



## Imaging Decision Making, Acute Ankle Injury (Adults or children > 5 years)

*This imaging protocol, due to its high sensitivity, is most useful in identifying trauma cases which do not require radiographs.*

### Indications for ankle/foot radiography immediately following acute injury\*

Radiographs of the ankle and/or foot (based on location of pain) are indicated immediately following injury if any one of the following exists:

- Inability to bear weight for four consecutive steps (2 steps with each foot) at the time of the injury or when presenting to the clinic regardless of limping or painful expression of the patient
- Bone tenderness (mechanical hyperalgesia) along crests of the tibial or fibular malleolus anywhere within a 6 cm zone proximal to the tip of either malleolus (not including tenderness localized only at the ligamentous attachments) (Buffalo modification) (Leddy 1998)
- Bone tenderness at the navicular or styloid process of the fifth metatarsal.

\* Ankle and/or foot radiographic series is indicated based upon location of pain. Based on the Ottawa Ankle Rules (Stiell 1992).

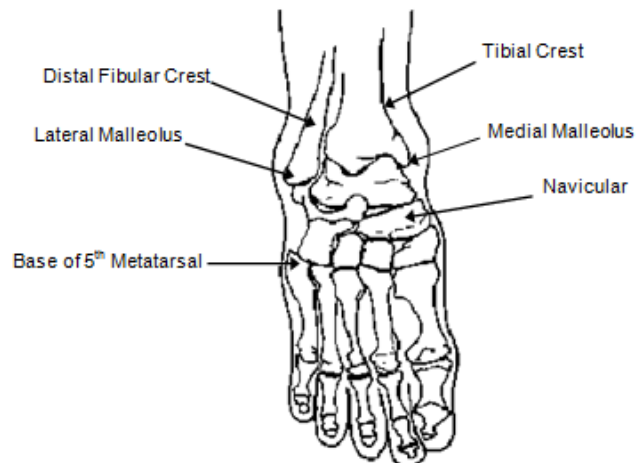
### Indications for ankle radiography 3 - 7 days following acute injury

Radiographs of the ankle are indicated after the injury if any one of the following exists (Loomer 1993, Libbetta 1999):

- Pain localizes over anterior talus
- Pain or swelling does not improve, or continues to get worse
- Patient develops inability to bear weight

Patients should be advised to return in 5-7 days if their symptoms have not improved.

Key Palpation Points



### Exclusions from the modified Ottawa Ankle Rules (OAR)

The OAR excludes certain groups that have a higher risk for fracture or a diminished capacity to follow the protocol. Studies validating the OARs also exclude pregnancy and so clinicians must rely on their own judgment to determine if radiographs will significantly impact management.

- Multiple injuries
- $\geq 10$  days post-injury
- Isolated skin injuries
- Obvious deformity of ankle and/or foot
- Altered sensorium: cognitive or sensory impairment (neurologic deficit), head trauma, intoxication, diabetes
- Pregnancy

INDICATIONS FOR PLAIN RADIOGRAPHS	VIEWS
inability to bear weight	area of pain
tibial/fibular tenderness	ankle (AP, lateral & medial oblique)
tenderness of mid foot structures,	foot (AP, lateral & medial oblique)
tenderness of tibia/fibula and mid foot structures	foot & ankle (AP, lateral & medial oblique)

## Indications for MRI or CT

MRI or CT should be ordered under the following circumstances (Loomer 1993 and ACR Appropriateness Criteria):

- Suspected talar fracture or radiographs demonstrate a talus fracture
- Negative radiographs with disproportionate pain that persists or fails to improve with immobilization
- Suspected Salter Harris type 1 fracture (suspect in cases of tenderness along anterior distal tibia, persistent pain while under care or severe swelling and bruising) in patients less than 18 years of age.
- Radiographs suggest an osteochondral injury

## MRI, CT or MSK-Ultrasound

- MRI, CT or MSK-ultrasound should be considered when there is > 1 week persistent pain and initial radiographs were negative (ACR Appropriateness Criteria)
- Radiographs and/or physical examination suggest syndesmotic injury

### View Selection

The Ottawa Ankle Rules (OAR) for acute ankle and midfoot injuries were developed to reduce the amount of radiography performed, while still detecting 100% of fractures, not counting avulsions under 3mm (Stiell 1992). Inability to bear weight indicates the need for radiographs. The presence of tibial/fibular tenderness indicates the necessity of ankle radiography. If there is tenderness of navicular, radiographs of the foot should be ordered. A positive finding of bone tenderness at both ankle and midfoot locations would call for both studies to be performed. Ankle and foot studies each entail anteroposterior (AP), medial oblique, and lateral radiographs.

