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ORIGINAL ARTICLE

Ottawa Ankle Rule: An Indian Perspective

[1]Sudhir Singh, [2]Dharmendra Kumar, [3]Alok Kumar Yadav

ABSTRACT

Introduction: Foot and ankle injuries are common clinical conditions treated by orthopedic surgeons accounting for 6 to 12% of the patients seen in emergency. Currently, almost all patients with foot and ankle injuries undergo radiographic examination to exclude fractures; however, fewer than 15% of these patients actually have fractures, thus, most of these radiographs are unnecessary. Unwarranted radiographic examination increases the demands on the healthcare system and also results in prolonged patient waiting times. Ottawa ankle rule (OAR) evolved to reduce the number of radiography and waiting time for patients in emergency department by excluding fractures using only clinical examination. Although, it has good sensitivity but it has not been much popular and not included in medical curriculum.

Aim: The aim of the study is to implement the OAR in an Indian tertiary care trauma setup with two different levels of clinical examiners (1st year postgraduate junior resident and senior resident) and report the finding.

Materials and methods: This prospective study was done in the Department of Orthopedics, for a period of 15 months. Clinical examiners were shown and given a video presentation about the OAR and a printed copy of the rules were provided to all. Clinical diagnosis of both levels of clinical examiners were evaluated and analyzed.

Results: Three hundred cases met our inclusion criteria. In first clinical examination done by junior resident, 115 clinically significant fractures were suspected while senior resident suspected 69 fractures. Radiography showed 5 cases with missed fractures. Accuracy of OAR by JR is 82.33% and by SR is 97.0%.

Conclusion: Ottawa ankle rule are very effective and can identify all clinically relevant fractures of ankle and foot with increased accuracy and sensitivity when applied by a trauma specialists. Although, these rules can also be applied by general doctors so as to help them to screen patients who need radiography in acute ankle injury, but it is more sensitive when it is applied by specialist doctor.

Keywords: Clinical decision rules, Ottawa ankle rule, Ankle injury.

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[1]Head, [2]Assistant Professor, [3]Junior Resident

[1-3]Department of Orthopedic Surgery, Era's Lucknow Medical College, Lucknow, Uttar Pradesh, India

Corresponding Author: Sudhir Singh, Head, Department of Orthopedic Surgery, Era's Lucknow Medical College Lucknow, Uttar Pradesh, India, Phone: 8799544905, e-mail: susi59@live.in

INTRODUCTION

Ankle injuries are one of the commonest sports injuries and extremity complaints presenting to the emergency department.[1] Although, generally benign, 20% or more of these injuries may have prolonged morbidity. It is thus, incumbent on the emergency physician to diagnose accurately and treat appropriately those patients who have presented with ankle injuries.[2] Usually less than 15% of patients with blunt trauma ankle have clinically significant fracture.[2-7] Emergency physicians order radiography for nearly all ankle injury patients, and typically 85% of these examinations are negative for fracture.[8] Low cost-high volume tests, like plain radiography contributes nearly as much to the rising healthcare costs as high technology—low volume procedures.[9] Clinical decision rules have evolved because of ever increasing population loads on emergency services, steadily increasing treatment costs and with the aim of providing quality primary healthcare to maximum number of people attending emergency, as efficiently as possible. The aim of any clinical rule is to provide correct and quick diagnosis with minimum investigations done in an emergency setup without missing a diagnosis. The clinical rule regarding ankle injuries is known as Ottawa ankle rule (OAR). Ottawa ankle rules was developed in Canada after many phases of trials, validation, implementation and has shown very good results in detecting fractures in malleolar zone and mid-foot zone.[10-13] Ottawa ankle rule has been used to reduce the need of radiography in detecting a clinically relevant fracture in mid-foot and ankle without missing a fracture, thus, leading to reduction in healthcare costs.[13-18] Also, there some reports in literature which does not favor implementation of OAR.[19-22] Ottawa ankle rule is basically designed to be used by paramedical workers (ENPs, NPs and ESPs) and general doctors in an emergency or a rural setup. Many different level of paramedical workers like:

- Primary care physicians (general practitioners, family physicians, pediatricians, general internist and geriatricians);
- Primary care nurses (nurse practitioners, clinical nurse specialists or advanced practice nurse;
- Emergency care (emergency physicians, emergency doctors, emergency care nurse
- Extended scope physiotherapist (ESP) have been used to implement OAR in various setup in many countries. The advantages cited are:
- Reducing the number of patients needing radiography,

- Reducing the cost of treatment,
- Reducing time spent by the patients in the emergency department,
- Reducing load on specialist doctors who are overloaded. It has been argued that to overcome the constrained supply of specialists in many rural or remote areas, the paramedical workers like nurses or physicians dealing in trauma emergency cases be trained to apply OAR. Many studies have recommended the use of triage nurses to implement OAR[23-26] while some others have not been so enthusiastic about it.[27,28]

AIMS OF THE STUDY

The aim of this study was to implement the OAR in an Indian tertiary care trauma setup with two different levels of clinical examiners (1st year postgraduate junior resident and senior residents) and report the findings.

