead of classifying them on the basis of the traumatic mechanism (2). Although the Lauge-Hansen system describes many fracture patterns, some fractures are more complicated and do not fit into a definitive pattern (11). Another pitfall of this system is that it was originally described in cadavers, with simulations of the traumatic mechanisms, a method that is not always as precise as studying the mechanisms in live patients (12).

In this article, we describe a simplified approach to classifying ankle injuries with the Lauge-Hansen system. We also correlate radiographic findings with three-dimensional movies of the ankle showing the sequence of ligament rupture and bone fractures that occurs with each type of traumatic mechanism to help simplify the Lauge-Hansen system and increase confidence in its use.

Anatomy and Deforming Forces

Lateral Collateral Ligament Complex

The ankle is stabilized by three sets of ligaments: the lateral collateral ligament complex, the syndesmotic ligament complex, and the medial collateral (deltoid) ligament complex. The lateral collateral ligament is the most commonly injured ligament in patients with ankle sprain and is often associated with ligament injury elsewhere in the ankle (13,14). The lateral collateral ligament complex has three components: the anterior talofibular (ATFL), posterior talofibular (PTFL), and calcaneofibular ligaments (Fig 1).

Syndesmotic Ligament Complex

The syndesmotic ligament complex comprises the anterior-inferior tibiofibular (AITFL), posteroinferior tibiofibular (PITFL), and transverse tibiofibular ligaments and the interosseous membrane. The AITFL attaches slightly above the talofibular ligaments, above the level of the talotibial joint line, and is one of the most commonly injured ligaments in the ankle (15).

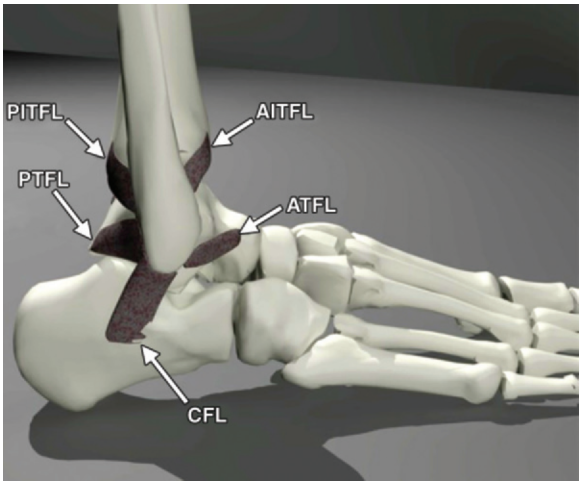


Figure 1. Anatomy of the ankle. Lateral model of the ankle shows the AITFL, ATFL, calcaneofibular ligament *(CFL),* PITFL, and PTFL.

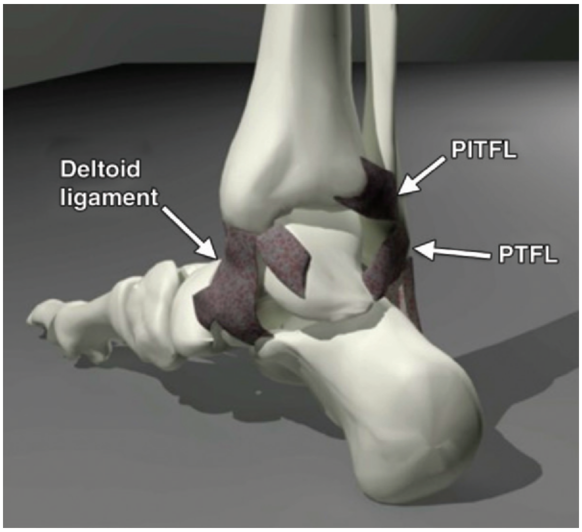
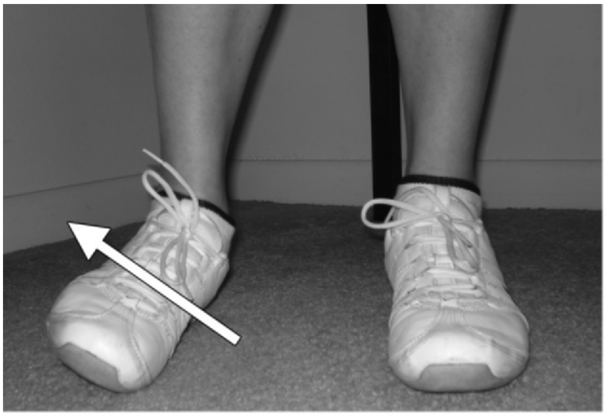


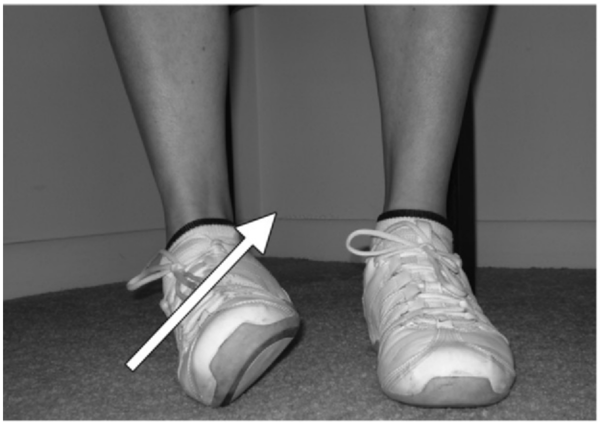
Figure 2. Anatomy of the ankle. Posteromedial model of the ankle shows the deltoid ligament, PITFL, and PTFL.

Medial Collateral Ligament Complex

The medial collateral ligament (MCL) complex lies deep to the medial flexor tendons and is divided into four components: the anterior and posterior tibiotalar, tibionavicular, tibiospring,



3.



4.

5.