### Validity

The OAR are more sensitive in predicting ankle and midfoot fractures than clinical suspicion alone and safely reduce the number of radiographs ordered. A sensitivity ranging from 93% to 100% has been demonstrated for ankle and midfoot fractures. (Stiell, Greenburg 1992, Stiell IG 1993, Chande 1995, Lucchesi 1995, Pigman 1994) Specificity of the rules ranged from 11% to 32% (Chande 1995, Lucchesi 1995, Pigman 1994, Verma 1997) Specificity was higher at 42% with the Buffalo modification for palpation of the distal tibia and fibula. (Leddy 1998) A positive predictive value of 28% and a negative predictive value of 100% have been reported. (Lucchesi 1995, Market 1998) One study (Kelly 1994) reporting poorer results (positive predictive value of 22% and only a 14% negative predictive value) has been refuted based on design flaws. (Stiell, Greenburg 1995, Stiell, Greenburg 1996)

A large number of studies of OAR have been done. A meta-analysis of 27 studies consisting of over 15,000 patients supported the implementation of these rules for excluding fractures of the ankle and mid-foot. Nearly every study analyzed noted a sensitivity of 1.0 and estimated that application of these rules would decrease the need of films by 30% to 40%. (Bachman 2003)

The value of these rules has again been confirmed both in a 2015 systematic review (Jonckleer 2016I) and an RCT on high school and college athletes (David 2015).

### Pediatrics

The use of the OAR would decrease the use of radiography in acute ankle injuries in children. (Clark 2003). However, the OAR cannot be applied to children younger than 18 years with the same sensitivity as it can be applied to adults. (Pediatric Emergency Care: April 2003, volume 19, issue 2, pp 73-78)

Studies have documented sensitivities ranging from 83% to 100% and specificities from 24% to 47%. All of these studies concluded that a significant decrease in unnecessary films and significant cost savings were seen in the pediatric population. (Lucchesi 1995, Karpas 2002, Libetta 1999, Plint 1999.)

The variation in sensitivities (between 83% and 100%) when the OAR are applied to pediatric populations is due to the definition of what constitutes a significant fracture. When a broader definition is used (i.e. fractures in which the avulsion fragment was 3 mm or smaller, as well as Salter-Harris type I fractures) then the sensitivity of the OAR is lower.

Extreme caution should be used if trying to apply these rules to children under 5 years old with suspected fracture. Sensitivity is thought to be even lower in this age group. Study cohorts that included children under 5 are very limited in size, and there remain issues about a young child's ability to communicate adequate feedback.

Because of the uncertainty of long term outcomes with Salter-Harris Type 1 epiphyseal injury, a second opinion from an orthopedic specialist is recommended even when plain film radiographs are negative if the clinical suspicion is high (e.g., cases of tenderness along anterior distal tibia, persistent pain while under care or significant swelling and bruising).

### **Implementation**

Studies examining impact on actual practice behavior have been very positive. Two such studies (Auleley 1997, Verbeek 1997) followed the rate of ankle radiography for 10 and 12 months, respectively, following the end of clinical trials. While one study (Verbeek 1997) showed a minor increase in radiography when physicians were no longer actively reminded to use the rules, the rates of radiographic examination were still substantially lower than before the implementation of the Ottawa rules. The other study (Salt 1997) demonstrated no significant increase after the end of the clinical trial.

Patients' expectation that films will be taken often influences the decision making of physicians even though most radiographs done for acute ankle injuries are not helpful. Patient satisfaction was not dependent on whether films were taken according to a recent Canadian study. In this study, patients who did not get radiographs were as satisfied with their care as those that did. (Noseworthy 2002)

There is evidence that the rules can be used effectively by trained and experienced ancillary personnel, for example nurses, as an effective method of triage. (Salt 1997, Karpas 2002) Little research on the efficacy of the OAR has been done in family practice settings and none has been done in chiropractic settings (Nugent 2004). Caution is recommended when in doubt.

**Note:** Caution should be exercised when applying the Ottawa rules in patients with other outstanding conditions, such as diabetes, pregnancy, intoxication, mental impairment, or injuries more than 10 days old. (McLaughlin 1998) According to Stiell, the originator of the Ottawa rules, "...the Ottawa ankle rules ... are not meant to override clinical judgment. The rules should be used with caution if patient assessment is unreliable..." (Stiell 1996)

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