MATERIALS AND METHODS

This prospective study was conducted in the orthopedics department of a medical college of north India from June 2013 to August 2014. We implemented clinical decision rule for ankle known as OAR in the all consecutive patients reporting to us with the complaint of ankle sprain or twisting of the foot during the study period. Acute ankle injury was defined as any painful ankle resulting from trauma.[29] Patients below the age of 18 years or those referred with the radiographs, pregnant females, those unable to walk (polytrauma patients, comatose patient, head injury), those with open ankle injuries and injury more than 1 week old were excluded from the study.

Ankle is usually involved in common twisting injuries and is broadly subdivided into malleolar and midfoot zones (Fig. 1). Zones are defined to include the following structure and their overlying soft tissues. Ankle was defined as the malleolar area and the foot area:[29]

Malleolar zone: Distal 6 cm of tibia and fibula and talus.

Midfoot zone: Navicular, cuboid, cuneiform, anterior process of calcaneus and base of 5th metatarsal. Body and tuberosity of calcaneus were not included.[10]

All junior residents and senior residents of orthopedics department were shown and given a video presentation about the Ottawa clinical rule for ankle and a printed copy of the rules were provided to all. Posters with descriptions were placed in emergency room and out-patient department for ready reference. All patients of suspected ankle sprain were examined first by junior residents of orthopedics department on duty as per OAR method and a clinical diagnosis was reached. The clinical findings and the clinical diagnosis were recorded in a performa. The patients were then again re-examined by a senior resident of orthopedic department, on the same visit, who was blinded to clinical findings and the clinical diagnosis of the first examiner (junior resident). Senior resident made his own clinical diagnosis, which was also recorded and initiated the treatment as per OAR. The radiographs were ordered only for those cases in who required a radiographic assessment as per decision rule. The radiographs were assessed and reported independently by a radiology consultant who also was blinded for clinical findings and the clinical diagnosis of both the examiners. The radiographic diagnosis was also recorded. Patients in whom no radiography was done were asked to report back after 5 days and meet the senior resident who had earlier done the second clinical examination. Patients were re-examined and results in terms of bony tenderness, pain and walking ability were noted. Patients who did show a marked clinical improvement were assumed as not to have a missed fracture. At this stage, the difference between clinical and radiological diagnosis, if any, was also recorded and treatment modified if required. Those who did not show a marked improvement in pain and increase in walking ability were asked to visit again after further 5 days and second re-examination was done. Patients who satisfied

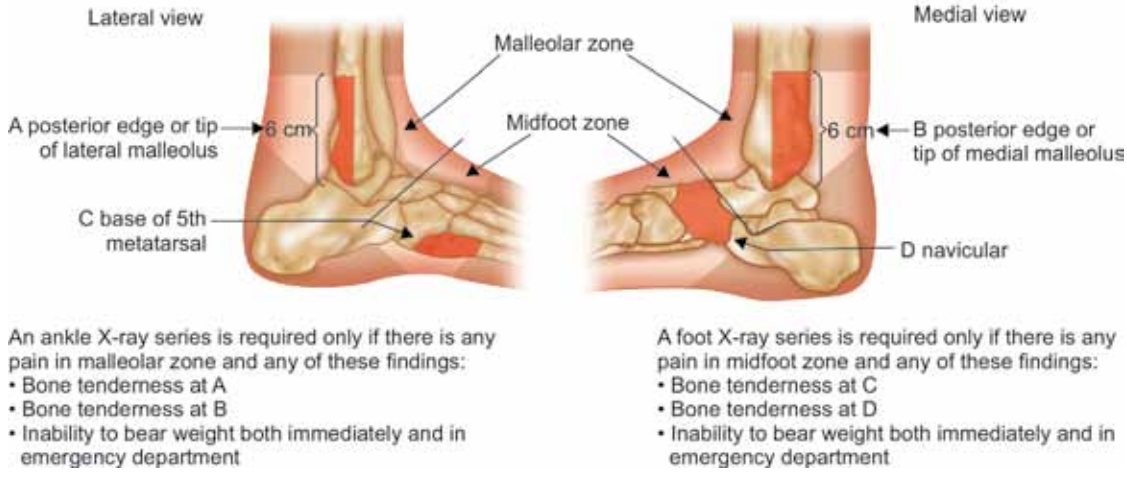

Fig. 1: Showing specified zones

these criteria were assumed as not to have a fracture. Any change in treatment plan, if any was decided by the senior resident in his follow-up examination of the patients. Time spent in the emergency department by the patient, total money spent by the patient, including treatment and transportation cost was recorded. All the data obtained (Clinical examination data, diagnosis and radiographic diagnosis) were predetermined form and analyzed statistically. The data were analyzed using SPSS (software version 17.05). We calculated the specificity, sensitivity, positive predictive value and negative predictive value and accuracy of OAR.