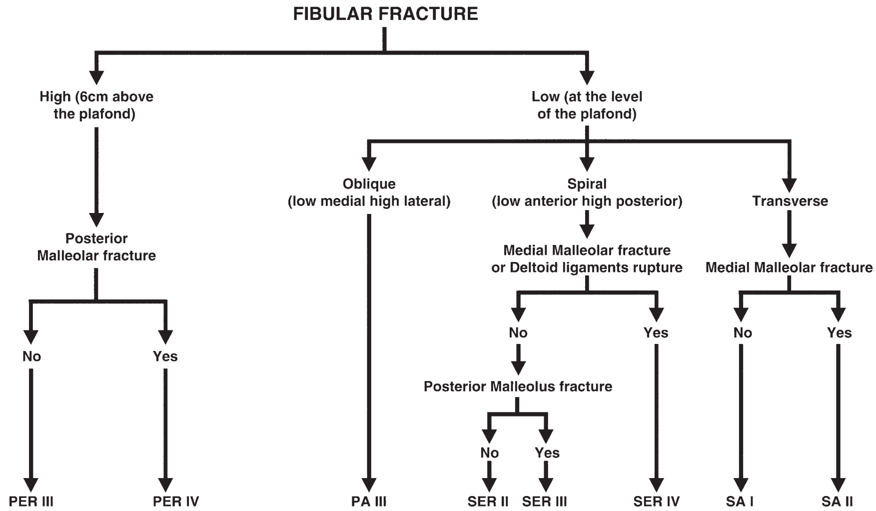
Figures 3–5. **(3)** Pronation. Photograph shows pronation, or eversion, in which the deforming force (abduction, arrow) stresses the medial structures of the ankle (eg, the deltoid ligament), with the inner surface of the foot touching the floor. **(4)** Supination. Photograph shows supination, or inversion, in which the deforming force (adduction, arrow) stresses the lateral structures of the ankle (eg, AITFL, ATFL, CFL, PITFL, and PTFL), with the lateral surface of the foot touching the floor. **(5)** External rotation. Photograph shows external rotation, in which the talus and foot rotate externally (arrows).

and tibiocalcaneal ligaments (Fig 2). The MCL complex is an important stabilizer against not only valgus forces but anterior and lateral talar excursion, as well as rotatory forces. Although descriptions of the MCL vary widely, there is general agreement that it consists of a deep layer that courses from the medial malleolus to the talus, with a delta-shaped superficial layer that courses from the medial malleolus to the navicular, spring ligament, and calcaneus (16–19). The ankle may be in one of two different positions at the time of trauma: pronation (eversion), and supination (inversion), and three deforming forces may occur: abduction, adduction, and external rotation (Figs 3–5).

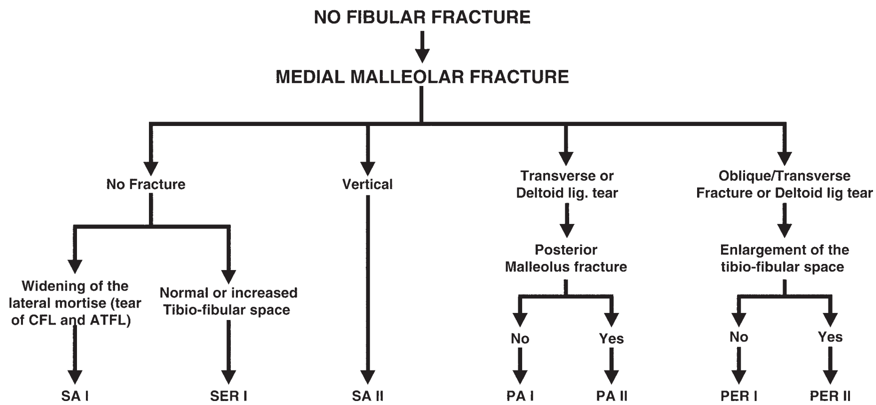
Lauge-Hansen Classification

In 1950, Lauge-Hansen (20,21) described a classification system for ankle fractures on the basis of the mechanism of injury that included more than 95% of all ankle fractures and consisted of two criteria: the position of the foot (supination or pronation) at the time of the traumatic event and the direction of the deforming force (abduction, adduction, or external rotation); thirteen subgroups were created according to these two factors. Injuries occur in a predictable sequence, and stages cannot be skipped. For instance, if the force ceases at some point in the sequence, the incomplete injury leads to a different classification (20,21). In any subclassification of the Lauge-Hansen system, findings from the previous stages are summed (eg, supination external rotation stage III = findings of supination external rotation stage I + findings of supination external rotation stage II + rupture of posterior tibiofibular ligament or fracture of posterior malleolus of the tibia). Three radiographic views of the ankle (anteroposterior, mortise, and lateral) are necessary to classify a fracture. As was previously described by Arimoto and Forrester (2), use of an algorithm may be of great assistance in applying the Lauge-Hansen classification system.

Teaching Point



6.



7.

Figures 6, 7. **(6)** Flowchart shows the algorithm for classifying an ankle fracture in the presence of a fibular fracture. *PA* = pronation abduction, *PER* = pronation external rotation, *SA* = supination adduction, *SER* = supination external rotation. (Modified, with permission, from reference 2.) **(7)** Flowchart shows the algorithm for classifying an ankle fracture in the absence of a fibular fracture. *CFL* = calcaneofibular ligament, *PA* = pronation abduction, *PER* = pronation external rotation, *SA* = supination adduction, *SER* = supination external rotation. (Modified, with permission, from reference 2.)

To classify an injury, it is important to follow the algorithm for interpreting radiographic findings set forth by Arimoto and Forrester (2). **Teaching Point** An efficient approach to classifying fractures is to identify the presence of a fibular fracture and determine which type of fracture is seen. When a fracture occurs at the level of the plafond, the orientation of the fracture line may be: *(a)* oblique, meaning it extends upward from medial to lateral, usually a result of pronation abduction; *(b)* transverse, meaning it extends parallel to the talotibial joint line, a possible result of supination adduction; or *(c)* spiral, meaning it extends upward from anterior to posterior, a result of supination external rotation. A fibular fracture may also be located above the level of the plafond, usually 6 cm from the joint, a result of pronation external rotation. The level of the fracture is what differentiates pronation external rotation stage IV from supination external rotation stage IV.

