

Observational Study to Assess the Potential of Reducing the Rate of Ankle X-Rays in Emergency Departments by Training Frontline Staff in the Ottawa Ankle Rules



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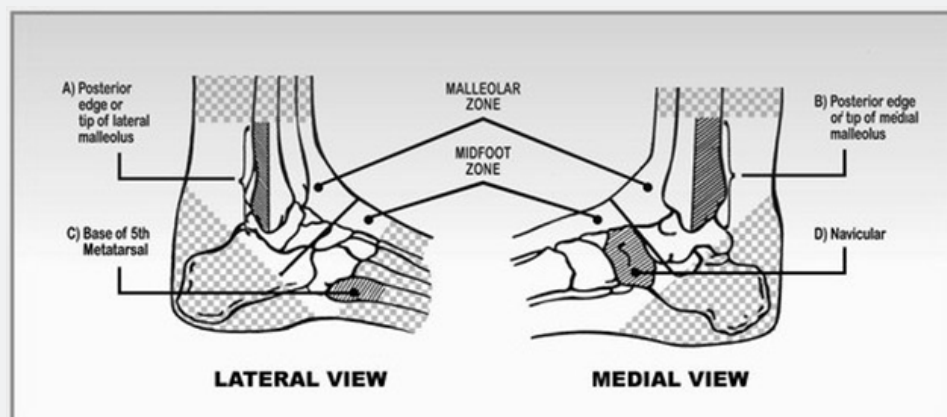
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Introduction

Ankle injuries, particularly inversion injuries are frequent presentations to Emergency Departments (ED) [1]. The majority of these patients routinely undergo an ankle x-ray [2,3] although it is well established that less than 15% of these patients sustain fractures [2]. These routine ankle radiographs represent a sizeable workload on radiology departments, they can cause increase in patients' waiting-times and have negative implications on available resources.

The Ottawa Ankle Rules (OR) (Figure 1) exists as a screening tool to safely identify those injuries that carry a low risk for ankle

fracture and do not need radiographic confirmation. Routine application of these is highly accurate to rule out a fracture and they create "a safe, cost effective and reliable approach to assessing injured ankles with impressive accuracy" [3]. The rules have been validated in a number of settings [4-8], including a small UK study from 2003 [9]. They have a sensitivity that approaches 100% but variable or low specificity. The reduction in x-ray requests following application of the rules is shown at 25% with a corresponding reduction in ED waiting-time, better use of resource and cost savings [6].



- a) An ankle x-ray series is only required if there is any pain in malleolar zone and any of these findings:
1. Bone tenderness at A
- OR
2. Bone tenderness at B
- OR
3. Inability to bear weight both immediately and in ED
- b) A foot x-ray series is only required if there is any pain in midfoot zone and any of these findings:
1. Bone tenderness at C
- OR
2. Bone tenderness at D
- OR
3. Inability to bear weight both immediately and in ED

Figure 1: Ottawa Ankle Rules for use in acute ankle injuries Stiell et al. [5].

A recent survey in Australia showed good uptake in emergency departments. The overall reduction in x-ray requests was less impressive (8.6% in a tertiary hospital; 12.5% in a community setting) although still highly significant ($p < .001$ at both sites). The same authors undertook a baseline audit to identify barriers to implementation in the ED and these fell into three main areas:

- i) Fear of missing a fracture and lack of confidence to exclude without radiography;
- ii) Perceived obligation to order a radiograph based upon patient expectation;
- iii) Organizational issues in ED (high staff turnover, shift patterns and direct x-ray access without assessment at busier times) [10].

This study examined the potential to reduce inappropriate ankle X-ray requests in a busy accident and emergency department in East London by training the staff in the Ottawa Ankle Rules and introducing a specially designed sticker-proforma to aid their application and documentation. The impact of documentation and differing ankle injury mechanisms (inversion versus fall/trauma) was also registered.

