



# Application of the Ottawa Protocol by Medical Students and Orthopedic Residents on Ankle Sprains at a Trauma Hospital\*

## *Aplicação do protocolo Ottawa por estudantes de medicina e residentes de ortopedia em entorses de tornozelo em um hospital de trauma*

José Marcos Lavrador Filho<sup>1</sup> Paulo Henrique Vogt<sup>1</sup>  Alexandre Roberto Roman Coelho<sup>2</sup>  
Daniel Kyubin Cho<sup>2</sup> João Luiz Vieira da Silva<sup>2</sup> Patrick Willian Padoani<sup>3</sup> 

<sup>1</sup> Department of Orthopedics and Traumatology, Hospital do Trabalhador, Curitiba, PR, Brazil

<sup>2</sup> Department of Orthopedics and Traumatology, Universidade Federal do Paraná, Curitiba, PR, Brazil

<sup>3</sup> Department of Orthopedics and Traumatology, Clínica de Fraturas e Ortopedia XV, Curitiba, PR, Brazil

Address for correspondence Paulo Henrique Vogt, Departamento de Ortopedia e Traumatologia, Hospital do Trabalhador, Avenida Republica Argentina, 4406, Curitiba, PR, 81050-000, Brazil (e-mail: paulovogt90@gmail.com).

Rev Bras Ortop 2020;55(5):620–624.

### Abstract

**Objective** To verify the applicability and agreement of the Ottawa ankle rules applied by medical students and orthopedic residents in a tertiary trauma service thus validating the Ottawa protocol for use on Brazilian soil.

**Prospective** This was a prospective study, conducted in a tertiary hospital, including all patients with acute torsional trauma of the tibiotalar joint. The patients underwent ankle and/or foot radiographs, and the questionnaire with the Ottawa ankle rules was applied by academics and, subsequently, by residents. The radiographs were evaluated by on-call orthopedists and specialist in foot and ankle, and the expert opinion was considered the gold standard for analysis.

**Results** Two hundred and sixty-three patients were evaluated, and, after application of the established inclusion criteria, 226 cases remained for evaluation. The sensitivity to detect lesions and negative predictive value (NPV) was 100%. The most sensitive test with higher NPV for both academics and residents was palpation of the lateral malleolus. The study presented potential for a reduction of 30% in the total number of tests requested.

**Conclusion** The data showed applicability and agreement between academics and residents, which allows for the validation of the Ottawa protocol in emergency care in Brazil.

### Keywords

- ▶ sprain fracture
- ▶ ankle
- ▶ foot
- ▶ radiography

\* Work developed in the Orthopedics and Traumatology Service of the Hospital dos Trabalhadores, Curitiba, PR, Brazil.

## Resumo

**Objetivo** Verificar a aplicabilidade e a concordância das regras do tornozelo de Ottawa aplicadas por estudantes de medicina e residentes de ortopedia em um serviço de trauma terciário, validando assim as regras de Ottawa para utilização em solo brasileiro.

**Método** Estudo prospectivo, realizado em um hospital terciário, incluindo todos os pacientes com trauma torcional agudo da articulação tibiotársica. Os pacientes realizaram radiografias de tornozelo e/ou pé, tendo sido aplicado o questionário com as regras do tornozelo de Ottawa por acadêmicos e, na sequência, por residentes. As radiografias foram avaliadas por ortopedistas plantonistas e especialista em pé e tornozelo, sendo a opinião do especialista considerada padrão-ouro da análise.

**Resultados** Foram avaliados 263 pacientes e, após aplicados os critérios de inclusão estabelecidos, restaram para a avaliação 226 casos. A sensibilidade para detectar lesões e o valor preditivo negativo (VPN) foi de 100%. O teste mais sensível e com maior VPN para ambos, acadêmicos e residentes, foi a palpação do maléolo lateral. O estudo apresentou potencial de redução de 30% no total de exames solicitados.

**Conclusão** Os dados demonstraram aplicabilidade e concordância entre acadêmicos e residentes, o que permite a validação do protocolo de Ottawa nos atendimentos de urgência e emergência no Brasil.

