



Diagnostic performance of the Bernese versus Ottawa ankle rules: Results of a randomised controlled trial



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ABSTRACT

Purpose: The Ottawa ankle rules (OAR) brought about a reduction of radiographs on the Emergency Department (ED). However, still 50% of patients with ankle injuries undergo unnecessary radiography. Compared to the OAR, the Bernese ankle rule (BAR) has an acclaimed 84% reduction in radiography without loss of sensitivity. The primary aim of this study was to compare the diagnostic accuracy and reproducibility of both rules. Furthermore, the ability of triage nurses to accurately interpret the BAR was assessed.

Methods: Participants were assessed by both the ED resident and the triage nurse, applying the OAR and the BAR. After standardised data collection, ankle and foot radiographs were performed in all patients. Sensitivity and specificity of both tests applied by both observers were obtained and compared by McNemar's test. Reproducibility was calculated with Cohen's kappa.

Results: A total of 203 patients with ankle trauma were included. For the OAR obtained by the ED residents, the sensitivity and specificity were 0.97 and 0.29, respectively. For the BAR, the sensitivity and specificity of the ED residents were 0.69 and 0.45, respectively. For the triage nurses, the OAR sensitivity and specificity were 0.86 and 0.25, respectively. The BAR sensitivity and specificity for the nurses were 0.86 and 0.40, respectively. The reproducibility of the OAR was 0.45, and for the BAR, it was 0.48.

Conclusion: Both rules showed comparable reproducibility. Although the BAR showed a superior specificity compared to the OAR, its sensitivity was too low to promote clinical use. The triage nurses demonstrated too low sensitivity on both rules to allow safe application. Therefore, the OAR remain the decision rules of choice for ankle injuries despite its modest 'ruling out' capacity.

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Introduction

Patients with acute ankle and midfoot trauma constitute approximately 5% of all Emergency Department (ED) presentations [1]. In about 15% of patients visiting the ED with ankle or midfoot trauma, a fracture is diagnosed [2]. To decide if radiography is needed, in 1992 Stiell et al. designed the Ottawa ankle rules (OAR) [3] (Fig. 1).

The OAR have an excellent potential to detect fractures with a sensitivity of nearly 100%, and they are routinely applied at EDs.

However, the capacity to rule out fractures is much less accurate with a reported specificity of only 32% [3]. Although the OAR reduced the number of ordered radiographs without missing significant fractures, the number of patients undergoing radiography still remains high (64%).

As only 15% of ankle and midfoot injuries concern fractures, approximately 50% of all injured patients undergo unnecessary radiography on the basis of the OAR findings. The use of the OAR therefore leads to unnecessary radiation exposure, increased waiting times, and medical costs. For this reason in 2003, Egli et al. developed the Bernese ankle rule (BAR) [4]. The BAR consists of three items: indirect fibular stress, direct medial malleolar stress, and compression stress of the midfoot and hindfoot (Fig. 2).

In the original study, all fractures were detected correctly by the application of the BAR, resulting in a sensitivity of 100%. They

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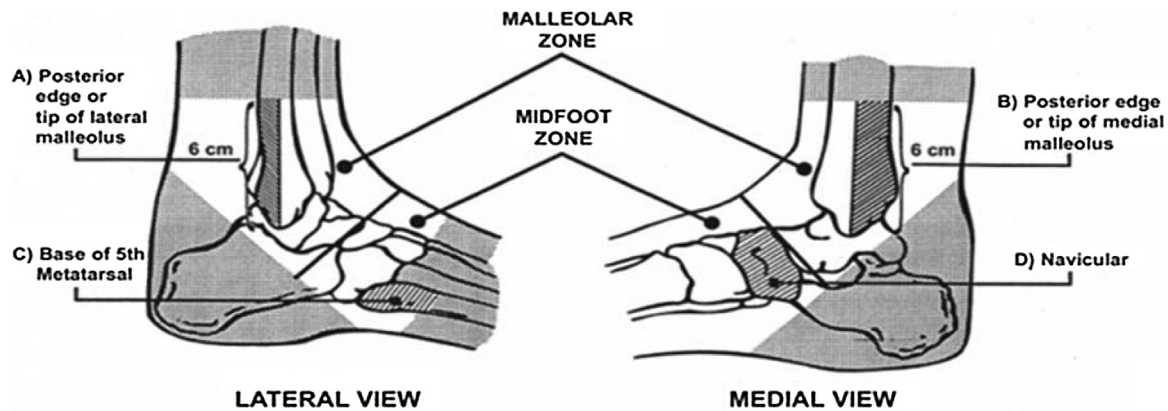


Fig. 1. The Ottawa ankle rules. Ankle radiography is required if there is pain in the malleolar zone, and if one of the following is present: bone tenderness at the posterior edge of the lateral (A) or the medial (B) malleolus or the inability to bear weight (four steps) immediately and in the ED. Foot radiography is required if there is pain in the midfoot zone, and if one of the following is present: bone tenderness at the base of the fifth metatarsal (C) or at the navicular (D) or the inability to bear weight (four steps) immediately and in the ED.

found a remarkably high specificity of 91%. Based on these results, a possible reduction of 84% of ankle and midfoot radiographs could be achieved.

