

# Acute ankle and knee injuries

## To x-ray or not?

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The Ottawa ankle and knee rules are validated clinical decision tools that guide clinicians in targeting radiology to those patients who are likely to have an ankle or knee fracture, thus minimising x-ray exposure of patients and reducing costs.

Acute injuries to the ankle and knee joints are common and patients usually present to an emergency department or a general practice. Differentiating soft tissue injuries from fractures is important because the management of these two groups differ. Medical practitioners are becoming increasingly aware of the accumulative effects of x-rays and there is a move to minimise x-ray exposure, especially in younger patients. Clinical tools have been developed to help clinicians

target x-rays to those patients who are likely to have a fracture and not those that almost certainly do not. Such clinical tools or rules must have a very high sensitivity and reasonable specificity to be helpful.

Acute knee injuries account for over one million emergency room visits in the USA annually.<sup>1</sup> Ankle injuries are even more common, and have been shown to be one of the most common presentations to an emergency department.<sup>2</sup> These injuries are rarely life- or limb-threatening but cause significant pain and disability for the patient. It has been shown that most patients presenting with knee and ankle injuries in the early 1990s underwent radiographic examination, and that more than 92% of this imaging for knees and 85% for ankles did not show a fracture.<sup>2,3</sup> The incidence of fracture in acute knee injury is less than 5%.<sup>4</sup> The individual cost of a radiograph is not high but the high frequency at which they are requested results in significant cost and unnecessary irradiation for patients. Furthermore, it has been suggested that radiography adds little information to a well performed clinical history and examination.<sup>5</sup>

This article discusses the Ottawa rules used to guide clinicians in the investigation of acute ankle and knee injuries.

### What are the Ottawa Rules and do they work?

In 1992, a set of criteria was developed that used clinical signs to determine if an x-ray should be performed for an acute ankle injury – the Ottawa ankle rules (Box 1 and Figure 1).<sup>6</sup> The criteria have been shown to have a sensitivity of 100% and a specificity of 40.1% for detecting malleolus fractures and result in a 36% reduction in radiography.<sup>6</sup> The rules have also been shown to reduce the time patients spend in emergency departments, without reducing patient satisfaction.<sup>7</sup> Pain in the midfoot region is covered by the Ottawa foot rules, which are often grouped with the ankle rules, as shown in Box 1.

The Ottawa knee rules developed later, in 1995, showed similar success to the ankle rules, with a sensitivity of 98.5 to 100% and a specificity of 49% for detecting fractures (Box 2 and Figure 2).<sup>8,9</sup> Furthermore, the Ottawa knee rules were shown to be superior when



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compared with other tools for assessing knee injuries, i.e. the Pittsburgh knee rules, the Weber and colleagues rule and the Fagan and Davies rule.<sup>10</sup> Use of the Ottawa knee rules has been shown to lead to a relative reduction in radiography of 37%.<sup>11</sup>

The Ottawa ankle rules are not used in patients who are younger than 18 years, pregnant or intoxicated, or if they have distracting painful injuries, diminished sensation in the legs or gross swelling preventing palpation of malleolar tenderness.

Uptake and utilisation of these rules has been variable.<sup>11-13</sup>

### Case scenarios

#### Case 1. A possible ankle fracture

A 45-year-old woman limped into the emergency department one afternoon with the assistance of her husband and clearly in a lot of pain. She explained to the triage nurse that she was carrying out her usual daily activities when she tripped over her dog at home, rolling her ankle.

The woman was unable to bear weight on her left leg. On closer physical examination, the left lower limb was neurologically intact with normal pulses, there was gross swelling around the lateral malleolus, marked tenderness over the lateral malleolar zone of the ankle and also tenderness on palpation over the posterior aspect of the lateral ankle, approximately 1 cm superior to the lateral malleolus.

According to the Ottawa ankle rules, this woman should have a radiograph performed. The Ottawa rules have a very high sensitivity but the specificity is fairly low at about 40%, meaning that although the criteria for an x-ray may be met there is still a reasonable chance a fracture may not be found.

The patient was informed that a radiograph was indicated but she was convinced it was just a severe sprain and was eager to leave to pick her children up from school. She reluctantly agreed

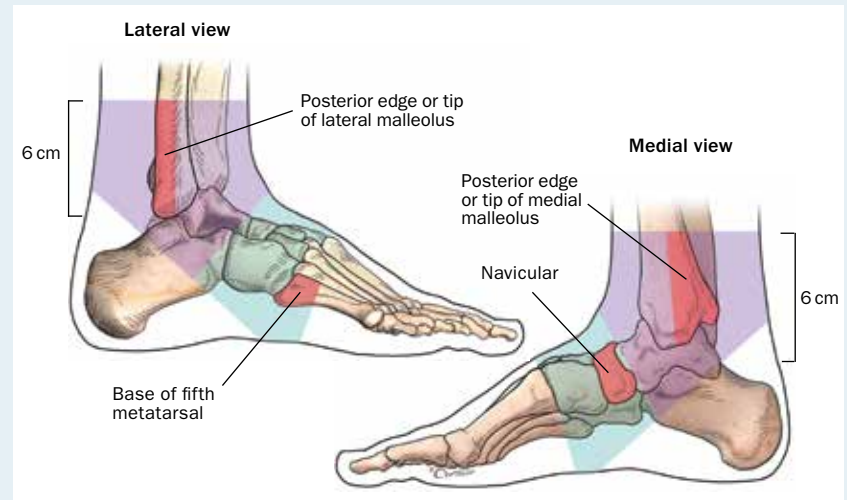
## 1. THE OTTAWA ANKLE RULES<sup>6</sup>