RESULTS

There were 328 cases with ankle injuries reporting to us. There were 300 cases that met our inclusion criteria and included in this study. There were 184 (61.3%) males and 116 (38.7%) females cases. The age ranged from 18 to 68 years (mean age: 34.76 years). Out of 300 cases 131 cases (77%) were below 41 years of age and mean body mass index (BMI) was 24.4 (±2.48) Kg/m.^{2}

The injury was sustained in outdoor activity in 187 (62.3%) cases and household activities in 113 (37.7%) cases. The time interval from the time of injury and reporting to us varied from 3 hours to 4 days with a mean of 1.72 days.

In first clinical examination done by orthopedics junior residents examined 300 cases and suspected fractures in 115 cases. The second clinical examination was done by a senior resident irrespective of the clinical finding and diagnosis of first examiner. He suspected fractures in only 75 cases out of 300 cases. Radiographs confirmed only 67 fractures in cases examined by junior residents and in 69 fractures in cases examined by senior residents. Rest of 225 cases, where no fracture was suspected, were asked to visit on 5th and 10th day for second clinical examination and radiography if required. Subsequent visits on 5th and 10th day showed that first examiner (junior residents) has missed 5 fractures on clinical examination while senior resident missed 3 cases of fracture in his clinical examination. These 5 fractures were diagnosed later in the subsequent visits on 5th and 10th day. Those who suffered a fracture were older (mean age: 54.3 years) than those who did not have a fracture (mean age: 51.7 years). The Ottawa ankle rule clinically identified 67 fractures when applied by junior residents and 69 fractures when applied by senior residents.

Ottawa ankle rule when done by senior residents show much improved statistical results especially specificity, positive predictive value and accuracy (Table 4). Radiography was not required in 74% cases (222/300 cases). The time saved in emergency department by cases not needing radiographs was about three quarters of an hour (mean 39.41 min). Those 222 cases that did not require radiographs saved the hospital a sum of Rs-44400/-(727 USD).

DISCUSSION

Inspite of very good results shown over last three decades, OAR has not gained much popularity nor has been included in any orthopedic text book or teaching protocols in medical colleges. We did an extensive internet search but found only one study done in India reporting the results of application of clinical decision rule in ankle injuries.[30] There is another study which has used another clinical method of assessing acute ankle injury in patients (n = 50 cases).[31] Ottawa ankle rule has not been adopted by most of the hospitals, especially in Indian subcontinent. This study was conducted with the aim of validating and implementing the OAR in a tertiary care setup in an Indian teaching hospital. In Indian subcontinent, nurses and physiotherapist or any other paramedical staff are not allowed to examine a patient, reach a diagnosis or order investigation including radiograph. But a general physician working in an emergency setup or in rural/remote area can use this rule to diagnose an ankle injury.

Extensive internet search on medical literature did not reveal any study reporting the results of OAR application done by doctors of trauma care department of two different levels of training and expertise (specialist trainee and specialists). The clinical acumen and expertise of a first year junior resident can be taken as an equivalent to an emergency physician (EP) or a medical officer (MO) while senior resident is a freshly trained and certified trauma care specialist. Hence, in our study we have implemented OAR with first year postgraduate trainee students (junior resident) and with specialists (senior residents) in orthopedic surgery department and have compared our results.

The results show that junior residents had suspected 115 clinically relevant fractures in 300 cases reporting to us with ankle injury but the fractures were shown in only 67 cases, which gave a sensitivity of 93.06% (Table 1). These cases were re-examined by senior residents on the same day they suspected fracture in only 73 cases, thus, increasing sensitivity to 95.72%. Decrease in number of patients needing radiography from 115 to 75 led to increase in sensitivity levels. Thus, by changing the clinical examiner has indirectly changed the level of competence of examiner. More the clinical competency and the expertise of the examiner, more is the sensitivity. This has been shown by other studies also.[27,28] In the remaining 185 cases in whom the junior resident did not suspect a fracture and not ask for radiography showed fractures in 5 cases at subsequent follow-up re-examination done by senior resident. This gave a negative predictive value of 97.03% and an accuracy of 82.33% (Table 2).

