The Professional Medical Journal
www.theprofesional.com

DOI: 10.17957/TPMJ/17.4124

ORIGINAL PROF-4124

ANKLE AND MIDFOOT FRACTURES;
DIAGNOSTIC ACCURACY OF OTTAWA RULES

1. FCPS (Ortho),
Associate Professor,
Department of Orthopedics
Lady Reading Hospital, Peshawar.
2. FCPS (Ortho)
Trainee Registrar,
Department of Orthopedics
Hayatabad Medical Complex
Peshawar.
3. MRCS (UK), FCPS (Ortho),
Assistant Professor,
Department of Orthopedics
Lady Reading Hospital, Peshawar.
4. MBBS
Trainee Medical Officer,
Department of Orthopedics
Hayatabad Medical Complex
Peshawar.
5. PhD
Assistant Professor,
Khyber Medical University
Peshawar.

Correspondence Address:
Dr. Muhammad Inam
Assistant Professor,
Department of Orthopedics
and Trauma Medical Teaching Institute
Lady Reading Hospital, Peshawar.
dr_mohammadinam@yahoo.co.uk

Article received on:
15/06/2017
Accepted for publication:
15/09/2017
Received after proof reading:
03/11/2017

Mohammad Shabir[1], Shahid Iqbal[2], Muhammad Inam[3], Arif Shehzad[4], Ihsanullah[5]

ABSTRACT… Objectives: To determine the diagnostic accuracy of Ottawa rule in ankle and midfoot fracture keeping x-ray as gold standard. **Study Design:** Descriptive study. **Setting:** Department of Orthopedics, Lady Reading Hospital Peshawar. **Period:** June 2014 to May 2016. **Materials and Methods:** Through a Cross Sectional Study Design, a total of 175 patients presenting with suspicion of ankle/mid foot fracture were selected in a consecutive manner from the OPD and subjected to detection of fracture through Ottawa Ankle Rule followed by X-ray to confirm the diagnosis of fracture. **Results:** The mean age group of patients in our study was 36.1+10.4 years. There were 85.7% males and 14.3% were females. The sensitivity analysis shows OAR has a sensitivity of 81.2% and specificity 61.9%., positive predictive value of the OAR is 79.1% and negative predictive value is 65.0% keeping X-ray as a gold standard. **Conclusion:** The overall sensitivity and specificity of the OAR lies within an acceptable range in our local population however, we still recommend further research work over it before recommendations as a routine screening test for the fracture of ankle or mid foot.

Key words: Ottawa Ankle Rule, Fracture, Ankle, Foot, X-ray.

Article Citation: Shabir M, Iqbal S, Inam M, Shehzad A, Ihsanullah. Ankle and midfoot fractures; Diagnostic accuracy of ottawa rules. Professional Med J 2017;24(11):1680-1684. **DOI:**10.17957/TPMJ/17.4124

INTRODUCTION

Ankle fractures are one of the most common fractures that are presented in the casualty. Approximately 10% of all fractures are ankle fractures.[1] It can cause significant morbidity in population.[2] External rotation, twisting force that causes the talus to rotate externally is the usual mechanism of injury.[3] Ankle injury after ankle sprain is the most common injury which also occurs with same trauma. The injury can be managed in a cast or a brace for about 6 weeks. Surgical fixation is required in about 50% of cases.[4] X-rays is the first investigation for diagnosis.[5] X-rays has been classified as a group 1 carcinogen by World Health Organization. If radiation hazards has to be reduce then either the exposure has be minimal or not to do X-rays.[6] Nowadays, most of the doctors prescribe X-rays to patients with foot and ankle injuries; but less than 15% have fractures. The rest of the patients were exposed unnecessary to radiation.[7]

To exclude the need of X-rays in ankle injuries there is an Ottawa Ankle rules.[8] The sensitivity, specificity, positive predictive value and negative predictive value of the Ottawa Ankle Rule (OAR) for diagnosis of ankle fractures were 96.8%, 45.8%, 48.4% and 96.5%, respectively.[9] The Ottawa Ankle Rules are clinical decision making questionnaire that is derived and validated by Stiell and his colleagues for diagnosis in acute ankle and midfoot injuries. If we use the Ottawa Rule in the adult population it has to decrease radiation exposure and at the same time will decrease in health care expenditures and wait time.[10,11] The objective of the study is to determine the diagnostic accuracy of Ottawa rule in ankle and midfoot fracture keeping x-ray as gold standard. There is paucity of local data available regarding Ottawa ankle rules and the available statistics are controversial with sensitivities ranging from 74.8% to 96% and specificities ranging from 45% to 68.6%. This study is therefore designed to validate the applicability of the Ottawa Ankle Rule

in our population and to compare the results with available data. Implementation of the rules would result in significant savings in healthcare costs and medical resources without compromising quality of care.