Once the type of fibular fracture is determined, the second step is to evaluate for additional injuries such as posterior malleolar fracture, medial malleolar fracture, widening of the tibiofibular space, medial mortise, and lateral mortise. **Teaching Point** In the absence of a fibular fracture, identifying a medial malleolar fracture or medial mortise widening (both of which imply rupture of the deltoid ligament) is the most helpful tool in classifying an ankle fracture. A medial malleolar fracture may be classified as: *(a)* vertical, which is associated with supination adduction stage II; *(b)* oblique, which

a.

b.

Figure 8. Supination external rotation stage I. **(a)** Frontal radiograph shows subtle widening of the tibiofibular space (arrow) secondary to rupture of the AITFL. **(b)** Mortise radiograph shows lateral soft-tissue swelling (arrow). **(c)** Lateral radiograph shows no fractures in the posterior malleolus. These findings are indicative of supination external rotation stage I, which may be radiographically occult.

c.

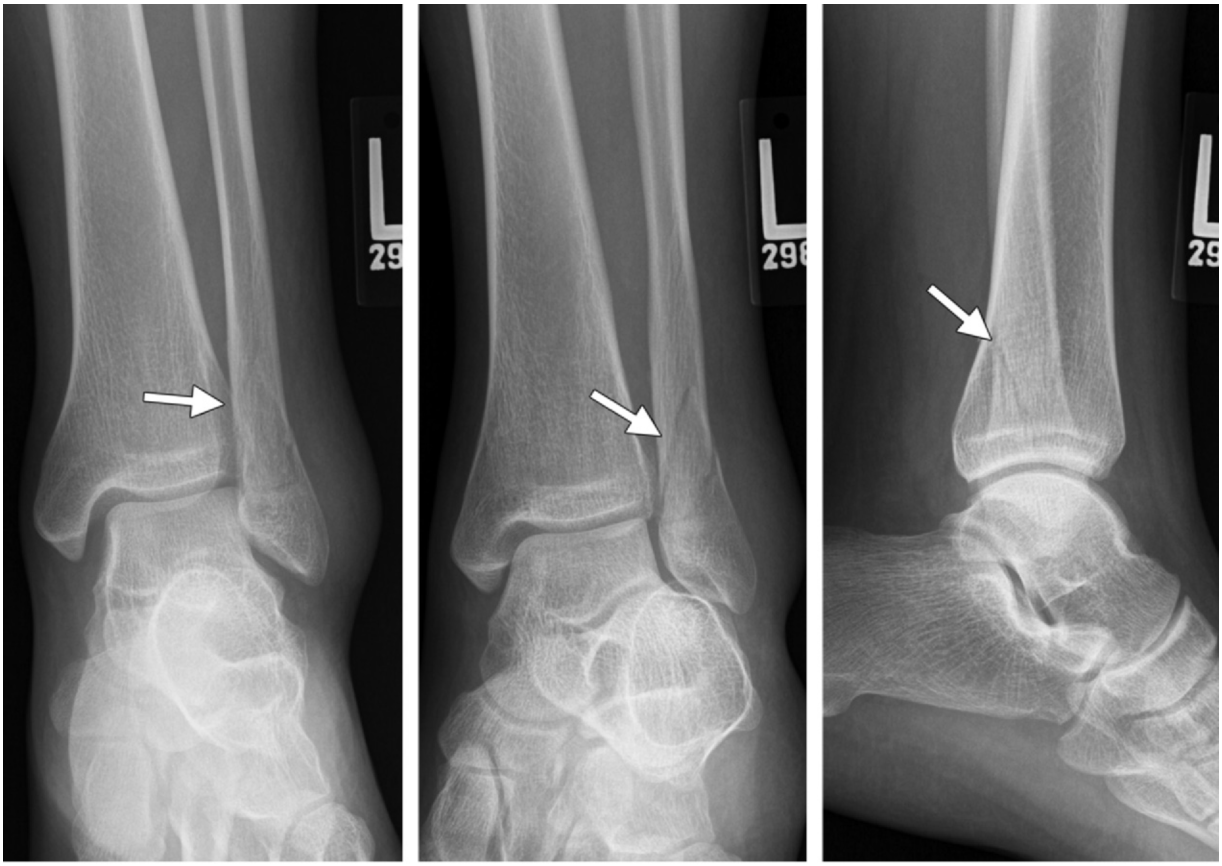
is associated with pronation external rotation; or *(c)* transverse, which is associated with pronation abduction. Although identifying the orientation of the fracture line helps pinpoint the mechanism of injury, it should not be used in isolation to classify the mechanism of trauma (Figs 6, 7).

In the absence of a lateral or medial malleolar fracture, widening of the medial or lateral mortise and the tibiofibular spaces must be evaluated. In such cases, an early stage is likely. Differentiation between pronation external rotation with supination adduction and pronation external rotation with pronation abduction is impossible at radiography alone. In either case, the lesion is stable, and no reduction is necessary.

Supination External Rotation

Supination external rotation is the most common mechanism of fracture, accounting for 40%–70% of all ankle fractures (7). In supination external rotation, the lateral structures are under stress, and as the force continues, the medial structures are ultimately compromised. In stage I, the talus rotates laterally and pushes the lateral malleolus posteriorly, stressing the AITFL, and the anterior inferior tibiofibular ligament ruptures, a mechanism that usually appears occult at radiography. Supination external rotation stage I is a stable injury (Fig 8; Movie 1).

