

EVALUATION OF THE ACCURACY OF "OTTAWA ANKLE RULES" FOR PREDICTING FRACTURES IN ACUTE ANKLE AND MIDFOOT INJURIES

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ABSTRACT

INTRODUCTION: Twisting injuries of ankle and foot are one of the most common injuries seen in emergency department and are the most common sports injuries. Almost all such cases are investigated by X-rays to rule out fractures, but clinically significant fractures are detected only in a small number of cases (approximately 15%). Ottawa Ankle Rules (OARs) are screening tools, applied in acute ankle and foot injuries to exclude those cases that are not likely to have fractures and thereby reduce the number of unnecessary X-rays. At the same time, all clinically significant fractures are included and not a single clinically significant fracture is missed when OARs are applied properly. This study was conducted to evaluate the accuracy of "Ottawa Ankle Rules" in our setup.

METHODS: This prospective study was conducted in the Emergency and Orthopaedics Department of Lumbini Medical College Teaching Hospital, Palpa. Eighty patients were included in this study. Fifty one patients were in ankle group and 30 patients were in midfoot group. All patients were sent for X-rays after evaluating them according to OARs.

RESULTS: Among 81 cases, 13 clinically significant fractures were detected. Sensitivity of the OARs for detecting fractures was 100%. Specificity of the OARs for detecting fractures was 36.76 % for combined ankle and midfoot zones, 36.36% for the ankle zone, and 37.5% for the midfoot zone. Negative predictive value was calculated as 1(100%). Potential of OARs to reduce unnecessary radiographs was calculated 30.86%.

CONCLUSION: OARs are very accurate and highly sensitive tools for detecting fractures in acute ankle and midfoot injuries. Implementation of these rules would lead to significant reduction in the number of radiographs and thereby reduce the cost of the treatment, radiation exposure and waiting time of patients at hospital.

KEY WORDS: Ankle sprain, Foot, Ottawa ankle rules

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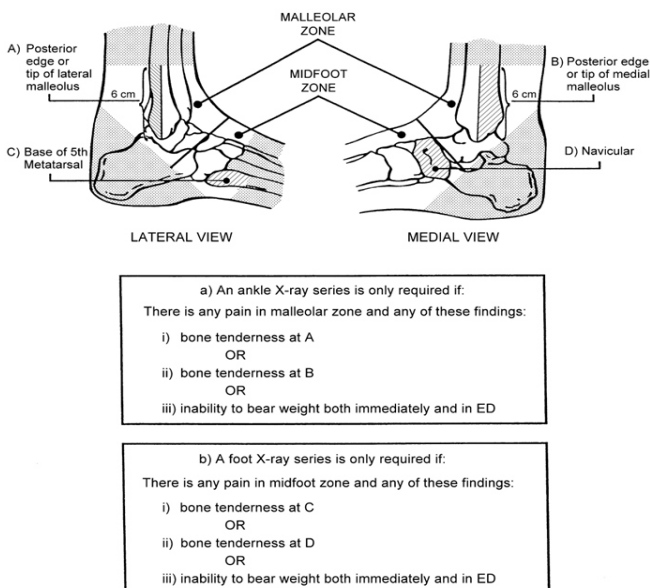
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INTRODUCTION

Acute ankle and foot injuries are among the most common injuries seen in Emergency Departments (ED) and are the most common sports related injuries.^{1,2} Almost all patients with such injuries undergo X-ray evaluation, whereas less than 15% have clinically significant fractures.³⁻⁵ This figure shows that significant number of patients are subjected to unnecessary X-ray exposure. So, there was a need for clinical tests that can reduce the unnecessary X-rays ordered for such injuries, while at the same time, these tests should have ability to include all clinically significant fractures and no fracture should be missed. Steill *et al*^{6,7} developed and validated such tests and named them Ottawa ankle rules (OARs). These rules are based on pain, bony tenderness and weight bearing ability (Fig. 1).⁷

Figure 1: The Ottawa Ankle Rules for ankle and foot radiography⁷



According to OARs, X-rays of the ankle is done, if there is pain in the malleolar zone and either (a) inability to bear weight immediately and in the ED (four steps) and/or (b) bone tenderness at the posterior edge or tip of either malleolus. They recommend midfoot X-ray only if there is pain in the midfoot zone and either (a) inability to bear weight immediately and in the emergency department (four steps) and/or (b) bone tenderness at the navicular or the base of fifth metatarsal.

OARs have been studied and validated in several countries.⁸⁻¹³ In the systemic review done by Bachman *et al*¹⁴ the sensitivity of the OARs ranges from 96.4% to 99.6% and specificity

ranges from 47.9% to 26.3%. However, in some studies OARs couldn't be validated.^{15,16} Since ankle and foot injuries are also common in our hospital and all cases are sent for X-rays, we evaluated the accuracy of the OARs in our set-up.

MATERIALS AND METHODS

This prospective study was conducted at Lumbini Medical College Teaching Hospital, Palpa in the Department of Emergency and Outpatient Department of Orthopaedics from December 2010 to July 2011, over a period of 8 months. This study was approved by ethical committee and a written informed consent was obtained from each patient for inclusion in the study. All adult patients coming to this institute with complaints of ankle and midfoot pain secondary to closed acute ankle and midfoot injuries were included in this study. Exclusion criteria were patients less than 18 years of age, patients with isolated injuries of skin, patients referred from outside hospital with radiography, injuries more than 10 days old, unconscious patients, patients with previously symptomatic ankle, intoxicated patients, insensate leg, open fractures, evidence of neurovascular compromise and patients with obvious ankle and foot deformities.