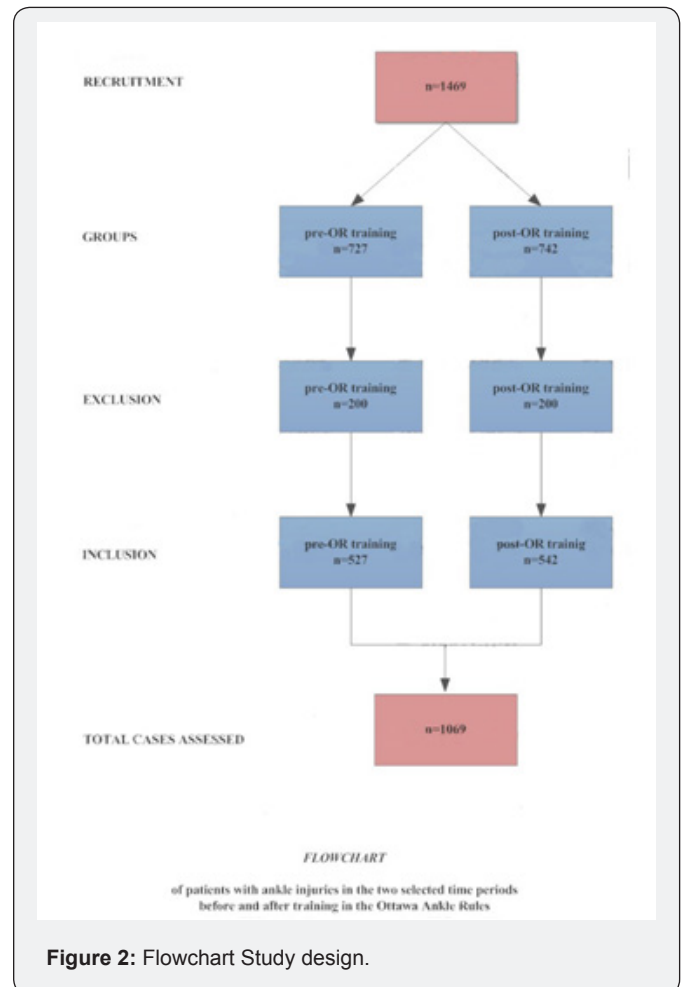
Methods

ED frontline staff members, both doctors and triage nurses, at Whipps Cross University Hospital in London were invited to attend for formal training in the OR. These sessions were carried out over a six-week period by the lead physician (SD). They constituted a 30 minute lecture with demonstration, a prior assessment of understanding and use of the rules with re-assessment after training. Specifically, staff was asked to record if they are familiar with and have confidence to apply the rules in routine work and if they understand what the rules seek to convey. Following training staff members were asked to record application of the rules in the clinical notes either in bold print as "Ottawa rules (OR) applied" or by inclusion of a pre-designed OR sticker. All staff signed informed consent for training without any impact on further training or evaluation and the study was approved by the ED and the regional ethical committee.

A three month period (February-April 2010) prior to training was compared with the three months after training and implementation (February-April 2011). All ED case notes for ankle injury or sprain, ankle fracture or a fall onto the ankle were included in the survey. Patients under 16 years of age were excluded.

A retrospective analysis of the case notes was applied. Data collection included classification of the method of ankle injury, documentation of the OR, x-rays performed, existing fracture site as well as frontline staff role (junior doctor or nurse). All x-rays were reviewed independently by a senior radiologist

unaware of the study. A total of 1469 notes of patients with ankle injuries were assessed out of which 1069 were included in the two periods of the study, 527 a year prior to the OR training and 542 in the three-months following the OR training (Figure 2). All patients meeting the inclusion criteria were assessed whether or not the rules had been applied at their assessment.



A chi-squared test was used to attest the primary hypothesis that the application of the OR will increase after formal training of staff members and that this will subsequently lead to a reduction in the number of requested ankle radiographs.

Results

A total of 51 staff members received training in the OR. Prior to training basic knowledge of the rules was very poor. Only 35% of those attending training had any prior knowledge of these rules and only 1 person could accurately describe their aim. Participants' rating of their confidence in knowledge and application of the rules was significantly higher after training (chi-square $p = .002$ in both cases). Baseline awareness of the rules and confidence to apply them, as stated by individual staff members before and following the training session is presented in (Figure 3).

