Lower limb acute joint injuries: when to refer for X-ray?

Abstract

This article summarises the clinical decision tools available to help decide when acute lower limb joint injuries should be referred for plain film radiography. The Ottawa foot and ankle rules are a tool for deciding whether to refer a patient for X-ray or not. The rules are highly sensitive, gaining National Institute for Health and Care Excellence recommendation in the UK, although they have limited benefit in some patient groups, such as those with peripheral neuropathy. The Ottawa knee rules are highly sensitive but less specific than the Pittsburgh decision rules. Although the Pittsburgh rules are more specific, they have been less extensively investigated and, unlike the Ottawa rules, are not National Institute for Health and Care Excellence recommended. A major barrier to use of these rules in clinical practice is the concern of litigation, although National Institute for Health and Care Excellence recommendation should reassure clinicians and thus reduce the amount of unnecessary radiation exposure.

Key words: Ankle; Fracture; Knee; Ottawa; X-ray

Submitted: 9 February 2020; accepted after double-blind peer review: 12 February 2020

Oliver J Negus[1]

Andrew Dunn[2]

William Ridsdill-Smith[3]

Author details can be found at the end of this article

Correspondence to:
Oliver J Negus;
olivernegus@doctors.org.uk

Introduction

A significant proportion of workload in emergency departments and minor injury units is spent assessing patients with acute joint injuries. These vary from children with twisted ankles to elderly patients with falls onto their knees. One of the hardest parts of assessing these patients is deciding between those who need further assessment with radiography to rule out fractures, and those who could be given analgesia and referred to the physiotherapy services. Fortunately, several well-validated decision aids exist, the most well documented being the Ottawa foot and ankle rules.

This article summarises the best evidence-based clinical decision tools available to help decide whether or not to refer acute lower limb joint injuries for plain film radiography.

Foot and ankle

The most well-documented clinical decision tools for acute foot and ankle injuries are the Ottawa rules. Devised in 1992 by a group of emergency medicine doctors, the Ottawa rules were designed to assess which patients needed imaging to rule out acute fractures following an injury to their foot or ankle. Their small study (Stiell et al, 1992) found this to be highly sensitive and the rules were subsequently trialled in multiple emergency departments and community settings, showing strong results (Stiell et al, 1995a).

The Ottawa foot and ankle rules form part of the National Institute for Health and Care Excellence (2016a) Guideline 38: *Fractures (non-complex): assessment and management*, which states 'Use the Ottawa ankle and foot rules to determine whether an X-ray is needed in people over 5 years with suspected ankle fractures'. The rules also feature in the National Institute for Health and Care Excellence (2016b) clinical knowledge summary: Sprains and strains. The rules are outlined below (Figure 1):

Ankle X-ray should only be requested if following an ankle injury there is malleolar pain and one of the following criteria (Table 1):

- Inability to bear weight (walk four steps) immediately after the injury and when examined
- Bone tenderness along the distal 6 cm of the posterior edge of the fibula or tip of the lateral malleolus

How to cite this article:
Negus OJ, Dunn A, Ridsdill-Smith W. Lower limb acute joint injuries: when to refer for X-ray? Br J Hosp Med. 2020. https://doi.org/10.12968/hmed.2020.0055

