Research Article | **Open Access**

Implementation of the Ottawa Ankle Rules by Resident Orthopaedic Surgeons in an Emergency Department

Ioannis Spanos*, Vasilis Samdanis, Anastasios Chytas, Theodoros Beslikas and Ippokratis Hatzokos

2ndOrthopaedic Department of the Aristotle University of Thessaloniki, Thessaloniki, Greece

Abstract

Background: Routinely in an emergency department, radiographs are ordered for almost every patient with ankle injury, despite there are decision rules such as Ottawa Ankle Rules (OAR) to distinguish the patients who need them. The use of these rules is limited due to imperfect sensitivity and subjectivity of the method.

Objectives: To validate the accuracy of the OAR implemented by resident orthopaedic surgeons to rule out clinical significant ankle fractures in patients with acute ankle injuries.

Design: prospective cohort study.

Method: One hundred and twenty three patients presented with ankle injury in our emergency department during a two-month period (January 2012 to February 2012).One hundred and nineteen patients fulfilled the inclusion criteria for this study. Resident orthopaedic surgeons examined the patients and filled the data forms. All patients underwent blinded radiographic assessment by an orthopaedic surgeon and a radiologist.

Main outcome measures: sensitivity, specificity, potential reduction in radiographs needed.

Results: An ankle fracture was observed in thirty-four (28.6%) patients. In this group of patients, the OAR failed to predict two fractures (sensitivity 94.12%) and showed a relative low specificity (37.65%). The possible reduction in the radiographs needed was 28.6%.

Conclusions: This validation study of the OAR implemented by resident orthopaedic surgeons in a Greek setting produced similar results than those published previously in various other settings. The OAR for ankle injuries seem to be an accurate, objective, cost effective method to rule out ankle fractures.

Introduction

Fractures and dislocations of the ankle and foot are among the most common injuries in the musculoskeletal system. Five to ten million ankle injuries occur each year in the United States [1], accounting for 36% of all lower limb injuries [2] and representing 10% of emergency room visits [3]. The prevalence and severity of ankle injuries have been increasing since the 1950s, and this has been attributed to the increase in recreational activity [1]. Ankle sprains are considered to be one of the most common injuries experienced during sports [4-6]. Lesions of the ankle and foot can alter the mechanics of gait and as a result cause stress on other lower limb joints. The disability and time away from occupation resulting from these injuries warrant close attention to diagnosis and management [7-11].

It is imperative to rule out a fracture after an acute ankle trauma. X-ray including anteroposterior and lateral views should be performed in situations where acute bony tenderness is present on the malleoli or the medial or lateral dome of the talus. X-rays of the ankle joint should include the base of the 5th metatarsal to exclude associated fracture.

Currently, radiographs are routinely ordered in almost every patient with ankle trauma, although clinical significant fractures account for only 15% of the injuries [12]. The main reasons are mostly patients' expectations and secondarily the doctors' fear of overlooking a fracture. This defensive approach may lead to unnecessary radiographical examinations, resulting in increased radiation exposure and health care expenditure, as well as longer waiting times in the emergency department [13,14]. Ankle films account for about 2% of all radiographic examinations and about 10% of emergency radiographs [1]. An estimated \$500 million is spent annually in Canada and the United States on ankle radiographs alone[15].

In order to reduce the need for radiography in patients with acute ankle trauma, prediction rules have been developed. These rules aim to reduce the amount of radiographs without the risk of missing clinical significant fractures. Clinical significant fractures are considered those that need treatment either surgical or conservative. The Ottawa Ankle Rules (OAR) were developed in Canada and state that ankle radiographs are needed only if there is pain on palpation on the posterior edge of either malleolus or inability to walk four steps [16,17].

Literature Review

The Ottawa ankle rules are decision rules that help to determine which patients with ankle injuries should undergo radiography. The OAR have been derived (N=750) [16], refined, and prospectively validated (N=1,485) [17] previously by two implementation trials; a local (N=2,342)[12] and a multicenter one (N=12,777)[18].

*Corresponding author: Ioannis Spanos, Orthopaedic Surgeon, Research Fellow, 2nd Orthopaedic Department of Aristotle University of Thesssaloniki, Thessaloniki, Greece, Tel: 00302310582290; info@ortho-thessaloniki.gr

It has been shown that these rules have high sensitivity (almost 100%) in detecting fractures with a reduction in radiographies of approximately 40%. The same systematic review assessing the diagnostic value of the OAR revealed substantial heterogeneity of specificity ranging from 22.3% to 46.1% [19].

Unfortunately the Ottawa rules have been proved as being unsuccessful in a few populations [20-23]. A possible explanation for this problem might be more or less severe ankle injury in different populations because of various thresholds for seeking medical assistance [24].