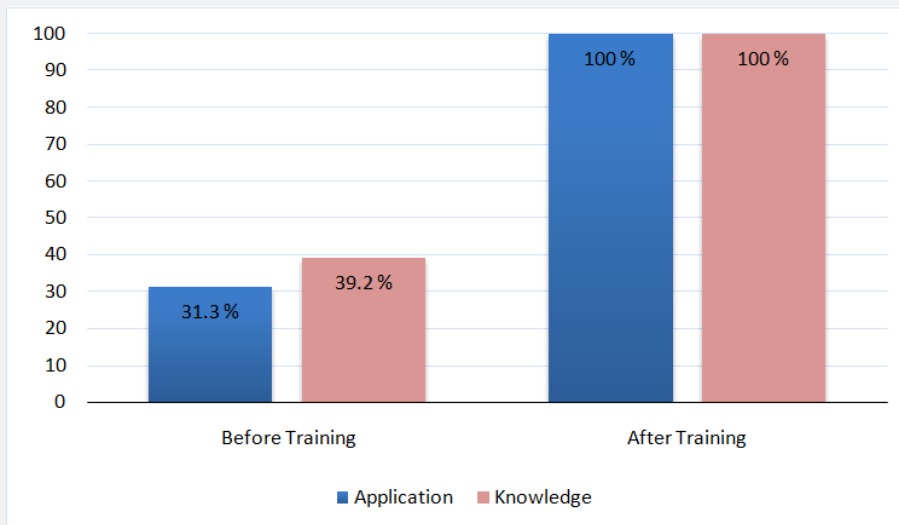


Figure 3: Knowledge and confidence in use of the Ottawa Rules before and after training.

It was noted that during the training period there was a structural reorganization within the ED that may have precluded more staff attending. There was also a high proportion of bank/agency staff in the department at all times. These factors could constitute as factors of bias and limitations of the study.

There were no statistically significant differences in gender, ethnicity (chi-square) or age (t-test) of the patient cohorts before or after training (Table 1). A total of 1469 patients with ankle injuries were identified in the two study-periods. 200 in each

group were excluded from the final analysis. These exclusions were based on the following criteria: less than 16 yrs. of age (125), incorrect coding (no ankle injury documented in the case notes (42), missing notes (25), patient did not wait for treatment (6), re-attendance with known ankle fracture (2). 99% (95% confidence interval (CI) 97.2, 99.4) of the pre-training cohort were referred for radiography. The overall referral rate was still high for the post-training cohort at 88% (95% CI 85.0, 90.5). This reduction though numerically small was statistical significant (chi-square $p < .0001$) (Figure 4).

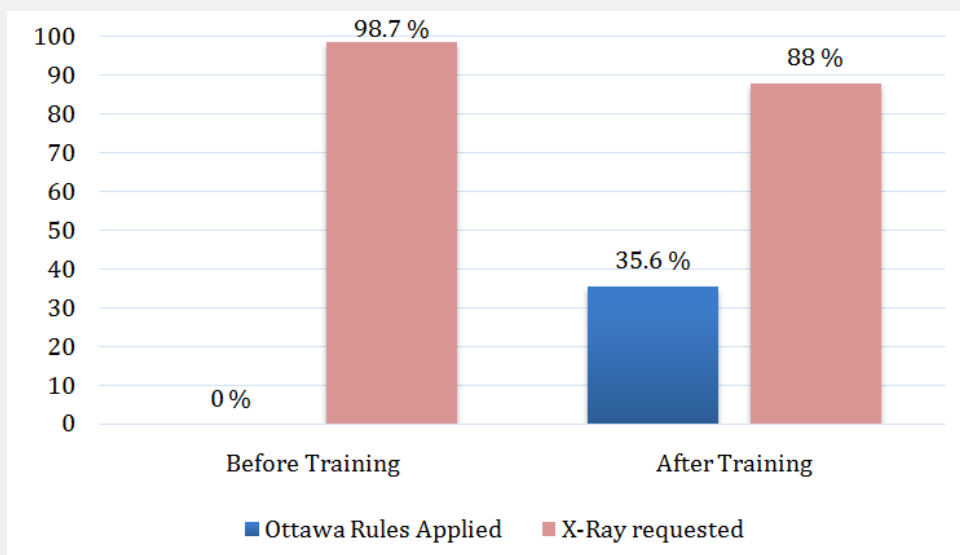


Figure 4: Application of Ottawa Rules before and after training and frequency of x-ray requests ($p < .0001$).

Table 1: Baseline characteristics.