**In patients with acute ankle injury, an ankle x-ray is necessary if there is:**

- Pain over the malleoli of the ankle and one or more of
  - patient is aged 55 years or older
  - inability to bear weight both immediately and in emergency department
  - bone tenderness at the posterior tip of either the lateral or medial malleolus or the posterior 6 cm superior to either malleolus (Figure 1)

**In patients with acute ankle injury, a foot x-ray is necessary if there is:**

- Pain in the midfoot and either of
  - bone tenderness at the navicular or the base of the fifth metatarsal (Figure 1)
  - inability to bear weight both immediately and in the emergency department



**Figure 1.** Ottawa ankle rules – regions of bone tenderness. (Purple indicates malleolar zone; green indicates midfoot zone.)

Adapted from Stiell et al., *Ann Emerg Med* 1992; 21: 384-390.<sup>6</sup>

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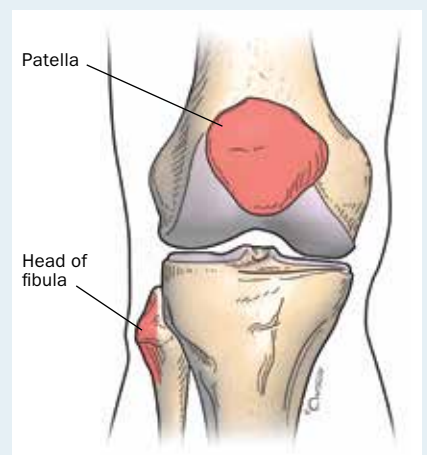
## 2. THE OTTAWA KNEE RULES<sup>9</sup>

**In patients with acute knee injury, a knee x-ray is necessary if any of the following criteria are met:**

- Patient is aged 55 years or older
- Isolated tenderness of the patella (Figure 2)
- Tenderness at the head of the fibula (Figure 2)
- Inability to flex the knee to 90°
- Inability to bear weight both immediately and in the emergency department

**Figure 2.** Ottawa knee rules – regions of bone tenderness.

Adapted from Stiell et al., *Ann Emerg Med* 1995; 26: 405-413.<sup>9</sup>



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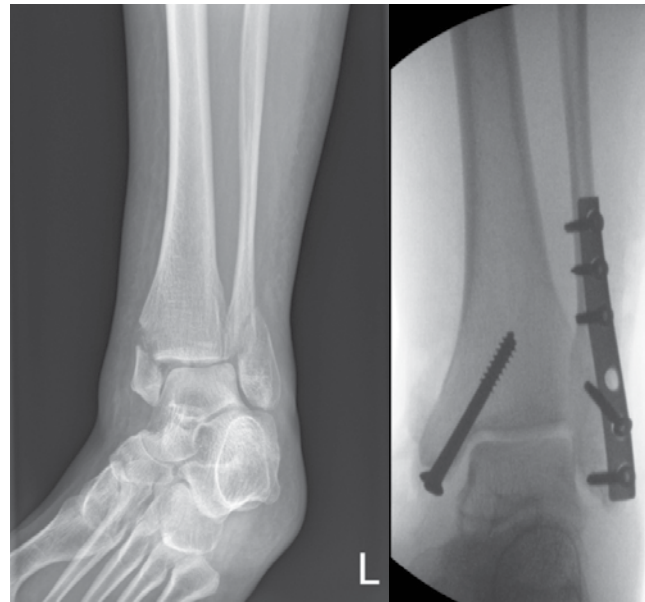
to the radiography. The x-ray showed an unstable Weber type B trimalleolar fracture of the fibula (Figure 3a; Table 1).<sup>14</sup>

The patient was admitted to hospital and her ankle was repaired surgically with plates and screws (Figure 3b). Outpatient physiotherapy helped her recovery.

**Case 2. A possible knee fracture**

A 22-year-old man, a semiprofessional soccer player, presented at the emergency department with right knee pain 24 hours after twisting his right knee while ‘turning on the ball’. He reported pain and a ‘locking’ sensation in the right knee.