MATERIALS AND METHODS

This is a Cross-sectional validation study that has been conducted in Department of Orthopedic surgery Lady Reading Hospital Peshawar from June 2014 to May 2016 on 175 patients of either sex, aged fifteen to fifty years with presentation within ten days or trauma. Patients with open fracture, unconscious patients, patients with pre-existing musculoskeletal disease, patients with previous history of surgery, revisits for the same injury and late presentation, after 10 days, patients with gross deformity of the ankle or foot, patients with polyneuropathy and patients with multisystem trauma were excluded from the study. All patients presenting to outpatient department or emergency department with history of trauma and pain at ankle joint qualifying the inclusion and exclusion criteria was registered, was thoroughly examined and managed according to the protocol of ATLS. The purpose of the study was explained, written and informed consent was taken from all the patients. On registering the patient data (age, gender, mechanism of injury, and laterality, Annex A) ankle joint and foot was assessed for Ottawa rule and recorded. Prediction of fracture was calculated for each patient according to Ottawa rule and then radiograph of the ankle joint and foot anteroposterior and lateral views was advised. Radiograph was checked for any fracture. All the data was analyzed with the help of SPSS v17. Frequency and percentages were computed for categorical variables like gender, ankle evaluated. Mean and standard deviation was calculated for numeric variables. Sensitivity, specificity, positive and negative predictive value was calculated.

RESULTS

There were 33.7% patients age upto 30 years, 20% of patients between 31-40 tears and 46.3% patients between 41-50 years with mean age of the patients was 36.1+10.4 years (Table-I). According to gender, 85.7% were males and 14.3% were females (Figure-1).

Age (Years)	Frequency	Percent	Cumulative Percent
Upto 30	59	33.7	33.7
31 to 40	35	20.0	53.7
41 to 50	81	46.3	100.0

Table-I. Age-wise distribution of the sample (n=175)

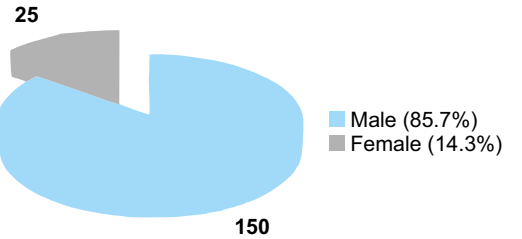


Figure-1. Gender-wise distribution of the sample (n=175)

The Ottawa Ankle Rule (OAR) was used as a screening test for the detection fractures of ankle or mid foot keeping X-ray as a gold standard. On presentation OAR was done on all patients with suspected ankle/mid foot fracture. The results obtained were that out of 175 patients, 64% had positive fracture and 36% had negative results (Table-II).

	Frequency	Percent	Cumulative Percent
Positive	112	64.0	64.0
Negative	63	36.0	100.0
Total	175	100.0	

Table-II. Fracture of ankle / mid foot on oar (n = 175)

Since X-ray was used as gold standard for the confirmation of fracture of ankle/mid foot, all patients after undergoing assessment on OAR underwent X-ray. On X-ray we found that fracture of the ankle/mid foot was seen in 65.7% of cases and negative in 34.3% of cases (Table-III).

	Frequency	Percent	Cumulative Percent
Positive	115	65.7	65.7
Negative	60	34.3	100.0
Total	175	100.0	

Table-III. Fracture of ankle mid foot on x ray (n = 175)

On applying the formulae for calculation, sensitivity of OAR was found to be 81.2% and

specificity 61.9%. The positive predictive value of the OAR is 79.1% and negative predictive value is 65.0% (Table-IV).

		Ankle/foot Fracture on X Ray		Total
		Positive	Negative	
Ankle/foot Fracture on Ottawa Rule	Positive	91	21	112
	Negative	24	39	63
Total		115	60	175

Table-IV. Cross-tabulation of ankle/foot fracture on Ottawa rule and ankle/foot fracture on X-Ray

Sensitivity: TP/TP + FN = 82.1%
Specificity: TN/TN + FP = 67.6%
Positive Predictive Value: TP/TP + FP = 84.2%
Negative Predictive Value: TN/TN + FN = 64.1%

DISCUSSION

The Ottawa Ankle Rule was developed for avoidance of unnecessary exposure to radiation. One study showed that Ottawa Ankle Rule is recognized the test tool, however its use was limited. Most of the doctors' objective is; diagnosis of missed fractures and therefore they want maximum sensitivity at all costs.[12]

It was showed that 80% to 98% of patients having ankle or foot injuries has to do X-rays during initial evaluation which shows less than 15% of fracture. This results in undue radiation exposure, increased health care costs and more waiting time for manangement.[13,14] Stiell et al[9] recommends radiography of the midfoot for patients with bone tenderness at the base of the fifth metatarsal, cuboid or navicular.