## Palavras-chave

- ▶ fratura por entorse
- ▶ tornozelo
- ▶ pé
- ▶ radiografia

## Introduction

Ankle traumas present as one of the most common complaints of emergency services, corresponding to 6 to 12% of cases<sup>1</sup> and affecting patients of various ages and occurring in low or high energy traumas. They affect approximately 1/10,000 inhabitants per day in the world<sup>2</sup> and stem from daily movements or sports practices, attending with fractures in 15% of cases.<sup>3</sup>

The current practice observed in emergency services is to request radiographs in anteroposterior incidences and profile for the evaluation of injuries resulting from torsional trauma of the ankle, even though the literature shows that 85% are sprains without bone injury.<sup>3</sup>

Seeking to standardize criteria and to reduce the requests for radiographs, Stiell et al.<sup>3</sup> developed, in the 1990s, the Ottawa ankle rules, consisting of a clinical analysis with objective criteria that indicate the need to perform radiographs in ankle traumas.

There is a need for ankle x-rays in patients who present a history of torsional trauma with reported malleolar pain associated with one or more of the following criteria:

1. Lateral malleolar pain at bone palpation (6 cm distal in the posterior region).
2. Medial malleolar pain at bone palpation (6 cm distal in the posterior region).
3. Inability to support the limb (immediately after trauma and for 4 steps in urgency).

Similarly, it is recommended to request foot x-rays when the patient has a history of torsional trauma with referred pain in the middle foot associated with one or more of the following factors:

1. Pain to bone palpation of the base of the 5th metatarsal.
2. Pain to bone palpation of the navicular.

3. Inability to support the limb (immediately after trauma and for 4 steps in urgency).

It is important to note that this protocol should not be used in patients with acute or non-cooperative intoxication, polytraumatized, with decreased sensitivity in the lower limbs, with large edema that makes palpation of the malleoli difficult, and patients under 18 years of age. Those patients submitted to the protocol who choose not to perform radiographs should be properly oriented, with written information regarding follow-up and need for reassessment if they persist with symptoms.

In the present study, we aim to verify the applicability and agreement of the Ottawa ankle rules applied by medical students, under supervised internship, and orthopedic residents after previous training in a tertiary trauma care service in our city, thus validating the Ottawa ankle rules for use on Brazilian soil.

## Materials and Methods

This is a prospective study conducted in the urgency and emergency sector of a tertiary hospital, with data collection from September to November 2014, including all patients with torsional trauma of the tibiotarsal joint with less than 24 hours of evolution.

The project was approved and supervised by the ethics committee of the institution where the protocol was applied and the data collection took place.

The exclusion criteria for the statistical analysis were cases of inadequate radiographs or those that presented open physis. Polytraumatized cases or victims of high-energy trauma were excluded from the data collection.

All patients underwent ankle and/or foot radiographs in anteroposterior and profile incidences, and the questionnaire with the Ottawa ankle rules was applied by medical students enrolled in the volunteer internship of traumatology of the

**Table 1** Sample characteristics (n = 263)

Variable	Category	N	%
Sex	Male	133	50.6
	Female	130	49.4
Age group	• 54 years old	240	91.0
	• 55 years old	23	9.0
Open physis	No	226	86.3
	Yes	37	13.7
Entry time	Morning	94	35.7
	Late	105	39.9
	Night	64	24.4

hospital and, subsequently, by the residents of the orthopedics and traumatology service.

The radiographs were evaluated by on-call orthopedists, who conducted the treatment and, later, by an orthopedist specialized in foot and ankle. The response was dichotomized in no or yes for statistical evaluation, and the expert's opinion was considered the gold standard for the analysis.

The variables of gender, age group ( $\leq 54$  years and  $\geq 55$  years), presence of open bone physis (no or yes), and period of care of the patient were used. The variables adopted for the identification of injury occurrence were obtained through the Ottawa protocol.

At the occurrence of injury, nomenclatures were standardized, and the variable was categorized dichotomously (no or yes) as well as the variables x-ray (no or yes) and occurrence of injury (no or yes) according to each examiner (academic and resident).