Teaching Point

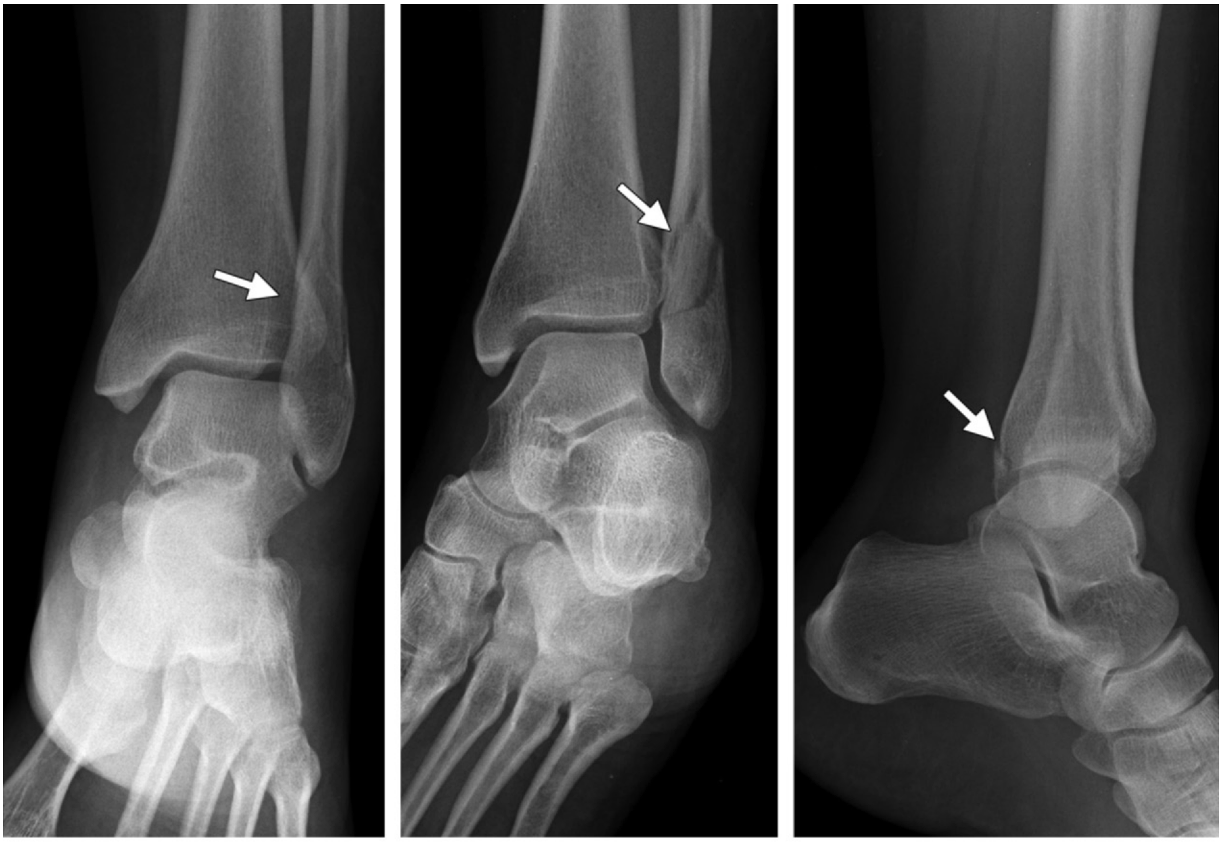


a. b. c.

Figure 9. Supination external rotation stage II. **(a)** Frontal radiograph shows widening of the tibiofibular space, a finding indicative of rupture of the AITFL (arrow). **(b)** Mortise radiograph shows a spiral fibular fracture (arrow). **(c)** Lateral radiograph shows the fibular fracture at the level of the plafond (arrow), with a low anterior, high posterior orientation. No medial or posterior malleolar fracture is seen. Stress radiography is necessary to assess the deltoid ligament integrity and distinguish supination external rotation stage II from stage IV.

As lateral rotation of the talus continues, the lateral structures undergo further stress, leading to stage II, in which the AITFL ruptures, with a spiral fracture of the fibular malleolus at the level of the joint in a low anterior, high posterior direction (Fig 9; Movie 2). This type of fracture is considered stable. In stage III, the next step in the sequence of supination external rotation injuries, rupture of the PITFL or fracture of the posterior malleolus of the tibia is seen in addition to rupture of the AITFL and a fibular spiral fracture (Fig 10; Movie 3). To classify an injury as stage III, rupture of the AITFL and a spiral fracture of the fibula must be present. In stage IV, the last stage of supination external rotation and the complete amplitude of injury, involvement of the medial ankle structures is seen in addition to the lateral (fibular fracture or AITFL) and posterior (PITFL or posterior maleollus) ankle structures. In this stage, fracture through the medial malleolus or disruption of the deltoid ligament is seen (Fig 11; Movie 4). In general, medial malleolar fractures have a transverse orientation, although an oblique orientation may be present. Stage IV fractures are considered unstable.

Figures 10, 11. **(10)** Supination external rotation stage III. **(a)** Frontal radiograph shows widening of the tibiofibular space, a finding indicative of rupture of the AITFL (arrow). **(b)** Mortise radiograph shows a spiral fibular fracture (arrow) with a low anterior, high posterior orientation at the level of the plafond. **(c)** Lateral radiograph shows a posterior malleolar fracture (arrow). The medial malleolus is intact. Stress radiography is necessary to assess the integrity of the deltoid ligament. **(11)** Supination external rotation stage IV. **(a)** Frontal radiograph shows widening of the tibiofibular space, a finding indicative of rupture of the AITFL (arrow). **(b, c)** Mortise **(b)** and lateral **(c)** radiographs show a spiral fibular fracture with a low anterior, high posterior orientation at the level of the plafond (arrow) and widening of the medial mortise, a finding indicative of rupture of the deltoid ligament (arrowhead in **b**). The posterior aspect of the tibia appears to be intact, but the PITFL is likely ruptured.



10a. 10b. 10c.

11a. 11b. 11c.

a. b. c.

Figure 12. Supination adduction stage I. Frontal **(a)**, mortise **(b)**, and lateral **(c)** radiographs show widening of the lateral mortise, a finding indicative of rupture of the calcaneofibular ligament and ATFL (arrow in **a**). No fibular or tibial fracture is seen. Supination adduction stage I fractures may be radiographically occult.

Supination Adduction

Supination adduction is caused by a compression force under the medial ankle structures and traction of the lateral ankle structures and has two stages. In stage I, adduction of the talus compresses the medial malleolus and stretches the lateral ankle structures. Transverse fracture of the lateral malleolus at or below the level of the plafond, with rupture of the ATFL or tearing of the calcaneofibular ligament (which may be occult or demonstrate lateral mortise widening), also occurs in stage I (Fig 12; Movie 5). As talar adduction continues, the medial malleolus is further compressed, leading to stage II, in which a vertical fracture of the medial malleolus is present in addition to the findings seen in stage I (Fig 13; Movie 6). Stage II fractures are considered unstable.