The purpose of Ottawa Ankle Rules was the high sensitivity for of detection of significant fractures. Stiell et al[9] has ignored the specificity (range = 26.3%–39.8%) in favor of high sensitivity. In our study, the sensitivity of OAR was found to be 81.2% and specificity 61.9%. The positive predictive value of the OAR is 79.1% and negative predictive value is 65.0%. Bachmann et al[15] showed accuracy of the Ottawa Ankle Rules by a quality systematic review of the literature.

There is evidence that OAR as an accurate clinical instrument to exclude fractures of the ankle. The OAR has a sensitivity of almost 100%.[16,17] The sensitivity of the OAR in our study was 81.2%. These results are similar to those reported in other studies.[18-21]

In another study reported by Dwivedi et al[22], 13 out of 81 cases has significant fractures. Sensitivity of OAR for detecting fractures was 100%. Study done by Leddy et al[17] shows 11 fractures. In his series of 132 patients, the Ottawa Ankle Rules had reduced the need for x-rays by 34%, which has sensitivity of 100%, and specificity of 37%. In another study report, OAR detected no injury in 17 patients without prior X-ray.[23] In a meta analysis it was concluded that, Ottawa ankle rules is an accurate tool for exclusion of fractures around the foot.[24]

A meta-analysis of 12 studies having 3,130 patients in which 671 fractures were identified which shows the prevalence of 21.4%. The sensitivity of OAR was 98.5% in that study. It suggest that the OAR can rule out a fracture around the foot.[25]

Pires et al[26] study showed thirteen percent fracture by OAR. The Ottawa ankle rules showed the sensitivity of 97.2%, specificity of 7.8%, positive predictive value of 13.9%, negative predictive value of 95% and accuracy of 19.9% respectively and as reported by Wang et al[27] reported that sensitivity, specificity, positive predictive value and negative predictive value of the OAR for detection of fractures of the ankle were 96.8%, 45.8%, 48.4% and 96.5%, respectively.

All these studies show that the Ottawa ankle rules have high sensitivity. It is an important tool in deciding for X-rays need in around the foot fractures and we strongly recommend the Ottawa ankle rules for ankle and foot injuries which reduce the need of unnecessary X-rays and additional expenses.

CONCLUSION

Ottawa Ankle Rule can be used as a first line technique for the assessment of patients suspected fractures around the foot as our study

showed it has an acceptable sensitivity and specificity. X-ray on the other hand carries risk of radiation and also not available specially in remote health facilities, but gold standard for the assessment of fractures of any kind.

REFERENCES

1. Van-der-Weert VS, Lieshout VA, De-Vries MR, Van-der-Elst M, Schepers T. **Determinants of outcome in operatively and non-operatively treated Weber-B ankle fractures.** Arch Orthop Trauma Surg 2012; 132(2):257–63.

2. Thur CH, Edgren GU, Jansson KA, Wretenberg PE. **Epidemiology of adult ankle fractures in Sweden between 1987 and 2004.** Acta Orthop 2012; 83(3): 276–81.

3. Mohammed R, Syed S, Metikala S, Ali SA, **Evaluation of the syndesmotic-only fixation for Weber-C ankle fractures with syndesmotic injury,** indian J orthop 2011;45(5):454-8.

4. Beckenkamp PA, Lin CC, Herbert RD, Haas MA, Khera KR, Moseley AN. **Exercise or advice after ankle fracture. design of a randomised controlled trial.** BMC Musculoskelet Disord 2011; 12:148.

5. Jarraya MO , Hayashi DA, Roemer FR , Crema MI, Diaz LU, Conlin JA, et al. **Radiographically occult and subtle fractures. A pictorial review.** Radiol Res Pract 2013; 2013:370169.

6. Mettler FR, Brenner DA, Coleman NO, Kaminski JO, Kennedy AN, Wagner LO. **Can radiation risks to patients be reduced without reducing radiation exposure? The status of chemical radioprotectants.** Am J Roentgenol 2011; 196:616-8.

7. Wang X, Chang SM, Yu GR, Rao Z. **Clinical value of the Ottawa Ankle Rules for diagnosis of fractures in acute ankle injuries.** PLoS One.2013; 8(4):e63228.

8. Dowling SH, Spooner CH, Liang YU, Dryden DM, Friesen CA, Klassen TP, et al. **Accuracy of Ottawa ankle rules to exclude fractures of the ankle and midfoot in children: a meta-analysis.** Acad Emerg Med 2009; 16:277–87.

9. Stiell I. G., Greenberg G. H., McKnight R. D., Nair R. C., McDowell I., Worthington J. R. **A study to develop clinical decision rules for the use of radiography in acute ankle injuries.** Ann Emerg Med 1992; 21(4):384–90.