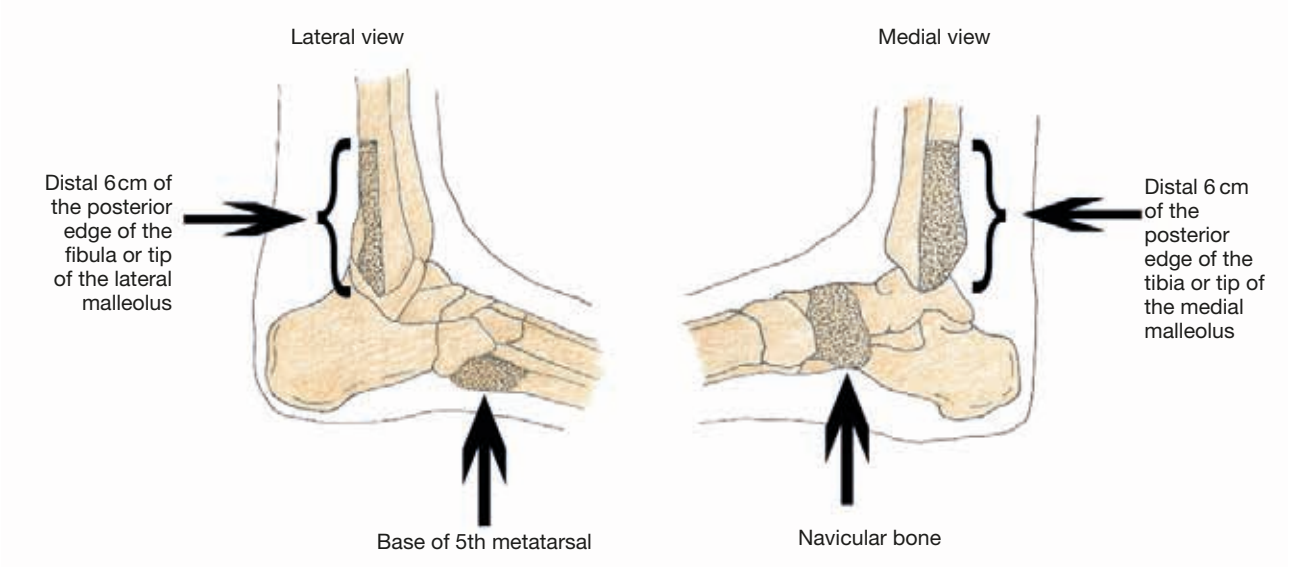

Figure 1. The Ottawa foot and ankle rules. X-ray should only be requested following an ankle or foot injury if there is pain on palpation over these bony landmarks with inability to bear weight.

- Bone tenderness along the distal 6 cm of the posterior edge of the tibia or tip of the medial malleolus.

Foot X-ray should only be requested if following a foot injury there is midfoot pain and one of the following criteria:

- Inability to bear weight (walk four steps) immediately after the injury and when examined
- Bone tenderness at the base of the fifth metatarsal
- Bone tenderness of the navicular bone.

The rules have been well validated with one meta-analysis (Bachmann et al, 2003) of 27 studies (n=15 581) of all age groups showing a sensitivity of identifying a midfoot or ankle fracture of 97.6% (95% confidence interval=96.4–98.9%) and a negative likelihood ratio of 0.10 (95% confidence interval=0.06–0.16). It is also a reliable tool in children over the age of 5 years, with a meta-analysis (Dowling et al, 2009) of 12 studies (n=3130) suggesting a sensitivity of 98.5% (95% confidence interval=97.3–99.2%). This same study estimates that the use of the Ottawa rules in children could reduce X-ray exposure by 24.8% (95% confidence interval=23.3–26.3%).

Like all clinical decision tools, the Ottawa rules do have limitations. Stiell et al (1995a), who first published the rules, accepted that they may not be effective in those with altered cognition, intoxication, other distracting injuries, peripheral neuropathy, language barriers, or significant swelling around the injury site, making palpation of the landmarks inaccurate.

The Ottawa foot and ankle rules provide a well-validated, sensitive clinical decision tool that can be used both in emergency departments by doctors and triaging nurses, but also by GPs to decide whether to refer to hospital for imaging, or to give ankle sprain advice and/or refer to community physiotherapy services. However, despite being called the foot and ankle rules, they are limited to ruling out only fractures of the distal tibia, distal fibula, base of 5th metatarsal and navicular. Pain more proximally in the leg or pain elsewhere in the foot should be investigated without the use of the Ottawa rules and X-ray imaging arranged based on clinical findings.

Knee

Much as with the foot and ankle, the most commonly used and known clinical decision tools for acute knee injuries are the Ottawa knee rules (Stiell et al, 1995b). The Ottawa knee rules were designed to be a highly sensitive tool to decide which patients would need imaging to rule out acute fractures following a blunt injury to their knee. Their initial small study (n=1047) suggested a sensitivity of 100% (95% confidence interval=95–100%) and specificity of 54% (95% confidence interval=51–57%).

The Ottawa knee rules also feature in the National Institute for Health and Care Excellence (2016a) guideline 38 and the National Institute for Health and Care Excellence (2016b) clinical knowledge summary: Sprains and strains. The rules are outlined below:

Knee X-rays should only be requested following acute knee injury if at least one of the following criteria is met (Table 1):

- Inability to bear weight (walk four steps) at the time of injury and when examined
- The person is aged 55 years or more
- Tenderness at the head of the fibula
- Isolated tenderness of the patella
- Inability to flex the knee to 90°.

Since the initial study, other studies have looked into the rules giving similar results for sensitivity and specificity. A systematic review (Bachmann et al, 2004) found six studies (n=4249) giving pooled sensitivity of 98.5% (95% confidence interval=93.2–100%) and specificity of 48.6% (95% confidence interval=43.4–51.0%) in adults. It is a sensitive decision tool for use in children, with one multicentre study (Bulloch et al, 2003) of 750 children (2–16 years) with acute knee injuries giving a sensitivity of 100% (95% confidence interval=94.9–100%) and specificity of 42.8% (95% confidence interval=39.1–46.5%). It suggested that use of the rules in these children would result in a 31.2% reduction in X-ray referrals.