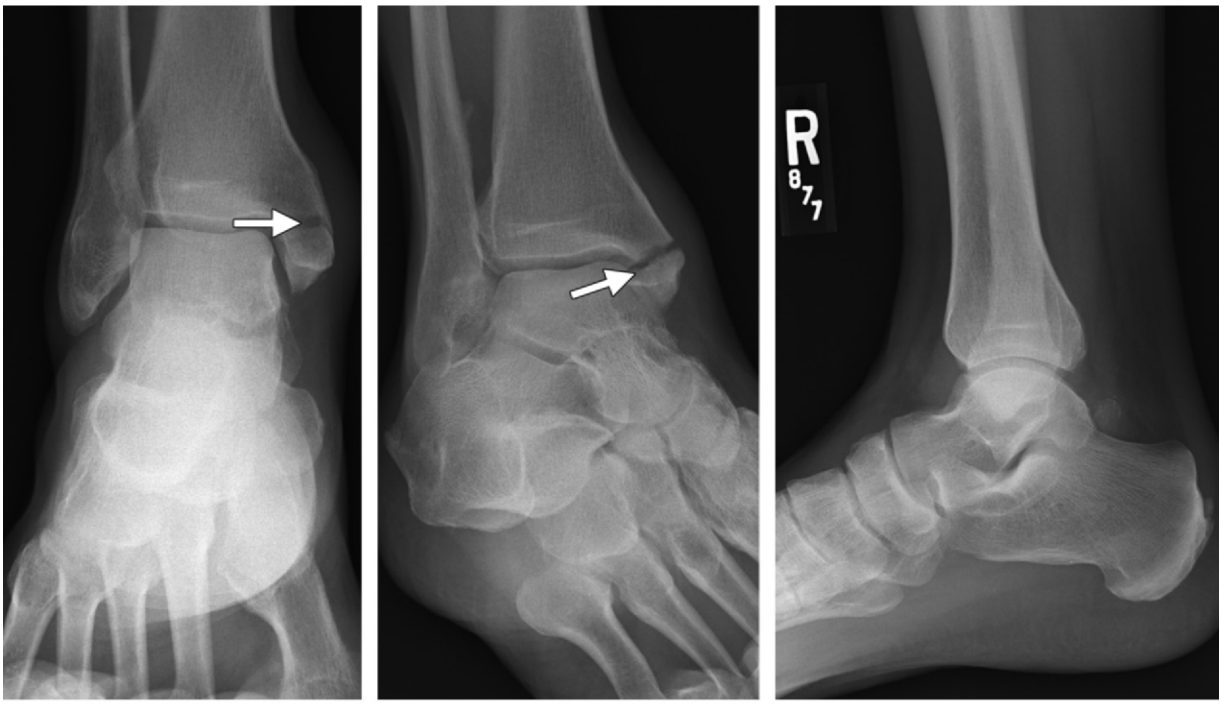
Pronation External Rotation

When the foot is in pronation, the deltoid ligament is under stress, leading to injury of the medial ankle structures. In pronation external rotation, the lateral and posterior ankle structures become involved as the deforming force continues, usually leading to spiral fracture of the fibula and posterior malleolus fracture.

Pronation external rotation has four stages. In stage I, rupture of the deltoid ligament, which appears occult or as medial mortise widening, or fracture of the medial malleolus is seen (Fig 14; Movie 7). In stage II, in addition to the medial ankle structures, involvement of the AITFL with extension into the interosseous membrane is seen (Fig 15; Movie 8). As the amplitude of injury continues, a spiral or oblique fibular fracture (>6 cm) is seen at the level above the talotibial joint (Fig 16; Movie 9). In stage IV, involvement of the posterior ankle structures, such as the PITFL, or fracture of the posterior malleolus is seen (Fig 17; Movie 10).

a. b. c.

Figure 13. Supination adduction stage II in three patients. **(a)** Frontal radiograph shows a transverse fracture of the fibula at the level of the plafond (arrow). **(b)** Mortise radiograph shows a subtle vertical fracture of the medial malleolus (arrow). **(c)** Lateral radiograph shows that the posterior malleolus is intact. These findings are indicative of a supination adduction stage II fracture.



a. b. c.

Figure 14. Pronation external rotation stage I. **(a, b)** Frontal **(a)** and mortise **(b)** radiographs show a transverse fracture of the medial malleolus (arrow). **(c)** Lateral radiograph shows that the posterior malleolus is intact. These findings are indicative of a pronation external rotation stage I fracture, an injury that closely resembles pronation abduction stage I.

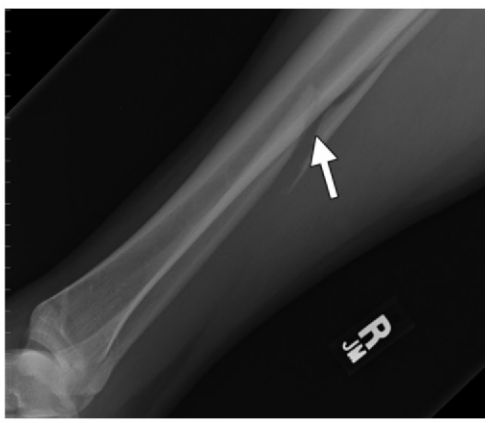
a.

b.

Figure 15. Pronation external rotation stage II. **(a)** Frontal radiograph shows widening of the medial mortise, a finding indicative of rupture of the deltoid ligament (arrow). **(b)** Mortise radiograph shows widening of the tibiofibular space, a finding indicative of rupture of the AITFL and extension into the interosseous membrane (arrow).

a.

b.



c.

Figure 16. Pronation external rotation stage III. **(a)** Frontal radiograph shows the site of pain (arrowhead), a medial malleolar fracture (white arrow), and a spiral fracture of the distal fibula (black arrow) about 9 cm above the plafond. **(b)** Mortise radiograph shows the site of pain (arrowhead), the fibular fracture (black arrow), and widening of the tibiofibular space (white arrow). **(c)** Lateral radiograph shows the fibular fracture (arrow). No posterior malleolar fracture is seen.