Studies have suggested that poor knowledge of the Ottawa Ankle Rules (OAR) limits its clinical impact [25].

Brehaut et al. reported a survey performed among Canadian emergency physicians to evaluate barriers to the implementation of clinical decision rules. While 99.2% of the respondents reported to be familiar with the OAR, only 30.9% were able to correctly remember all its components. Errors in remembering rule components were more common among part-time (beta=0.18, p=0.009) and older (beta=0.18, p=0.04) physicians, and those who do not apply the rule consistently (beta=0.14, p=0.04). Most physicians (89.6%) reported using the OAR always or most of the time in appropriate circumstances, while only 42.2% reported basing their decisions to order radiography primarily on the rule. Physicians reported considering non-rule factors that are not related to the presence of a fracture (e.g., swelling: 54%), and factors that add no more predictive value over and above the rule (e.g., age>55 years: 55.2%) [26].

The reason for disagreement between clinical studies and real-life situations may be related to the fact that physicians do not adequately remember the OAR [25] or because ordering unnecessary radiographs had no negative consequences [27] or even because physicians are hesitant to rely on the results of their physical examination [28].

Gracham et al. evaluated the international diffusion of the Ottawa Ankle Rules and determined emergency physicians' (EPs) attitudes toward clinical decision rules. The results indicated that a majority of Canadian (89%) and U.K. (73%) EPs use the rules. However, less than one third of Spanish, French, and U.S. physicians reported frequent use of the rules [29].

Materials and Methods

This is a prospective study performed at a medium-sized hospital in Thessaloniki (Greece). Consecutive patients presenting to the emergency department with an acute ankle injury from January 2012 to February 2012 were eligible. Acute ankle injury was defined as any painful ankle resulting from trauma. Ankle was defined as the malleolar area and the midfoot area, both of which are commonly involved in twisting injuries.

All the patients were examined by resident orthopaedic surgeons. The examiners had to fulfill a predetermined form which contained a set of patients' characteristics and contextual information, such as age, gender, height, weight, injury mechanism and the time passed between the injury and examination. They also recorded the result of the OAR.

All examiners received a presentation about the use and interpretation of the rules and received a printed card with the descriptions. We also placed posters with a description of the OAR in the emergency department as suggested by the developers [16,17]

All patients underwent a series of ankle x-rays (anteroposterior and lateral) and a series of mid-foot x-rays (anterioposterior and oblique)

after the initial assessment. All radiographs were independently interpreted by a radiologist and an orthopaedic surgeon, who were both blinded to the information on the data form. Their interpretation was regarded as the reference against which we assessed the accuracy of the OAR.

A clinically significant fracture was any avulsed fracture fragment greater than 3 mm on the radiograph. If the avulsed fracture fragment was smaller than 3 mm, the radiograph was interpreted as a clinically insignificant fracture and was regarded as no fracture in data analysis.

Patients were excluded if they were under 18 years of age, if they were pregnant, if the ankle injury was older than 5 days ago and if they were unreliable due to severely altered mental health, lack of cooperation or drug use.

Of the 123 patients presented with an ankle injury (9.7% of the patients presented for orthopaedic examination), 119 patients both met recruitment criteria and provided data for this study.

No changes in clinical management were made as a result of this study, so approval was not obligatory from the hospital's ethics committee, nor were the patients asked to provide informed consent.

Statistical Analysis

We calculated the diagnostic capability of the OAR in terms of sensitivity, specificity, and the potential reduction of radiographies needed.

All the quantitative variables were checked for the regularity of their distribution according to the criterion of Kolmogorov-Smirnov. Where normal distribution did not exist non-parametric methods of presentation of variables and analysis were used. Analyses were performed with the IBM SPSS Statistics Version 20 (Chicago, Illinois).

Results

During the study 1268 patients were referred to the orthopaedic emergency department of our hospital out of which 123 with an acute ankle trauma. Four out of these patients met the exclusion criteria or refused to participate and had to be excluded from the study. The mean age of the patients included in the study was 38.46 years and the mean body mass index (BMI) was 26.11. Fifty-seven patients were males (47.9%) and sixty-two were females.

The mechanism of the injury was mostly a simple fall. Almost one fourth of the injuries happened during sport activities.

Thirty-four clinical significant fractures were observed on the radiographs, sixteen in males (47.1%) and eighteen in females (52.9%). Patients who sustained a fracture were older than patients without a fracture and that difference was statistically significant (U=964.000, p=0.005, two-tailed).

The time between the injury and the evaluation at the emergency department did not play any important role in tenderness at the malleoli area. On the contrary there is important difference between those who are able to make four steps and those not, in correlation with the time passed between injury and examination.