The Pittsburgh decision rules are an alternative well-validated decision tool. Although not formally recommended by the National Institute for Health and Care Excellence, the evidence suggests that they may be more specific, thus reducing unnecessary imaging. The Pittsburgh rules (Seaberg and Jackson, 1994) state that knee X-rays should only be requested following a blunt knee trauma or fall and at least one of the following:

- Age younger than 12 years or older than 50 years
- Inability to walk four weight-bearing steps when examined.

The key difference between the two tests is that the Pittsburgh rules classify weight-bearing as the ability to transfer weight from heel to toe, as seen in normal gait; whereas the Ottawa rules classify any weight transfer, even if antalgic, as acceptable weight-bearing.

A multicentre study (Seaberg et al, 1998) (n=934) which compared both sets of rules showed both had very similar sensitivities, but the Pittsburgh decision rules had a specificity of 60% (95% confidence interval=56–64%) whereas the Ottawa knee rules had a specificity

Table 1. Summary of the clinical decision tools used in management of lower limb acute joint injuries

	Gait assessment	Palpation	Other
Ottawa ankle rules	Inability to bear weight* for 4 steps immediately after injury and when examined	Bone tenderness along the distal 6 cm of the posterior edge of the fibula or tip of the lateral malleolus Bone tenderness along the distal 6 cm of the posterior edge of the tibia or tip of the medial malleolus	
Ottawa foot rules	Inability to bear weight* for 4 steps immediately after injury and when examined	Bone tenderness at the base of the fifth metatarsal Bone tenderness of the navicular bone	
Ottawa knee rules	Inability to bear weight* for 4 steps immediately after injury and when examined	Tenderness at the head of the fibula Isolated tenderness of the patella	The person is aged 55 years or more Inability to flex the knee to 90°
Pittsburgh decision rules	Inability to bear weight† for 4 steps immediately after injury and when examined		Age younger than 12 years or older than 50 years

Ottawa rules describe ability to bear weight as any weight transfer. †Pittsburgh rules describe ability to bear weight as the ability to transfer weight from heel to toe as seen in normal gait.

of 27% (95% confidence interval=23–30%). A more recent British study (Konan et al, 2013) of 106 patients showed that by using the Pittsburgh rules, 30% of patients could avoid X-ray imaging compared to 25% if the Ottawa rules were used.

Both sets of rules are well validated and highly sensitive. Although the National Institute for Health and Care Excellence guidance recommends using the Ottawa knee rules when assessing whether to refer for radiography or not, the Pittsburgh decision tool appears to be an acceptable, more specific alternative. As both provide good reduction in the rate of unnecessary radiography with very few false negatives, the choice of which tool to use may be left to the clinician's discretion.

In practice

Decision tools provide a very useful and often well-validated method of helping the clinician decide who to investigate further, but are they actually used in the clinical setting? A two-part study in the USA (Beutel et al, 2012) investigated this question. The first part consisted of a short survey of 47 emergency physicians at three hospitals to test their knowledge of the Ottawa knee rules. The average score was 73.2% (95% confidence interval=66.6–79.8%) with only one physician answering all the questions correctly; 36.2% of physicians questioned admitted to never using the decision tool. The second part was a retrospective review of case notes which identified that out of 260 patients with acute knee pain, the rate of compliance was 63.1%. The most commonly cited reasons for not following the decision rule were patient expectation and patient satisfaction. Approximately 15% of physicians surveyed cited legal concerns as a barrier to rule implementation.

With an increasingly litigious society, clinicians are finding themselves having to make decisions that cover themselves. With decision tools, this provides a grey area. On one hand the evidence shows that these tools are highly sensitive, but on the other hand, imaging may provide a more definitive answer and lessen the risk of a missed fracture. Is it legally acceptable to use a well-validated clinical tool when a definitive investigation such as radiography is readily available? In the UK, use of the Ottawa rules in acute knee and ankle pain assessments is recommended by the National Institute for Health and Care Excellence, which should certainly provide clinicians with confidence should they find a patient with a missed fracture looking to pursue legal action.

