

# Validation of the Ottawa ankle rules in children

Carole Libetta, Derek Burke, Patricia Brennan, Janet Yassa

## Abstract

**Objective**—To assess whether the Ottawa ankle rules can be used to accurately predict which children with ankle and midfoot injuries need radiography.

**Methods**—Prospective study with historical control group of all children aged 1–15 years presenting to Sheffield Children's Hospital accident and emergency department with blunt ankle and/or midfoot injuries during two five month periods before and after implementation of the Ottawa ankle rules.

**Results**—In the study group 432 out of 761 (56.76%) patients received radiography compared with 500 out of 782 (63.93%) in the control group. This was a statistically significant reduction in radiography rate of 7.2% (95% confidence interval 2.3% to 12.1%,  $p < 0.01$ ). The sensitivity of the Ottawa ankle rules was 98.3% and the specificity 46.9%. There was no increase in the number of missed fractures (one in each group).

**Conclusion**—The Ottawa ankle rules can be applied in children to determine the need for radiography in ankle and midfoot injuries. Their implementation leads to a reduction in the radiography rate without leading to an increase in the number of missed fractures.

(J Accid Emerg Med 1999;16:342-344)

Keywords: Ottawa ankle rules; children

Ankle and midfoot injuries are a common reason for presentation to accident and emergency (A&E) departments. Studies in adults have shown that 80%–98% of patients with such injuries receive radiography but that usually fewer than 15% of these have a fracture.<sup>1-4</sup> Concerns about the high number of radiographs being performed with relatively low specificity for detecting fractures led to the development of the Ottawa ankle rules<sup>1</sup> as a clinical decision making tool which leads to a reduction in the number of radiographs being performed while not missing any fractures. The Ottawa ankle rules state that ankle radiography is indicated only if there is pain in the malleolar zone accompanied by bony tenderness over the posterior edge of the medial or lateral malleolus (including the distal 6 cm of the tibia and fibula), or an inability to weight bear both immediately and in the A&E department. Foot radiography is indicated if there is pain in the midfoot zone with bony tenderness over the navicular or base of the fifth metatarsal, or an inability to weight bear both immediately and in the A&E department. Validation of the Ottawa ankle rules have

shown them to have a sensitivity of 93%–100%.<sup>2-10</sup> Even when the Ottawa ankle rules were not 100% sensitive they were better than clinical suspicion alone.<sup>5</sup>

Despite the large number of studies validating the results there have been no large studies looking at whether the Ottawa ankle rules are applicable in children. Two small studies, one involving 31 children<sup>3</sup> and one 71 children,<sup>10</sup> found that implementation of the rules could have properly identified all fractures while reducing the radiography rate by 22% and 25% respectively.

In the absence of any recognised guidelines for ankle radiography in children, and the available evidence that the Ottawa ankle rules are better than clinical judgment alone, it was decided to adopt the Ottawa ankle rules as a standard for managing ankle injuries in this department in an attempt to decrease children's exposure to ionising radiation without leading to misdiagnosis. The opportunity was taken to prospectively validate them at the same time.

## Subjects and methods

Validation of the Ottawa ankle rules included a prospective study group and a historical control group. All 761 eligible children presenting with blunt ankle and/or midfoot injuries between 1 September 1997 and 31 January 1998 were included in the study group. While the lower age limit was 1 year, children were only included if they had started to walk before their injury. Patients seen in August were excluded to allow the medical staff to develop experience in the use of the Ottawa ankle rules. All medical staff in the A&E department were given a lecture on the rules and their implementation before the start of the study period. Each patient who then presented with an appropriate injury had a form depicting the Ottawa ankle rules attached to their notes by the triage nurse that the doctor could then use as an *aide mémoire* when deciding whether radiography was required. If radiography was not performed the patient was advised to return after 5–7 days if their symptoms had not improved. Each morning the data sheets for the previous days attendances were checked and the notes of those patients coded as presenting with any injury to the leg or foot were reviewed to ensure all eligible patients had been included in the study. The notes of those patients included in the study were reviewed again after one month to ensure that the patient had not returned and had subsequently had a radiograph that had shown a fracture. If the patient had not returned it was assumed that they did not have a clinically significant fracture. As no other

Accident and  
Emergency  
Department, Northern  
General Hospital,  
Sheffield  
C Libetta

Accident and  
Emergency  
Department, Sheffield  
Children's Hospital  
D Burke  
P Brennan  
J Yassa

Correspondence to:  
Carole Libetta,  
Lecturer/Specialist Registrar  
in Emergency Medicine,  
Emergency Department,  
Hope Hospital, Stott Lane,  
Salford M6 8HD.