	Pre- OR Training	Post- OR Training
Included in study	527	542
Male sex of patients	54%	58%
Age of patients – mean (SD)	35% (15.5)	35% (15.2)

Ethnicity of patients: White UK/European	45%	49%
Exclusion criteria		
a. Incorrectly coded - no documented ankle injury	36	42
b. Missing notes	31	25
c. Patient did not wait for treatment	3	6
d. Re-attendance with known ankle fracture	0	2
e. Aged < 16yrs	132	125

In these 193 cases the X-ray request was 76% (95% CI 69.1, 91.2), significantly lower than the 95% (95% CI 92.0, 96.7) who had radiographs where there was no evidence of application of the rules (chi-square $p < .0001$).

Application of the Ottawa Rules was documented in the notes for 193 patients (36%) in the after training cohort (91 by doctors, 93 by nurses, 9 not known), and 0% before training (Figure 4). 8 patients had an X-ray despite documentation that the OR indicated otherwise. In 6 of these cases the reason was not recorded but in one case there was a specific orthopedic instruction and in another a specific GP request.

On review of the notes, it was possible to retrospectively identify 762 patients across both cohorts for whom the OR would have indicated a requirement for radiography and in 158 (21%, 95% CI 18.0, 23.7) of these cases a fracture was confirmed on X-ray.

Discussion

The study shows that ED staff in the UK can improve their understanding of the OR with local training in the short term. The uptake and formal documentation of the rules in the ED following training was only modest (36%) and the overall reduction in referral for radiographs was numerically small (10%) but still significant ($p < 0.001$). These findings were similar to the ones presented in a comparison study conducted in Australia [10] and showed the high sensitivity of the OR featured in all previous studies.

There is an evolving culture to “risk stratify” patients within EDs to allow confident and more predictable management pathways. In theory this should reduce overall risk and it is expected to be applied by frontline staff. The risk stratification pathways often use a numerical prediction tool such as the GRACE/TIMI scores for mortality risk in unstable angina [11], CHADS2 score for stroke prevention in atrial fibrillation [12], and ABCD2 score for transient ischemic attack mortality. [13] Such prediction tools are often accompanied by a local management guideline based on the score achieved. These tools measure hard numerical end points such as presence of co-morbidities or a hemodynamic value and are easy to apply. The Ottawa Ankle Rules are different as a degree of clinical interpretation is necessary to safely apply them. The assessor is required to make a clinical decision about the patient’s ability to take four steps, is requested to identify four anatomical sites and identify tenderness on palpation at those sites. This decision can later be found incorrect. The fear of misdiagnosis and possible individual

litigation cannot be easily discounted in this process. Bessen et al. [10] in Australia audited potential barriers to implementation of the Ottawa rules and they identified that staff remained reluctant not to X-ray for fear of missing ankle fractures.

Nonetheless the main advantage of the OR remains its high sensitivity. If applied correctly there is no risk of missing a fracture. The disadvantage is its low specificity and the clinical responsibility placed on the individual using it. High sensitivity at the expense of low specificity generally acts to improve safety. In the case of the OR our study shows that this limits its use and may become cost prohibitive as it only leads to a small reduction of performed radiography. This finding is consistent with outcomes of previous studies [14,15].

There are additional factors that could influence uptake of the rules in ED. Training of front line staff members may be relevant and most studies do not record experience of staff members. We have shown that a better understanding of the rules and higher confidence to apply them follows a training program but the subsequent uptake remains poor. Of note is that not all staff working in the studied time-frame of three months was trained and this likely altered the outcome. Better uptake may require a universal ED acceptance of the rules as the primary assessment tool for ankle injuries to determine the need for radiography. Front line staff tasked to use these rules must be confident that they are fully supported following training and individual criticism for potential missed fractures would not generally apply. This is the natural end point of our survey and our aim is to fully implement the OR on our site.

Conclusion

The Ottawa Ankle Rules represent a reliable tool to prevent routine radiography following ankle injuries in an emergency setting. Training of medical professionals is simple however routine implementation proves to be difficult leading to a modest reduction in unnecessary radiography. Brief clinical assessment and judgment is required alongside training to safely apply these rules. As such widespread acceptance and use in the UK is only attainable if they are adopted as a benchmark tool for screening ankle injuries with full support within emergency departments and hospital hierarchy.

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