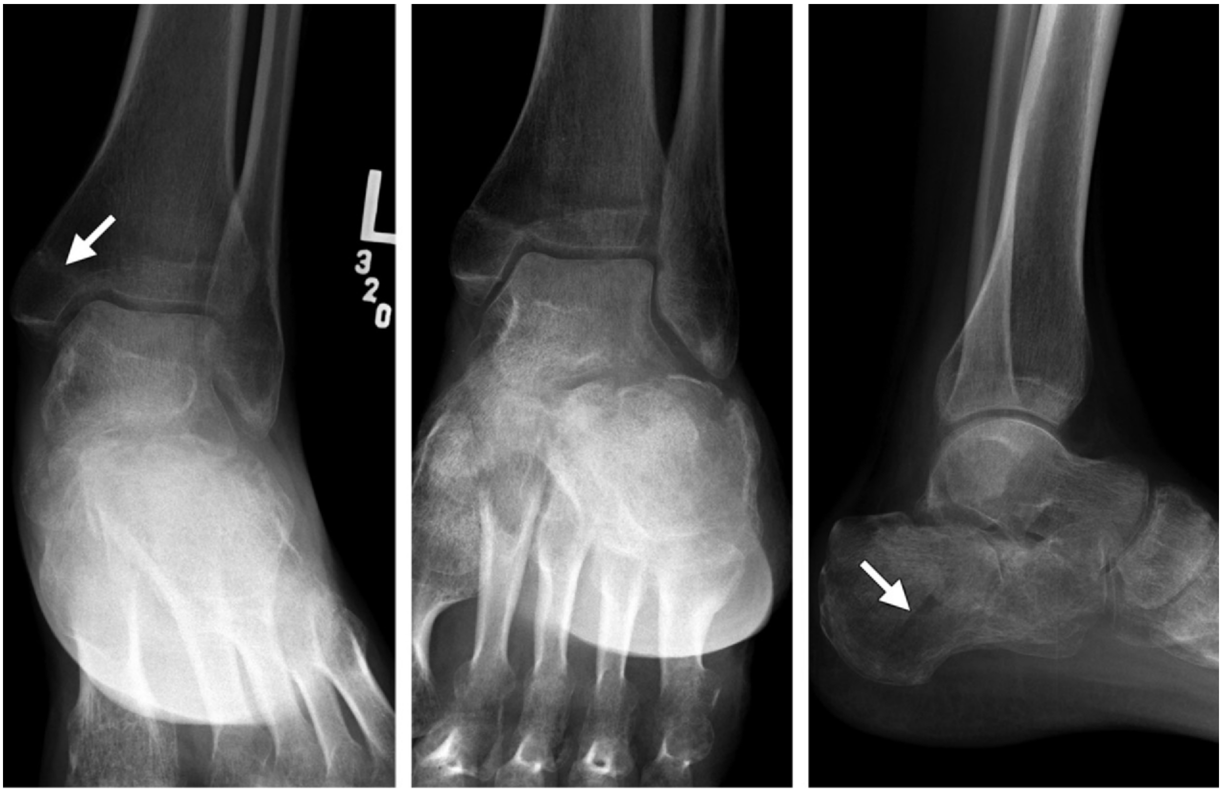
RadioGraphics

a. b. c.

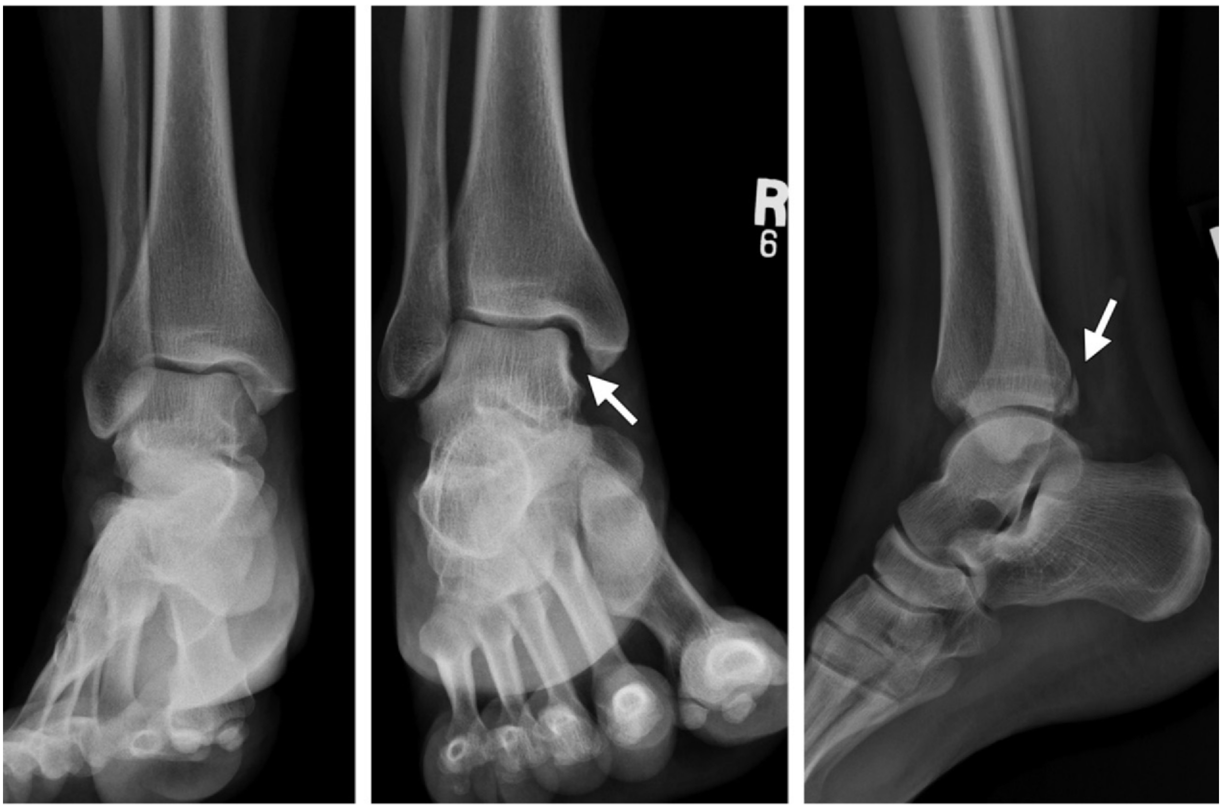
Figure 17. Pronation external rotation stage IV. **(a)** Frontal radiograph shows a medial malleolar fracture (arrow). **(b)** Mortise radiograph shows widening of the tibiofibular space (arrowhead), a finding indicative of rupture of the AITFL and PITFL, and an oblique fracture of the distal fibula with an atypical posterosuperior-to-anteroinferior orientation 7 cm above the plafond (arrow). **(c)** Lateral radiograph shows anterior displacement of the tibia and an avulsed fragment of the posterior malleolus (arrow). The full amplitude of a pronation external rotation injury may mimic supination external rotation stage IV, although a high fibular fracture is atypical for such fractures.