Accepted 20 March 1999

Table 1 Characteristics of patients in the control and study groups

Characteristic	Control (n=782)	Study (n=761)
Age distribution (years)		
1	3	10
2	10	13
3	16	16
4	15	18
5	28	24
6	36	23
7	52	35
8	69	44
9	72	72
10	82	72
11	68	83
12	98	107
13	86	92
14	77	86
15	70	66
Median age	11	11
No (%) of boys	375 (47.9)	385 (50.6)
Type of radiograph (% total number of patients)		
Ankle	309 (39.5)	247 (32.4)
Ankle and foot	48 (6.1)	49 (6.4)
Foot	143 (18.3)	136 (17.9)
No of fractures (% total who had radiography)		
Ankle	27 (5.4)	32 (7.4)
Foot	26 (5.2)	27 (6.2)

hospitals in the city manage children under 16 years they could not have presented to an alternative A&E department in the area without being referred back to us. While patients with continuing symptoms could have presented to their general practitioners it is likely that they would also have been referred back if the symptoms were severe enough to warrant radiography.

A historical control group was used in order to avoid the Hawthorn effect and to allow a greater number of patients to be included in the study, bearing in mind that most of the A&E staff are senior house officers who change posts every six months, thus allowing the same staff to be involved for the whole of the study period. The control group comprised all 782 patients who presented with blunt ankle and/or midfoot injuries between 1 March 1997 and 31 July 1997. The A&E database for this period was searched and again the notes of any patients coded as having an injury to the leg or foot were checked to ensure all appropriate patients were included.

#### STATISTICAL ANALYSIS

$\chi^2$  Analysis was used to test the primary hypothesis that there was no difference in the number of patients who had radiography of the ankle and/or foot between the control and study groups.

#### Results

The 1543 patients seen during the control and study periods were comparable with respect to age and sex (table 1).

In total 63.93% (500/782) of the control group and 56.76% (432/761) of the study group received radiography. This demonstrated a significant reduction of 7.17% (95% confidence interval 2.3% to 12.1%,  $p < 0.01$ ) for the study group. The Ottawa ankle rules had a sensitivity of 98.3% and specificity 46.9%. Of those patients who received radiography 53 (10.6%) in the control group and 59 (13.6%) in the study group had a fracture.

There was no significant difference in missed fracture rate. In the control group a 12 year old girl presented with an inversion injury to the ankle that was initially diagnosed as a sprain and she did not have radiography. She subsequently returned after one week complaining of persistent pain and swelling over the lateral malleolus and had a radiograph that revealed an avulsion fracture of the lateral malleolus. This did not require any further treatment and she made a complete recovery. In the study group a 12 year old boy presented with an injury to the ankle. The Ottawa ankle rules were correctly applied and he did not meet any of the criteria for radiography. He subsequently returned after one week with persistent pain in the ankle and radiography was performed which showed a Salter Harris IV fracture of the lower tibial epiphysis. He was treated with a below knee plaster and did not suffer any clinical sequelae from having the injury missed initially.

#### Discussion

The Ottawa ankle rules were originally devised in a setting in which the pre-existing radiography rate was 99%. They were specifically precluded from use in those under the age of 18 years presumably because of concerns relating to the potential for missed epiphyseal injuries and the difficulties in assessing very young children. In this setting the reduction in the radiography rate was up to 30%.

In our study a more modest reduction in radiography rate of 7.2% was found. This reduction occurred against a pre-implementation rate of 64%. It is likely that our lower pre-implementation rate was due to a different medicolegal environment within the UK compared with Canada. It is also possible that doctors in the control group may have been applying the rules in an ad hoc manner if they had prior experience of A&E. However this may be the case in all A&E departments where there is no formal Ottawa ankle rules protocol. This study would suggest that adopting such a protocol will still lead to a reduction in radiography rate.

Early follow up of our patients to one month post-injury revealed only one missed fracture with no sequelae in both study and control groups. By specifically advising patients to return if their symptoms did not improve we feel it is unlikely that any clinically significant injuries were missed. To date (18 months after the start of the study, mean follow up period nine months, minimum follow up period six months) we have had no patients represent with evidence to suggest late epiphyseal injury. We will continue to review both groups for further attendances in order to detect late presenting problems.