10. Beceren G.N, Yolcu S, Tomruk O, Atay T, Baykal Y.B. **Ottawa versus Bernese: which is better?** Eur J Trauma Emerg Surg 2013; 39:147-50.

11. Dowling SH, Wishart IA. **Use of the Ottawa Ankle Rules in children. A survey of physicians practice patterns.** CJEM 2011; 13(5):333-8.

12. Puntmann VO. **How-to guide on biomarkers: biomarkers definitions, validation and applications with examples from cardiovascular disease.** Postgrad Med J 2009; 85:538–45.

13. Cameron C, Naylor CD. **No impact from active dissemination of the Ottawa ankle rules: further evidence of the need for local implementation of practice guidelines.** CMAJ 1999; 160:1165–8.

14. Brooks SC, Potter BT, Rainey JB. **Inversion injuries of the ankle: clinical assessment and radiographic review.** Br Med J Clin Res 1981; 282(6264):607–8.

15. Bachmann LM, Kolb E, Koller MT, Steurer J, ter Riet G. **Accuracy of Ottawa Ankle Rules to exclude fractures of the ankle and mid-foot: systematic review.** BMJ 2003; 326(7386):417–23.

16. Leddy JJ, Smolinski RJ, Lawrence J, Snyder JL, Priore RL. **Prospective evaluation of the Ottawa Ankle Rules in a university sports medicine center: with a modification to increase specificity for identifying malleolar fractures.** Am J Sports Med 1998; 26(2):158–65.

17. Leddy JJ, Kesari A, Smolinski RJ. **Implementation of the Ottawa Ankle Rules in a university sports medicine center.** Med Sci Sports Exerc 2002; 34(1):57–62.

18. Auleley GR, Ravaud P, Giraudeau B, Kerboull L, Nizard R. **Implementation of the Ottawa ankle rules in France: a Multicenter randomized controlled trial.** JAMA 1997; 277:1935–9.

19. Yuen MC, Sim SW, Lam HS, Tung WK. **Validation of the Ottawa Ankle Rules in a Hong Kong ED.** Am J Emerg Med 2001; 19:429–32.

20. Knudsen R, Vijdea R, Damborg F. **Validation of the Ottawa Ankle Rules in a Danish emergency department.** Dan Med Bull 2010; 57:A4142.

21. Can U, Ruckert R, Held U, Buchmann P, Platz A. **Safety and efficiency of the Ottawa Ankle Rules in a Swiss population with ankle sprains.** Swiss Med Wkly 2008; 138:292–6.

22. Dwivedi R, Ale SB. **Evaluation of accuracy of Ottawa ankle rules for predicting fractures in acute ankle & midfoot injuries.** J Univ Coll Med Sci 2014; 2(2):2-5.

23. Van der Wees PJ, Hendriks EJ, Bruls V, Dekker J, de Bie

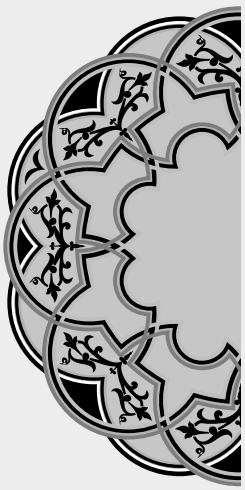
RA. **Applicability of the Ottawa Ankle Rules in primary care: results from a pilot study.** [Online]. [Cited on July 23, 2011].Available at http://scholar.google.com.pk/Applicability+of+the+Ottawa+ankle+rules+in+primary+care%3A+results+from+a+pilot+study&btnG=&as_sdt=1%2C5&as_sdtp.

24. Bachmann LM, Kolb E, Koller MT, Steurer J, Riet G. **Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review** BMJ 2003; 327(7405):17.

25. Dowling S, Spooner CH, Liang Y, Dryden DM, Friesen C. **Accuracy of Ottawa ankle rules to exclude fractures of the ankle and midfoot in children: A meta-analysis.** Acad Emerg Med 2009; 16:277–87.

26. Pires R, Pereira AA, Abreu-e-Silva GM, Labronici PJ, Figueiredo LB, Godoy-Santos AL, et al. **Ottawa ankle rules and subjective surgeon perception to evaluate radiograph necessity following foot and ankle sprain.** Ann Med Health Sci Res 2014; 4:432-5.

27. Wang X, Chang S, Yu G, Rao Z. **Clinical value of the Ottawa Ankle Rules for diagnosis of fractures in acute ankle injuries.** PLoS One 2013; 8(4):e63228.



"Truth is not diminished by the number of people who believe it."

Unknown

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Mohammad Shabir	Writing of manuscript & compiling resutls.	
2	Shahid Iqbal	Data collection & writing of manuscript.	
3	Muhammad Inam	Statistical analysis	
4	Arif Shehzad	Designing of project	
5	Ihsanullah	Guidance in writing the manuscript	