Pronation Abduction

When the foot is in pronation, abduction of the talus leads to traction of the medial ankle structures. As the traumatic amplitude continues, fractures of the fibula and posterior malleolus occur. In stage I, rupture of the deltoid ligament or transverse fracture of the medial malleolus is seen. If a deltoid rupture is present at this early stage, it may be occult at radiography (Fig 18; Movie 11). It may be difficult to distinguish between pronation abduction stage I and pronation external rotation stage I. In pronation abduction stage II, the posterior malleolus is the next structure involved as the amplitude of injury continues. The deltoid ligament rupture or medial malleolar fracture that occurs in stage I is also seen (Fig 19; Movie 12). In stage III, involvement of the lateral ankle structures occurs, and an oblique fracture of the fibula, with a high lateral, low medial fracture line orientation, is seen above the talotibial joint (Fig 20; Movie 13).

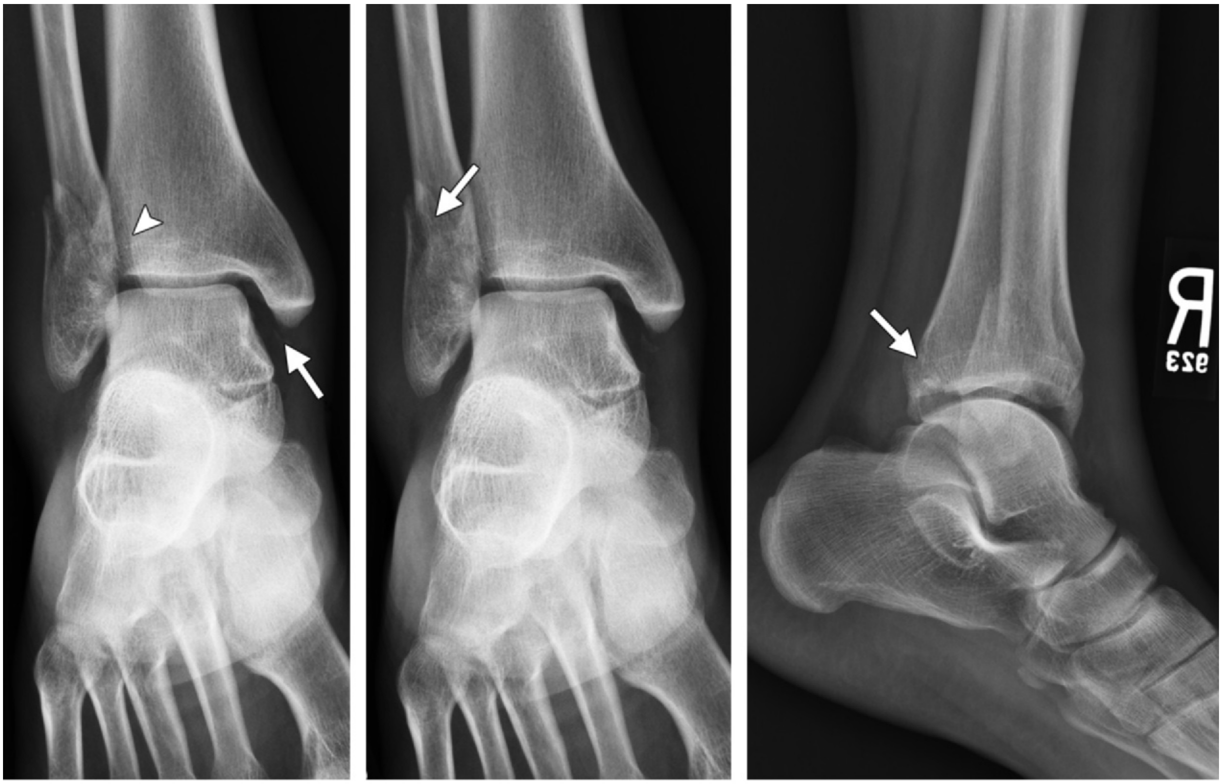


18a. 18b. 18c.



19a. 19b. 19c.

◀ **Figures 18, 19.** **(18)** Pronation abduction stage I. **(a, b)** Frontal **(a)** and mortise **(b)** radiographs show a transverse fracture through the medial malleolus (arrow in **a**), a finding that is indiscernible from that seen in pronation external rotation stage I. **(c)** Lateral radiograph shows a comminuted calcaneal fracture (arrow). No fibular fracture is seen. **(19)** Pronation abduction stage II. **(a)** Frontal radiograph shows no fibular fracture. **(b)** Mortise radiograph shows widening of the medial mortise, a finding indicative of a ruptured deltoid ligament (arrow). **(c)** Lateral radiograph shows a posterior malleolar fracture (arrow). Care must be taken in evaluating patients with ankle fractures in whom a high fibular fracture may not be included in the field of view because the presence of such a fracture would change the classification to a pronation external rotation injury.



a. b. c.

Figure 20. Pronation abduction stage III. **(a)** Frontal radiograph shows widening of the medial mortise (arrow) and the tibiofibular space (arrowhead), findings indicative of rupture of the deltoid ligament and both the AITFL and PITFL, respectively. **(b)** Mortise radiograph shows an oblique fibular fracture with a low medial, high lateral orientation (arrow). **(c)** Lateral radiograph shows a fracture of the posterior malleolus (arrow). These findings are indicative of the full amplitude of injuries in pronation abduction stage III.