The cases were again examined by senior residents on the same day irrespective of the clinical finding or diagnosis of junior residents. They suspected fractures in only 73 cases and 67 of these had fractures as shown by

Table 1: The fractures diagnosed on clinical and radiological examination

	Clinical diagnosis		*Radiological diagnosis*	
Suspected fractures	*Junior resident (1st Clinical examination)*	*Senior resident (2nd Clinical examination)*	*Positive*	*Negative*
Medial malleolus	18	13	11	07
Lateral malleolus	26	17	15	11
Both malleolus	20	11	11	09
Base of 5th metatarsal	26	16	16	10
Navicular	12	09	06	06
Any other point	13	09	08	05
Total	115	75	67	48

Table 2: Ottawa ankle rule results with junior resident as clinical examiner

Clinical examination	*Total*	*Radiological diagnosis*	
		Fractures (+)	*No. fracture (−)*
Radiography required (+)	115 (a + b)	67 (a)	48 (b)
Radiography not required (−)	185 (c + d)	5 (c)	180 (d)
Total	300	72 (a + c)	228 (b + d)

Sensitivity: 93.06%; Specificity: 78.95%; PPV: 58.26%, NPV: 97.30%; Accuracy: 82.33%

radiography (Table 1). In rest of the 224 cases in whom no radiographs were ordered and treated as per his clinical diagnosis alone, showed fractures in 3 cases in first or second follow-up examination. This gave a sensitivity of 97.71%, specificity of 97.39%, positive predictive value of 91.78%, and negative predictive value of 98.68% with an accuracy of 97.07% (Table 3). The efficacy of OAR especially in terms of specificity, PPV and accuracy was increased by replacing a more skilled person (senior resident) with a less skilled and trained person (junior resident) as the clinical examiner. Studies in which OAR was applied by nurse practitioners (NP) and emergency physicians show that sensitivity and specificity both improve when clinical examiner is a physician.[28,32] Similarly, in a study done in a sports injury center in Greece showed excellent sensitivity (100%) when performed by an orthopedic resident.[32] Yet another study done in Greece also showed a high sensitivity (94.12%) but a low specificity (37.65%). The results of our study are matching with both of the Greek studies. Furthermore, our study also shows that all parameters of statistical analysis are improved when the rules are applied by trained trauma physicians especially the specificity, positive predictive value and accuracy (Table 4). In this study, we have shown the usefulness of OAR for excluding fractures of ankle and midfoot in patients presenting to us with an acute ankle sprain.

The reason of OAR not becoming popular with general medical doctors can be:

- Lack of awareness and dissemination of usefulness of OAR
- The medicolegal aspect of missing a fracture using relatively newer diagnostic criteria as compared to the established technique of X-ray
- Patients insisting on radiography
- Availability of free treatment and hence, lack of treatment-cost concerns. One study has shown that medical practitioners continue to use OAR after the concept of OAR has been introduced to them.[33] But other study has also shown that the impact on clinical behavior of the clinicians remains less, even when they very well receive the information regarding the advantages of using the widely accepted clinical decision OAR.[19] An active plan to implement the use of OAR is necessary to encourage physicians to adopt clinical guidelines. We believe that multicenter large studies to be conducted and evaluated by experts and health policy makers. If encouraging results are found then OAR should be considered for inclusion in course curriculum of orthopedics at graduation level.

CONCLUSION

We conclude that OAR are very effective and can identify fractures of ankle (mid-foot and malleolar zone) without

Table 3: Ottawa ankle rule results with senior resident as clinical examiner

Clinical examination	*Total*	*Radiological diagnosis*	
		Fractures (+)	*No. fracture (−)*
Radiography required (+)	75 (a + b)	69(a)	6 (b)
Radiography not required (−)	225 (c + d)	3 (c)	222 (d)
Total	300	72 (a + c)	228 (b + d)

Sensitivity: 95.83%; Specificity: 97.36%; PPV: 92.0%; NPV: 98.67%; Accuracy: 97.0%

Table 4: Diagnostic efficacy of OAR between junior resident and senior resident

	OAR by JR	*OAR by SR*
Sensitivity	93.06%	95.83%
Specificity	78.95%	97.36%
Positive predictive value	58.26%	92.0%
Negative predictive value	97.30%	98.67%
Accuracy	82.33%	97.0%

missing on a fracture (high sensitivity and specificity). Statistical parameters especially specificity, positive predictive value and accuracy improves significantly when a trained trauma specialist applies OAR. These rules can also be applied by general doctors so as to help them to screen patients who need radiography in acute ankle injury. This would help in reduction of number of referral of patients to tertiary healthcare center and need for radiography and radiation exposure.

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