On examination, the patient was able to bear weight on the affected leg and there was no deformity or obvious



**Figures 3a and b.** Ankle fracture. a (far left). X-ray at presentation. b (left). X-ray after surgical repair.

**TABLE 1. MANAGEMENT OF ANKLE FRACTURES<sup>14</sup>**

Injury	Description	Management
<i>Lateral malleolar fractures – Weber ankle fracture classification</i>		
Type A	Fracture below the syndesmosis Avulsion fractures often associated with oblique or vertical medial malleolar fractures	If stable fracture (undisplaced or minimally displaced), nonoperative: <ul style="list-style-type: none"> <li>walking cast ± crutches for 6 weeks</li> <li>weight bear as tolerated in walking cast, cast can be taken off when not weightbearing</li> <li>x-ray at 6 weeks – clinical union indicated by no pain at fracture site</li> </ul> If unstable fracture, surgical repair (open reduction and internal fixation)
Type B	Fracture begins at the joint level and extends proximally in an oblique direction If accompanied by medial malleolus fracture or with deltoid ligament rupture, the ankle is considered unstable	If stable fracture (undisplaced and mortice intact), nonoperative: <ul style="list-style-type: none"> <li>full below knee plaster with crutches</li> <li>repeat x-ray at 1 to 2 weeks</li> <li>plaster for 6 weeks total</li> <li>x-ray at 6 weeks out of plaster – clinical union indicated by no pain</li> </ul> If unstable fracture, surgical repair (open reduction and internal fixation)
Type C	Fractures above the joint line, usually with syndesmotic injury Can be associated with transverse avulsion medial malleolus fracture or deltoid ligament rupture	Surgical repair (open reduction and internal fixation)
<i>Other injury</i>		
Ligamentous injury	Damage to any of the ligaments supporting the ankle joint	R – Rest I – Ice C – Compression E – Elevation

effusion. Both lower limbs were warm and neurovascularly intact. He had a positive swipe test (a fluid wave bulge just below the medial distal portion or patellar border on a particular pattern of stroking the leg in the knee area) on his right knee, consistent with a small effusion in the knee joint. There was joint line tenderness on the medial aspect of the knee but no isolated patellar or fibular head tenderness.

The patient had a normal range of motion of both knees and the ligaments stabilising his knee joint (the anterior and posterior cruciate ligaments and the medial and lateral collateral ligaments) were intact. McMurray's ligament test for injury to the meniscus was positive (pain felt by the patient or a click felt by patient or examiner on particular palpation of the knee).

The combination of injury mechanism and clinical signs suggested medial meniscus tear. The patient was informed of this, and subsequently asked if he could have an x-ray to confirm the diagnosis.

It was explained to the patient that, based on the Ottawa knee rules, his chance of having a fracture in the knee was extremely slim, with the rules having a negative predictive value of 1. He agreed that radiography was unnecessary and was then discharged, within an hour of his presentation, with a referral for outpatient orthopaedic management. As an outpatient he received advice to treat his knee with RICE (rest, ice, compression and elevation) and use NSAIDs for pain relief (Table 2).<sup>15,16</sup> He subsequently received physiotherapy for the injury.

In this situation, applying the Ottawa knee rules allowed a much faster discharge of the patient from the emergency department, without sacrificing patient care or outcome. This approach reduces unnecessary x-ray exposure, which is particularly important for a young person.

### Possible new direction

New imaging techniques are being developed to investigate acute injuries

Injury	Description	Management
Extra-articular fracture	Supracondylar, in which the fracture does not extend to the knee joint line	Undisplaced: groin to toe plaster Displaced: surgically with intramedullary nails
Partial articular fracture	Partial articular or condylar, in which the fracture extends to the knee joint line but part of the condyles remain attached to the femur shaft	Undisplaced: groin to toe plaster Displaced: surgically with intramedullary nails
Complete articular fracture	Complete articular or intercondylar, in which the fracture extends to the knee joint line but the condyles are completely separated from the femur shaft	Undisplaced: groin to toe plaster Displaced: surgically with plate and screws
Ligamentous injury	Tear in the anterior cruciate, posterior cruciate, medial collateral or lateral collateral ligament of the knee	R – Rest I – Ice C – Compression E – Elevation Surgical repair if major tear present
Meniscal tear	Tear in either the medial or lateral meniscus of the knee	R – Rest I – Ice C – Compression E – Elevation NSAIDs Physiotherapy Surgical repair if tear present in the vascularised outer third of the meniscus

without exposing patients to x-rays. A recent study in the USA has shown that, with minimal training, orthopaedic registrars are able to use ultrasound imaging during the primary examination in the emergency department to exclude significant ankle fractures.<sup>17</sup> This could decrease the need for radiographic imaging, resulting in rapid diagnosis with no exposure to ionising radiation.

### Conclusion

The Ottawa ankle and knee rules have been proven to be highly sensitive and specific for detecting fractures and have been shown to significantly decrease the need for radiographic imaging of

injured joints. If applied correctly, they have the potential to reduce unnecessary x-ray exposure and cost in an acute setting, as well as avoiding significant inconvenience to the patient. **MT**

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### References

A list of references is included in the website version ([www.medicinetoday.com.au](http://www.medicinetoday.com.au)) and the iPad app version of this article.

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