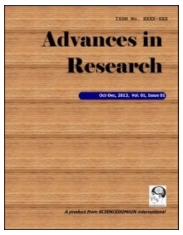

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The Validation of Ottawa Ankle Rules in a Prospective Study of 315 Consecutive Patients: A Prevelance Study in a Single-center

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Authors' contributions

Authors CA and MSY designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors CK and FY managed the analyses of the study. Author MAC managed the literature searche. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was a prospective validation of the Ottawa Ankle Rules (OAR) in our patient population with ankle injury.
Materials and Methods: This was a prospective study conducted. Each patient's demographic characteristics, radiography results, and status of meeting OAR criteria were recorded on a previously prepared study form. The descriptive statistics were presented as Mean, Standard Deviation, and percentage. Categorical variables were analyzed using Chi-Square test. The correlation between OAR positivity and presence of a fracture was analyzed using the Spearman's correlation analysis.
Results: The sensitivity of OAR was 100%, specificity 27%, negative predictive value 100%, and the positive predictive value 17%.
Conclusion: A careful physical examination and use of OAR may allow avoiding unnecessary tests.

Keywords: Emergency; ottawa ankle rules; injury.

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1. INTRODUCTION

As in the rest of the world, acute ankle injuries constitute a considerable proportion of emergency department (ED) admissions in our country. They constitute 40% of sport injuries, 25% of musculoskeletal injuries, and 5% of ED admissions [1].

Although acute ankle injuries are a major reason of ED admissions, only a minority of patients with this condition have a clinically significant fracture. Even so, these patients are often sent to radiographic imaging [2]. The basic incentive behind this practice is the mistrust against physical examination and the concern of missing a possible fracture. Therefore, foot and/or ankle films are routinely ordered. Fortunately, several decision rules have been developed in an attempt to guide clinicians to order a radiologic test, in order to avoid unnecessary radiological imaging in low risk patients. The Ottawa Ankle Rules (OAR) Fig. 1 is the best known example [3,4]. Studies from a number of different countries have proven that unnecessary radiological tests have been considerably reduced in centers implementing OAR [5].

It has been reported that OAR shows inter-societal differences [6]. This study was a prospective validation of the Ottawa Ankle Rules (OAR) in our patient population with ankle injury.

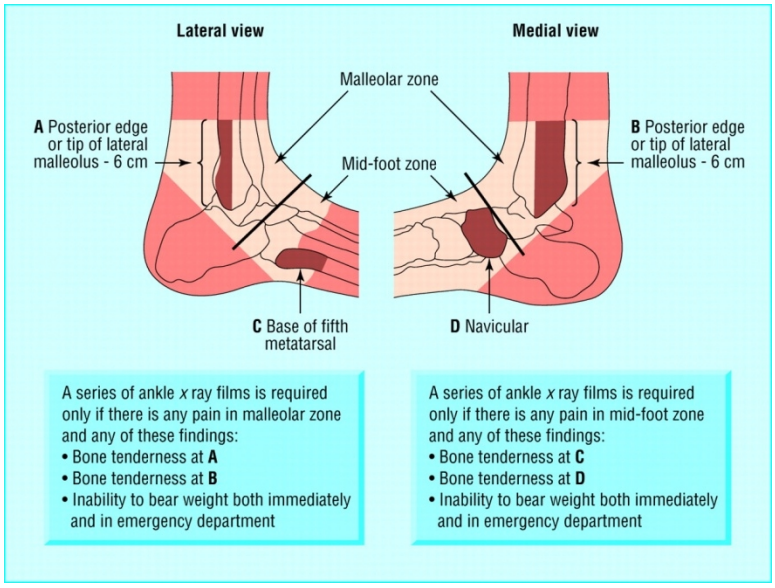

Fig. 1. Ottawa ankle rules

2. MATERIALS AND METHODS

This was a prospective study conducted between 1 June 2012 and 30 September 2012 at the Emergency Department of Ankara Numune Training and Research Hospital after approval by the local ethical committee (2012-134). A total of 315 consecutive patients over the age of 18 who presented to our emergency department with ankle sprain were included in the study after having given written informed consent. Patients who did not agreed to

participate in the study were excluded. We applied OAR whenever the ankle appeared very swollen. Multi-trauma patients, pregnant women, and patients with open fractures were excluded from the study. The patients were examined by the senior emergency physicians trained for OAR for two hours. An informed consent was obtained from each patient. First, the patients were examined and then Antero-Posterior (AP) and lateral foot-ankle films were taken. The study form was filled before radiologic tests. All radiologists were blind to OAR positivity and all radiographic films were reported by the blinded radiologist. Demographic characteristics, radiography results, and status of meeting OAR criteria were recorded on a previously prepared study form.

Study data were recorded on a computer and analyzed using SPSS (Statistical Package for Social Sciences) Windows 19.0 software package. The descriptive statistics were presented as median (min-max), and percentage. Categorical variables were analyzed using Chi-Square test. The correlation between OAR positivity and presence of a fracture was analyzed using the Spearman's correlation analysis. A Receiver Operating Characteristic (ROC) curve was drawn to test the validity of OAR in the studied Ankara population. Sensitivity, specifity, positive predictive value and negative predictive value of OAR criteria were calculated. The results were evaluated within a confidence interval of 95% and at a significance level of $p<0.05$.