Conclusions

As there is a small but possible chance of missed fracture, if patients who do not fit these rules are failing to respond after a period of rehabilitation it may be prudent to investigate with imaging or refer for orthopaedic input. With acute ankle, foot and knee injuries, it is important to note that in addition to use of the above clinical decision tools, clinical examination of ligamentous laxity and menisci is vital to rule out other serious, non-bony injuries that may also require orthopaedic input. In an era of increased litigation for missed diagnoses, it would certainly be understandable if a clinician still opted for imaging instead of applying these rules. However, as National Institute for Health and Care Excellence guidance recommends their use, UK clinicians should feel more comfortable to make decisions based on clinical findings rather than practicing defensive medicine with its risk of radiation exposure.

Authors details

[1]Department of Trauma and Orthopaedics, Norfolk and Norwich University Hospital NHS Foundation Trust, Norwich, UK

[2]Department of Trauma and Orthopaedics, West Suffolk Hospital, Bury St Edmunds, UK

[3]Woolpit Health Centre, Bury St Edmunds, UK

Conflicts of interest

The authors declare no conflicts of interest.

Key points

- Several well-validated clinical decision tools may be used to choose whether or not to refer a patient with an acute knee, ankle or foot injury for plain film radiography.
- The National Institute for Health and Care Excellence recommends the Ottawa rules, although the Pittsburgh rules for the knee appear to be just as sensitive and more specific.
- The Ottawa foot and ankle rules only apply to patients with pain in the distal tibia, distal fibula, base of 5th metatarsal and navicular. Pain elsewhere in the foot may indicate a fracture of a different bone.
- Missed diagnoses carry legal implications, but the Ottawa rules are National Institute for Health and Care Excellence recommended, providing reassurance for clinicians.

Acknowledgement
Figure 1 was drawn by Maxine Negus and is used with her permission.

Funding
None.

References

Bachmann LM, Kolb E, Koller MT, Steurer J, ter Riet G. Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review. BMJ. 2003;326(7386):417–417. https://doi.org/10.1136/bmj.326.7386.417

Bachmann LM, Haberzeth S, Steurer J, ter Riet G. The accuracy of the Ottawa knee rule to rule out knee fractures: a systematic review. Ann Intern Med. 2004;140(2):121–124. https://doi.org/10.7326/0003-4819-140-5-200403020-00013

Beutel B, Trehan S, Shalvoy R, Mello M. The Ottawa Knee Rule: examining use in an academic emergency department. West J Emerg M. 2012;13(4):366–372. https://doi.org/10.5811/westjem.2012.2.6892

Bulloch B, Neto G, Plint A et al. Validation of the Ottawa Knee Rule in children: a multicentre study. Ann Emerg Med. 2003;42(1):48–55. https://doi.org/10.1067/mem.2003.196

Dowling S, Spooner CH, Liang Y et al. Accuracy of Ottawa ankle rules to exclude fractures of the ankle and midfoot in children: a meta-analysis. Acad Emerg Med. 2009;16(4):277–287. https://doi.org/10.1111/j.1553-2712.2008.00333.x

Konan S, Zang TT, Tamimi N, Haddad FS. Can the Ottawa and Pittsburgh rules reduce requests for radiography in patients referred to acute knee clinics? Ann R Coll Surg Engl. 2013;95(3):188–191. https://doi.org/10.1308/003588413X13511609954699

National Institute for Health and Care Excellence. 2016a. Fractures (Non-Complex): Assessment and Management. NICE Guideline (NG38). London: National Institute for Health and Care Excellence

National Institute for Health and Care Excellence. 2016b. Sprains and Strains. NICE Clinical Knowledge Summary. London: National Institute for Health and Care Excellence

Seaberg DC, Jackson R. Clinical decision rule for knee radiographs. Am J Emerg Med. 1994;12(5):541–543. https://doi.org/10.1016/0735-6757(94)90274-7

Seaberg DC, Yealy DM, Lukens T, Auble T, Mathias S. Multicentre comparison of two clinical decision rules for the use of radiography in acute, high-risk knee injuries. Ann Emerg Med. 1998;32(1):8–13. https://doi.org/10.1016/S0196-0644(98)70092-7

Stiell IG, Greenberg GH, McKnight RD et al. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. Ann Emerg Med. 1992;21(4):384–390. https://doi.org/10.1016/S0196-0644(05)82656-3

Stiell IG, Wells G, Laupacis A et al. Multicentre trial to introduce the Ottawa ankle rules for use of radiography in acute ankle injuries. BMJ. 1995a;311(7005):594–597. https://doi.org/10.1136/bmj.311.7005.594

Stiell IG, Greenberg GH, Wells GA et al. Derivation of a decision rule for the use of radiography in acute knee injuries. Ann Emerg Med. 1995b;26(4):405–413. https://doi.org/10.1016/S0196-0644(95)70106-0