This study included all children of 1 year and over who were able to walk before their injury. However there were relatively few numbers of preschool children who presented (see table 1). Children under the age of 5 years are often difficult to assess, and while no child in this study returned with problems it may be that the Ottawa ankle rules are a less reliable

predictor of the need for radiography in children of this age group with apparent foot and ankle injuries. Care must be taken not to miss other injuries, for example spiral fractures of the tibia in toddlers.

### Conclusion

This study shows that the Ottawa ankle rules are a valid decision making tool to determine the need for radiography in children with ankle and midfoot injuries. Their implementation leads to a reduction in radiography rate without leading to an increase in missed fractures. The one patient in the study group and the one in the control group who did not receive an radiography on initial presentation but were subsequently found to have a fracture, both represented within one week of injury. We would recommend therefore that if the decision is made not to take a radiograph, the patient should be advised to return after one week if their symptoms have not improved. Care should be exercised when applying the Ottawa ankle rules in preschool children.

Conflict of interest: none.

Funding: none.

- 1 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;21:384-90.
- 2 Stiell I, Wells G, Laupacis A, et al. Multicentre trial to introduce the Ottawa ankle rules for radiography in acute ankle injuries. Multicentre Ankle Rule Study Group. *BMJ* 1995; 311:594-7.
- 3 McBride KL. Validation of the Ottawa ankle rules. Experience at a community hospital. *Can Fam Physician* 1997;43: 459-65.
- 4 Aueley GR, Ravaud P, Giraudeau B, et al. Implementation of the Ottawa ankle rules in France. A multicenter randomised controlled trial. *JAMA* 1997;277:1935-9.
- 5 Anis AA, Stiell IG, Stewart DG, et al. Cost-effectiveness analysis of the Ottawa ankle rules. *Ann Emerg Med* 1995;26:422-8.
- 6 Stiell IG, Greenberg GH, McKnight RD, et al. Decision rules for the use of radiography in acute ankle injuries: refinement and prospective validation. *JAMA* 1993;269: 1127-32.
- 7 Lucchesi GM, Jackson RE, Peacock WF, et al. Sensitivity of the Ottawa rules. *Ann Emerg Med* 1995;26:1-5.
- 8 Kerr L, Kelly AM, Grant J, et al. Failed validation of a clinical decision rule for a use of radiography in acute ankle injury. *N Z Med J* 1994;107:294-5.
- 9 Verma S, Hamilton K, Hawkins HH, et al. Clinical application of the Ottawa ankle rules for the use of radiography in acute ankle injuries: an independent site assessment. *AJR* 1997;169:825-7.
- 10 Chande VT. Decision rules for roentgenography of children with acute ankle injuries. *Arch Pediatr Adolesc Med* 1995;149:255-8.

### Safety at Scene Course (in association with MED-ALERT)

A new course being run at Lancashire Fire and Rescue Service's International Training Centre in Lancashire has brought doctors, ambulance crews, and firefighters together in a unique venture in which knowledge and skills are shared between the services.

The morning of day 1 deals with road traffic accident management, the changes the fire service are making to their operating procedures in order to reduce the length of time a casualty is trapped, and the hazards associated with such incidents.

The afternoon session starts with hazardous chemicals, their identification, and decontamination procedures for casualties affected by them. This is followed by a presentation on backdraught and flashover and a chance for students to gain experience in handling and putting out fires with fire extinguishers.

Day 2 begins with a lecture on the dangers of collapsed structures. The candidates are soon putting their newly gained knowledge to good use when they are given a casualty to evacuate from the centre's collapsed structures gallery.

After lunch safety on railway lines is covered, followed by a quick exercise on an embankment to demonstrate the best way to use the light rescue ropes the ambulance service has just issued in Lancashire.

The course is completed by first explaining the use of heavy rescue equipment and then by allowing the participants to use it. Simple techniques are taught that may allow rescue without specialised equipment.

The course is rated for six hours PGEA and the current fee is £256 with accommodation available on site at £20.60 per night.

For further information contact Mrs Jean Gardner, Washington Hall International Training Centre, Euxton, Chorley, Lancs PR7 6DH (tel: 01257 266611, fax: 01257 261767, web site: [www.washingtonhall.co.uk](http://www.washingtonhall.co.uk)).