Cases were evaluated according to OARs (fig.1). Malleolar and midfoot zones were defined as described by Stiell *et al*.^{6,7} Tenderness was evaluated first followed by assessment of weight bearing abilities. Weight bearing was described as the ability to transfer weight twice onto each leg (a total of four steps) regardless of limping or discomfort. Clinical diagnosis was reached and recorded. X-rays were sent for both OAR negative and positive cases. X-rays ordered for ankle was Antero-Posterior (AP), Lateral (Lat.) and mortise view. For foot, AP, Lateral and oblique views were ordered. The X-rays were evaluated and fracture fragment displacement more than 3mm breadth was considered as clinically significant fracture. OARs were evaluated by calculating sensitivity, specificity and predictive values. Amount of X-rays that can be reduced when OARs are applied was calculated.

RESULTS

We studied a total of 81 patients (51 in ankle group and 30 in midfoot group). All patients underwent x-ray evaluation, giving 100% radiography rate. Twisting injury was the commonest mechanism of injury in both ankle and midfoot group. Among 51 patients in ankle group, 35 (68.62%) were diagnosed as OARs positive. Out of 35 OAR positive cases, 7 patients had clinically significant fracture. Among 30 patients in midfoot group, 21 (70%) patients were diagnosed as OARs positive. Out of 21 patients 6 had clinically

significant fractures. None of the patients in OAR negative group had clinically significant fracture. Patient's characteristics, pattern of fractures, outcome and performance of Ottawa ankle rules are shown in detail in table 1, 2, 3 and 4 respectively.

Table 1: Patient characteristics

Patient characteristics	Ankle group	Foot group
Total no. of cases (81)	51	30
Age (mean)	35.78yrs(st.dev.11.39)	36.4 (st.dev.11.19)
Sex(male/female)	28/23(54.9%/45.1%)	18/12(60%/40%)
Time since injury	Mean :20.05hrs Range: 1hrs to 140hrs	Mean :25.2hrs Range :1hrs to 168hrs
Side affected (R/L)	30/21	18/12
Mechanism of injury	Twisting 43 Fall from height 4 RTA 4 Direct trauma 0	Twisting 26 Fall from height 1 RTA 2 Direct trauma 1
Swelling	Mild :34 cases Moderate:17 cases Severe: 0 case	Mild :17 cases Moderate :13 cases Severe: 0 case
Echymosis present in	6 cases (11.76%)	2 (6.6%)case
OARs positive cases	35	21
Clinically Significant fractures	7 (13.7%) cases	6(20 %) cases

Table 2: Fracture pattern

Total no of fractures	13 (16.04%)
Lateral malleolus fracture	6
Medial malleolus fracture	1
Base of 5 th metatarsal fracture	5
Navicular fracture	1

Table 3: Outcome of OARs for ankle, midfoot and combined ankle and midfoot groups

	Ankle zone			Midfoot zone			Combined ankle and midfoot zone		
	OAR +	OAR-	Total	OAR +	OAR-	Total	OAR +	OAR-	Total
Fracture	7	0	7	6	0	6	13	0	13
No fracture	28	16	44	15	9	24	43	25	68
Total	35	16	51	21	9	30	56	25	81

Table 4: Performance of OARs

	Sensitivity	Specificity	Positive predictive value	Negative predictive value	X-ray that could be saved
Ankle zone	1(100%)	36.36%	20%	1(100%)	31.37%
Midfoot zone	1(100%)	37.5%	28.57%	1(100%)	30%
Combined ankle and midfoot zone	1(100%)	36.76%	23.21%	1(100%)	30.86%

DISCUSSION

Several studies have been performed since 1981 to develop clinical rules for evaluation of acute ankle and midfoot injuries regarding need of X-rays in such injuries.^{5-7,17-21} OARs were developed and validated by its Canadian inventors^{6,7} and used in various clinical settings. OARs are easy to memorize and simple to apply, in addition, these rules have been successfully and favorably validated in various countries.⁶⁻¹³ However, without evaluation, even well-defined decision making rules are not suitable for application in all clinical settings due to differences in patients' characteristics, different clinical settings and behavior of treating physicians'. Moreover, some study results have rejected the generalization of the OARs.^{15,16} Therefore, evaluation of the OARs was considered in this study.

In present study, twisting injury was the most common mechanism of injury. This result was similar to several other studies worldwide.⁶⁻¹³ Result of present study is similar to those of Stiell et al^{6,7} and various other studies.⁸⁻¹³ In this study, sensitivity of OAR was calculated 100 %. That means all patients with clinically significant fracture were picked up by OARs and none of the clinically significant fractures were missed. Specificity was calculated 36.6% for ankle group, 37.5% for midfoot group and 36.76% for combined ankle and midfoot group. Specificity of OARs appears to be moderate and about two third of cases were diagnosed as false positive. Negative predictive value (NPV) was calculated 100% for ankle, midfoot and for combined ankle and midfoot group. That means chances of getting clinically significant fractures in those patients who were diagnosed as OAR negative was zero. With application of OARs, the amount of X-rays that could be saved was calculated as 30.86%. This figure shows that approximately one third of the X-rays could be avoided with application of OARs. Though X-ray is a low cost investigation, it is done in high volume and is not free of hazards. Therefore, reduction in X-rays even by one third can lead to significant impact on our health care cost along with reduction in radiation hazards.

CONCLUSION

OARs are highly sensitive tools, which can be used for screening of patients with acute ankle and midfoot injuries regarding need for radiological evaluation. Application of OARs can reduce significant number of X-rays thereby reducing the cost of treatment and radiation exposure as well as saving the time of patients and hospital staffs. This study was conducted in single centre with relatively small sample size. Therefore, further studies are required with large

samples, in hospitals of different levels including community health centers and by doctors of different levels of clinical skill and expertise.

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