3. RESULT

From 327 patients presenting to the Emergency Department of Ankara Numune Training and Research Hospital with ankle trauma, a total of 315 patients agreeing to participate in the study were enrolled. The median age of the patient population was 32 (18-82) years. Among 315 patients, 171 (54.3%) were female and 144 (45.7%) were male.

The etiology of the ankle trauma was a fall in 108 (34.2%) patients, stubbing one's foot against an object in 79 (25%) patients, and rolling the ankle in 128 (40.6%) patients. Various localizations of fractures were showed on Table 1. There was a weak correlation between OAR positivity and presence of a fracture ($r=0.209$, $p<0.001$). However, the ability of OAR to predict fractures was improved as the number of positive criteria increased.

Seventy-four (23%) patients did not meet OAR while 241 (77%) met OAR. Among 241 patients meeting OAR criteria, 42 (17.4%) had a fracture. The ROC analysis showed that the sensitivity of OAR was 100%, specificity 27%, negative predictive value 100 %, and the positive predictive value 17% Table 2, Fig. 2.

Table 1. Localization of fractures

Localization of fracture	n	%
Ankle fracture		
Medial malleol	2	4
Lateral malleol	11	26
Mid-foot fracture		
Lateral side	20	47
Median side	9	21

Table 2. Relationship between OAR and presence of a fracture

OAR	Radiograhy		Total
	Fracture present	Fracture absent	
Positive	42 (%17.4)	199 (%82.6)	241
Negative	0	74 (%100)	74
Total	42 (%13.3)	273 (%86.7)	315

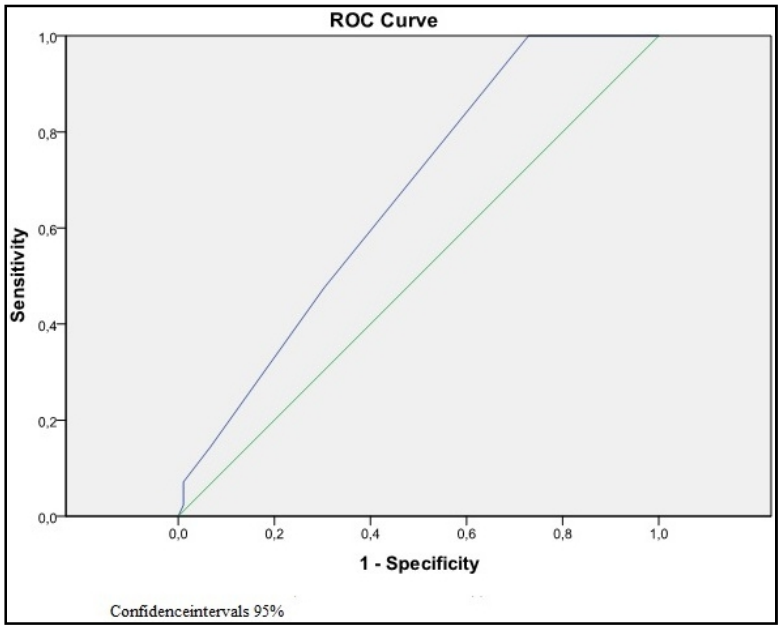

Fig. 2. The ROC curve of the relationship between OAR and presence of a fracture

4. DISCUSSION

The primary objective of our study was to study the validity of OAR in our study population. Validity of OAR has previously been studied in many other countries and some countries including USA, Germany, Switzerland, France, Greece, Iran, Portugal, and Canada have begun to use it owing to its considerably high sensitivity (very close to 100%). These countries have implemented OAR in patients not only above 18 years of age but also above 5 years of age and reduced the number of radiological examinations by 25-51% [7-15].

Jepkin et al. [16] reported that the sensitivity of OAR was 98%, specifity was 39.8%, and the fracture rate was 24.32%; Bachmann et al. [9] reported a sensitivity of 97.3%; Aslan et al. reported a fracture detection rate of 42.3%, a sensitivity of 98-100%, and a specifity of 22-45% [1]. Stiell et al. showed that the sensitivity of OAR was 99% [17]. Wang et al. [18] reported that the sensitivity of OAR was 96.8% and specifity was 48.4%. Rodriques et al. [19] reported that the sensitivity of OAR was 100%. According to Glas et al., OAR correctly

identified 66 of the 74 fractures (sensitivity 89% and specificity 26%) [20]. Beceren reported that OAR correctly identified 235 of 314 fractures (sensitivity 74.8%) [21].

Our results showed that OAR's sensitivity was 100% and specifity 27%. The fracture rate in our population was 13.3%. Despite the limited number of our patients, we suggest that our study reflected the whole universe since it was in agreement with previous studies in the literature.

Although OAR is a physical examination method, it is merely used to decide whether a direct film is necessary. Patients not meeting any of OAR criteria can be safely discharged without ordering a radiographic examination. In contrast, it is necessary to order a radiographic test when any of the criteria is positive.

5. CONCLUSION

In contrast to conventional approaches, a careful physical examination and use of OAR may allow avoiding unnecessary tests. By implementing these practices, both economic burden of health expenditures and unnecessary radiation exposure can be reduced.

6. LIMITATION OF STUDY

The main limitation of the study was the relatively small sample size.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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