The Ottawa Ankle Rules identified 32 of the 34 clinical significant fractures (sensitivity 94.12% and specificity 37.65%).

The OAR recommended radiography in 71.4% of the cases. The corresponding potential savings in radiographs were 28.6%.

Discussion

Until recently, many decisions to perform investigations have been based more on personal experience than on evidence-based medicine. Under the current socio-economical conditions, doctors have to deal with rising pressure to provide proper health care with less cost. Clinical decision rules (CDRs) are tools that help clinicians to take diagnostic and therapeutic decisions at the bedside. By standardizing the collection and interpretation of clinical data, CDRs attempt to reduce uncertainty in medical decision-making [30]. It is important to ensure that the sensitivity and specificity of the rule are accurate and that there are few missed diagnoses.

Since the early 1980s, several studies have been conducted to establish predictive rules for the use of radiography in ankle injuries. The best established and validated protocol seemed to be the OAR. Our study proved that the OAR protocol could be used in the Greek population.

Our results showed sensitivity of 94.12%, specificity of 37.65%, and possible reduction of 28.57% in use of radiographs. Our results are similar to those found in literature [5].

In the Greek national health system every patient with a musculoskeletal injury is examined and assessed by either orthopaedic residents or consultants so there are no discrepancies observed in other studies, which arise mainly because of differences in level of clinical training and experience. Greek patients' mentality involves asking for an x-ray examination for any musculoskeletal injury, having in mind that x-rays is the only way to rule out a fracture. Many of them are also reluctant to be examined and to provide the proper information. Doctor's fear of a bad professional reputation or litigation by missing a fracture leads him to overestimate patients' complaints and therefore maximizes sensitivity while on the same time minimizes specificity. Soft-tissue tenderness and swelling make bone tenderness difficult to assess. It also appears plausible that the subtlety of palpation technique might impact on the false-positive rates, that is, the percentages of patients who apparently indicated pain or inability to walk four steps, but had no fracture [28]. We think that the main disadvantage of the OAR protocol is that it is influenced by subjective factors.

The OAR protocol is calibrated towards high sensitivity at optimal specificity. High sensitivity minimizes false negative results. On the other hand specificity correlates with the usefulness of the rule in helping avoid unnecessary x-rays and associated costs.

It is obvious that in times of increased legal pressure and the growing obligation to document and prove clinical findings for social and health insurance purposes it is likely that the performance of the decision rules measured in a study cannot be reached in clinical practice. In our study as in almost every other earlier validation study all patients underwent radiography irrespective of the decision rule result. So the capacity of the rule to reduce the number of unnecessary x-rays remains somewhat theoretical.

Conclusions

This validation study of the OAR implemented by resident orthopedic surgeons in a Greek setting produced similar results than those published previously in various other settings.

Emergency physicians around the world should adopt the use of clinical decision rules for ankle injuries. With relatively simple implementation strategies, care can be standardized and costs reduced while providing excellent clinical care. Cost-effective decision rules that do not compromise the acute or chronic medical situation of a patient are generally of great acceptance. The OAR protocol for ankle injuries seems to be an accurate, objective, cost effective method to rule out ankle fractures.

References

1. Birrer RB, Fani-Salek MH, Totten VY, Herman LM, Politi V (1999) Managing ankle injuries in the emergency department. J Emerg Med 17: 651-660.

2. Lambers K, Ootes D, Ring D (2012) Incidence of patients with lower extremity injuries presenting to US emergency departments by anatomic region, disease category, and age. Clin Orthop Relat Res 470: 284-290.

3. Cass JR, Morrey BF (1984) Ankle instability: current concepts, diagnosis, and treatment. Mayo Clin Proc 59: 165-170.

4. Garrick JG, Requa RK (1988) The epidemiology of foot and ankle injuries in sports. Clin Sports Med 7: 29-36.

5. Beynnon BD, Murphy DF, Alosa DM (2002) Predictive Factors for Lateral Ankle Sprains: A Literature Review. J Athl Train 37: 376-380.

6. Yeung MS, Chan KM, So CH, Yuan WY (1994) An epidemiological survey on ankle sprain. Br J Sports Med 28: 112-116.

7. Gerber JP, Williams GN, Scoville CR, Arciero RA, Taylor DC (1998) Persistent disability associated with ankle sprains: a prospective examination of an athletic population. Foot & ankle international/American Orthopaedic Foot and Ankle Society [and] Swiss Foot and Ankle Society, 19: 653-660.

8. Beynnon BD, Vacek PM, Murphy D, Alosa D, Paller D (2005) First-time inversion ankle ligament trauma: the effects of sex, level of competition, and sport on the incidence of injury. Am J Sports Med 33: 1485-1491.