Summary

Ankle injuries occur in a predictable sequence that is related to the mechanism of trauma. The Lauge-Hansen classification system describes this mechanism and is useful as an initial assessment tool and to help guide treatment. Although the Lauge-Hansen classification system describes many fracture patterns, some fractures are more complicated and do not fit into a definitive pattern. The three-dimensional animations with radiographic correlation presented in this article may aid understanding of this classification system and ultimately enable radiologists to translate radiographic findings into a traumatic mechanism.

***Disclosures of Potential Conflicts of Interest.*—S.L.:** *Related financial activities:* none. *Other financial activities:* expert witness for Calderhead, Lockemeyer, and Faddis; Faddis and Faddis; and Rice, Dolan, and Kershaw.

References

1. Clare MP. A rational approach to ankle fractures. Foot Ankle Clin 2008;13(4):593–610.
2. Arimoto HK, Forrester DM. Classification of ankle fractures: an algorithm. AJR Am J Roentgenol 1980;135(5):1057–1063.
3. Haraguchi N, Armiger RS. A new interpretation of the mechanism of ankle fracture. J Bone Joint Surg Am 2009;91(4):821–829.
4. Martin JS, Marsh JL. Current classification of fractures: rationale and utility. Radiol Clin North Am 1997;35(3):491–506.
5. Gardner MJ, Demetrakopoulos D, Briggs SM, Helfet DL, Lorich DG. The ability of the Lauge-Hansen classification to predict ligament injury and mechanism in ankle fractures: an MRI study. J Orthop Trauma 2006;20(4):267–272.
6. van den Bekerom MP, Mutsaerts EL, van Dijk CN. Evaluation of the integrity of the deltoid ligament in supination external rotation ankle fractures: a systematic review of the literature. Arch Orthop Trauma Surg 2009;129(2):227–235.
7. Michelson J, Solocoff D, Waldman B, Kendell K, Ahn U. Ankle fractures: the Lauge-Hansen classification revisited. Clin Orthop Relat Res 1997;(345):198–205.
8. Nielsen JO, Dons-Jensen H, Sørensen HT. Lauge-Hansen classification of malleolar fractures: an assessment of the reproducibility in 118 cases. Acta Orthop Scand 1990;61(5):385–387.
9. Shariff SS, Nathwani DK. Lauge-Hansen classification: a literature review. Injury 2006;37(9):888–890.
10. Yde J. The Lauge Hansen classification of malleolar fractures. Acta Orthop Scand 1980;51(1):181–192.
11. Hermans JJ, Beumer A, Mulder PG. Ankle stress test for predicting the need for surgical fixation of isolated fibular fractures: statistical analysis. J Bone Joint Surg Am 2005;87(8):1885–1886; author reply 1886.
12. Nielson JH, Gardner MJ, Peterson MG, et al. Radiographic measurements do not predict syndesmotic injury in ankle fractures: an MRI study. Clin Orthop Relat Res 2005;(436):216–221.
13. Erickson SJ, Smith JW, Ruiz ME, et al. MR imaging of the lateral collateral ligament of the ankle. AJR Am J Roentgenol 1991;156(1):131–136.
14. Perrich KD, Goodwin DW, Hecht PJ, Cheung Y. Ankle ligaments on MRI: appearance of normal and injured ligaments. AJR Am J Roentgenol 2009;193(3):687–695.
15. Cheung Y, Perrich KD, Gui J, Koval KJ, Goodwin DW. MRI of isolated distal fibular fractures with widened medial clear space on stressed radiographs: which ligaments are interrupted? AJR Am J Roentgenol 2009;192(1):W7–W12.
16. Milner CE, Soames RW. Anatomy of the collateral ligaments of the human ankle joint. Foot Ankle Int 1998;19(11):757–760.
17. Mengiardi B, Pfirrmann CW, Vienne P, Hodler J, Zanetti M. Medial collateral ligament complex of the ankle: MR appearance in asymptomatic subjects. Radiology 2007;242(3):817–824.
18. Mengiardi B, Zanetti M, Schöttle PB, et al. Spring ligament complex: MR imaging–anatomic correlation and findings in asymptomatic subjects. Radiology 2005;237(1):242–249.
19. Rule J, Yao L, Seeger LL. Spring ligament of the ankle: normal MR anatomy. AJR Am J Roentgenol 1993;161(6):1241–1244.
20. Lauge-Hansen N. Fractures of the ankle. IV. Clinical use of genetic roentgen diagnosis and genetic reduction. AMA Arch Surg 1952;64(4):488–500.
21. Lauge-Hansen N. Fractures of the ankle. III. Genetic roentgenologic diagnosis of fractures of the ankle. Am J Roentgenol Radium Ther Nucl Med 1954;71(3):456–471.

Simplified Diagnostic Algorithm for Lauge-Hansen Classification of Ankle Injuries

Heitor Okanobo, MD • Bharti Khurana, MD • Scott Sheehan, MD • Alejandra Duran-Mendicuti, MD • Afshin Arianjam, MD • Stephen • Ledbetter, MD, MPH

RadioGraphics 2012; 32:E71–E84 • **Published online** 10.1148/rg.322115017 • **Content Codes:** ER MK

Page E71
Knowing the precise mechanism of ankle fractures is important because it helps surgeons assess the fracture pattern and soft tissues to determine the sequence of the injury (1).

Page E73
Injuries occur in a predictable sequence, and stages cannot be skipped. For instance, if the force ceases at some point in the sequence, the incomplete injury leads to a different classification (20,21). In any subclassification of the Lauge-Hansen system, findings from the previous stages are summed (eg, supination external rotation stage III = findings of supination external rotation stage I + findings of supination external rotation stage II + rupture of posterior tibiofibular ligament or fracture of posterior malleolus of the tibia).

Page E74
An efficient approach to classifying fractures is to identify the presence of a fibular fracture and determine which type of fracture is seen.

Page E74
In the absence of a fibular fracture, identifying a medial malleolar fracture or medial mortise widening (both of which imply rupture of the deltoid ligament) is the most helpful tool in classifying an ankle fracture.

Page E75
Supination external rotation is the most common mechanism of fracture, accounting for 40%–70% of all ankle fractures (7).