These results are promising; however, to date, only two studies have compared the OAR with the BAR [5,6]. In these studies, a sensitivity of the BAR ranging from 56% to 94% and a specificity of 79–95% were found compared to 75–100% and 69–77%, respectively, for the OAR. This variation in diagnostic characteristics is too large to ascertain a dependable sensitivity and specificity for the BAR. Furthermore, the interobserver agreement (reproducibility), another important clinimetric property of a diagnostic test, has not been assessed in the previously mentioned studies. Furthermore, in many hospitals, triage nurses assess patients with ankle distortions. The nurses order radiographs after the application of a decision rule. It is therefore important to assess whether triage nurses are capable of interpreting the ankle rules with sufficient accuracy.

This study was primarily aimed at assessing and comparing the diagnostic accuracy of the BAR versus the OAR. Secondly, the diagnostic accuracy of triage nurses in interpreting both rules is compared to ED residents. Finally, the study aimed at assessing and comparing the reproducibility of both tests.

Our null hypothesis is that the sensitivity of BAR is non-inferior to the OAR, and that the specificity of the BAR is significantly higher than that of the OAR. The triage nurses are expected to show non-inferior accuracy results compared to the ED residents for both rules. Furthermore, the reproducibility of the BAR is expected to be higher than that of the OAR due to fewer items in the rule.

Materials and methods

Study design and setting

A double randomised (both for first observer and for first rule applied), single-blinded (radiologist), controlled, interobserver trial was performed between November 2013 and August 2014. This monocentre study was conducted in the ED of an urban teaching hospital (patient census 30,000 visits/year). Randomisation occurred by the drawing of concealed envelopes. The study protocol was approved by both the regional and the local medical ethics committees as required in the Netherlands (registration number NL43168.094.13). The research project was carried out in accordance with the Declaration of Helsinki (2013) of the World Medical Association. Written informed consent was obtained from all study participants.

Selection of participants

Patients were eligible for the study when they had sustained a foot or an ankle sprain within 48 h prior to presentation in the ED. Included patients needed to be ≥ 18 years. Patients were excluded if they were unwilling to provide written informed consent, if the ankle sprain was part of a multitrauma, if there was a history of ankle or midfoot fracture on the ipsilateral side, and in case of substance abuse interfering with pain perception and in case of mental or physical disabilities, which could lead to an unreliable

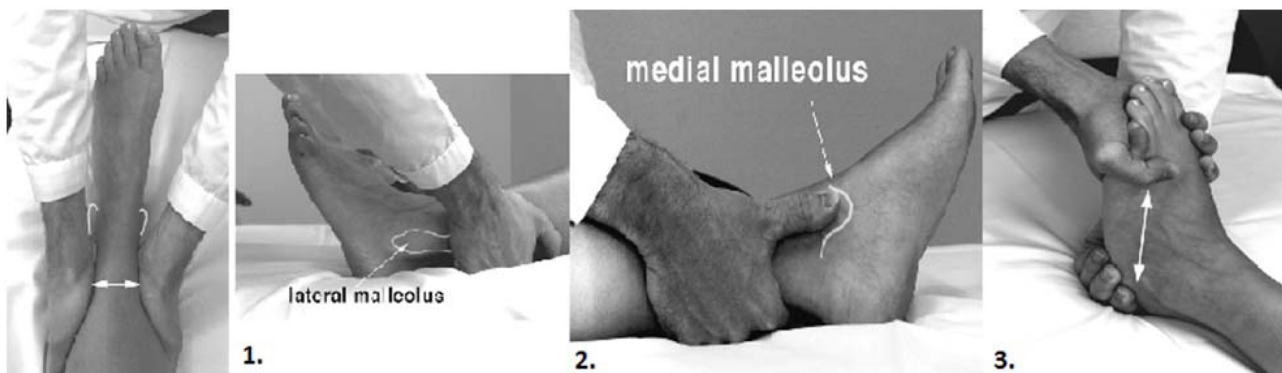


Fig. 2. The Bernese ankle rule. The rules are positive and indicate the need for radiography if one of these steps caused pain. (1) Indirect fibular stress: the malleolar fork is compressed approximately 10 cm proximally to the fibular tip. (2) Direct medial malleolar stress: the thumb is pressed flat on the medial malleolus. (3) Compression stress of the midfoot and the hindfoot: one hand fixes the calcaneus in a neutral position and the other hand applies a sagittal load on the forefoot, so that the midfoot and hindfoot are compressed.

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