9. Konradsen L, Bech L, Ehrenbjerg M, Nickelsen T (2002) Seven years follow-up after ankle inversion trauma. Scand J Med Sci Sports 12: 129-135.

10. Anandacoomarasamy A, Barnsley L (2005) Long term outcomes of inversion ankle injuries. Br J Sports Med 39: e14.

11. Cooke MW, Marsh JL, Clark M, Nakash R, Jarvis RM, et al. (2009). Treatment of severe ankle sprain: a pragmatic randomised controlled trial comparing the clinical effectiveness and cost-effectiveness of three types of mechanical ankle support with tubular bandage. The CAST trial. Health technology assessment 13: 1-121.

12. Stiell IG, McKnight RD, Greenberg GH, McDowell I, Nair RC, et al. (1994) Implementation of the Ottawa ankle rules. JAMA 271: 827-832.

13. Bairstow PJ, Jennifer Persaud, Richard MendelsonLong Nguyen (2010) Reducing inappropriate diagnostic practice through education and decision support. International journal for quality in health care: journal of the International Society for Quality in Health Care/ISQua 22: 194-200.

14. Perry JJ, Stiell IG (2006) Impact of clinical decision rules on clinical care of traumatic injuries to the foot and ankle, knee, cervical spine, and head. Injury 37: 1157-1165.

15. Stiell I (1996) Ottawa ankle rules. Can Fam Physician 42: 478-480.

16. Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, et al. (1992) A study to develop clinical decision rules for the use of radiography in acute ankle injuries. Ann Emerg Med 21: 384-390.

17. Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, et al. (1993) Decision rules for the use of radiography in acute ankle injuries. Refinement and prospective validation. JAMA 269: 1127-1132.

18. Stiell I, Wells G, Laupacis A, Brison R, Verbeek R, et al. (1995) Multicentre trial to introduce the Ottawa ankle rules for use of radiography in acute ankle injuries. Multicentre Ankle Rule Study Group. BMJ 311: 594-597.

19. Bachmann LM, Kolb E, Koller MT, Steurer J, ter Riet G (2003) Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review. BMJ 326: 417.

20. Chandra A, Schafmayer A (2001) [Diagnostic value of a clinical test for exclusion of fractures after acute ankle sprains. A prospective study for evaluating the "Ottowa Ankle Rules" in Germany]. Unfallchirurg 104: 617-621.

21. Cameron C, CD Naylor (1999) No impact from active dissemination of the Ottawa Ankle Rules: further evidence of the need for local implementation of practice guidelines. CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne 1165-1168.

22. Kelly AM, Richards D, Kerr L, Grant J, O'Donovan P, et al. (1994) Failed validation of a clinical decision rule for the use of radiography in acute ankle injury. N Z Med J 107: 294-295.

23. Tay SY, Thoo FL, Sitoh YY, Seow E, Wong HP (1999) The Ottawa Ankle Rules in Asia: validating a clinical decision rule for requesting X-rays in twisting ankle and foot injuries. J Emerg Med 17: 945-947.

24. Glas AS, Pijnenburg BA, Lijmer JG, Bogaard K, de RM, et al. (2002) Comparison of diagnostic decision rules and structured data collection in assessment of acute ankle injury. CMAJ 166: 727-733.

25. Gravel J, Roy M, Carrière B (2010) 44-55-66-PM, a mnemonic that improves retention of the Ottawa Ankle and Foot Rules: a randomized controlled trial. Acad Emerg Med 17: 859-864.

26. Brehaut JC, Stiell IG, Visentin L, Graham ID (2005) Clinical decision rules "in the real world": how a widely disseminated rule is used in everyday practice. Academic emergency medicine: official journal of the Society for Academic Emergency Medicine: 948-956.

27. Bessen T, Clark R, Shakib S, Hughes G (2009) A multifaceted strategy for implementation of the Ottawa ankle rules in two emergency departments. BMJ 339: b3056.

28. Can U, Ruckert R, Held U, Buchmann P, Platz A, et al. (2008) Safety and efficiency of the Ottawa Ankle Rule in a Swiss population with ankle sprains. Swiss Med Wkly 138: 292-296.

29. Graham ID, Stiell IG, Laupacis A, McAuley L, Howell M, et al. (2001) Awareness and use of the Ottawa ankle and knee rules in 5 countries: can publication alone be enough to change practice? Ann Emerg Med 37: 259-266.

30. Stiell IG, Bennett C (2007) Implementation of clinical decision rules in the emergency department. Academic emergency medicine: official journal of the Society for Academic Emergency Medicine 955-959.