The lesions considered were the fractures of the medial malleolus, the lateral malleolus, bimalleolar fractures, fractures of the base of the 5th metatarsal, avulsions of the deltoid ligament, and avulsions of the lateral ligament complex evidenced by radiographic examination.

For the description of the sample, the distribution frequency (absolute and relative) of the total sample was performed according to the examiner (academic and resident). The instrument's ability to identify positive and true negative lesions was performed using sensitivity and specificity analysis, respectively, according to the age of the patient ( $\leq 54$  years and  $\geq 55$  years).<sup>4</sup> Positive predictive value indicates in what proportion individuals can have a positive test result and that they actually had the characteristic/attribute. Similarly, the negative predictive seeks to predict the actual absence of the particularity variable explored.<sup>5</sup>

As a measure of reproducibility for agreement between evaluators (academic and resident), was made through the Cohen Kappa Index test by the criteria proposed by Landis and Koch apud Barros et al.<sup>4</sup> To perform the analyses, the SPSS 20.0 for Windows (IBM Corp., Armonk, NY, USA) software was used. A significance level of 5% was maintained, and certain calculations for sensitivity, specificity, positive predictive value (PPV) and NPV were determined.

## Results

A total of 263 patients (133 male and 130 female) with a mean age of 30.3 years were evaluated, out of whom 22 patients were 55 years or older (8%). Presence of open physis was evident on the radiographs of 37 patients (13%). The occurrence of lesions was determined by the evaluation of the on-call physician and, later, by the specialist, totaling 23 (8.7%) and 26 lesions (9.9%), respectively (► **Table 1**).

In accordance with the established inclusion criteria, 226 patients remained for statistical evaluation.

The application of the Ottawa ankle rules on the 226 patients by academics and residents obtained the results shown in (► **Table 2**). The interobserver agreement obtained after the application of the Kappa method was considered moderate for the palpation variables of the medial malleolus, the lateral malleolus, and for the base of the 5th metatarsal and navicular, while for the variable inability to ambulate,

**Table 2** Analysis of Ottawa protocol variables and agreement between academic and resident in criterion analysis\* (n = 226)

Variable	Category	Academic		Resident		% agreement	Kappa	Rating**	p
		N	%	N	%				
Lateral malleolus	No	86	38.1	118	52.2	78.7	0.580	Moderate	< 0.001
	Yes	140	61.9	108	47.8				
Medial malleolus	No	189	83.6	154	68.1	80.1	0.473	Moderate	< 0.001
	Yes	37	16.4	72	31.9				
B5	No	202	89.4	170	75.2	82.3	0.413	Moderate	< 0.001
	Yes	24	10.6	56	24.8				
Navicular	No	196	86.7	169	74.8	83.7	0.471	Moderate	< 0.001
	Yes	30	13.2	57	25.2				
Wandering	No	174	77.0	145	64.2	84.5	0.643	Great	< 0.001
	Yes	52	23.0	81	35.8				

\*Ottawa's Protocol.

\*\*by Landis and Koch.

**Table 3** Agreement between on-call orthopedist and x-ray specialist (n = 226)

Variable	Category	On-call orthopedist		Specialist orthopedist		% agreement	Kappa	Rating*	p
		N	%	N	%				
Occurrence of injuries	No	205	90.7	202	89.4	98.7	0.926	Perfect	< 0.001
	Yes	21	9.3	24	10.6				

\*by Landis and Koch.

the result of the agreement was excellent (0.643). All of these results had statistical significance ( $p < 0.001$ ). (► **Table 2**)

A 98.7% percentage of agreement was evidenced in the radiographic evaluation of the occurrence of lesions by the on-call orthopedist and the specialist in foot and ankle, showing a Kappa index considered perfect ( $p < 0.001$ ) (► **Table 3**)

The protocol criteria for academics and residents were analyzed separately, and the values of sensitivity, specificity, PPV and NPV were determined. The most sensitive test with higher VPN for both academics and residents was palpation of the lateral malleolus, with sensitivity of 83% and 78%, respectively, and 96% NPV for both groups.

The stratified analysis of the Ottawa protocol data in our study demonstrated that sensitivity to detect fractures as well as NPV were 100%. Of the total of 203 patients, 61 had all negative criteria, not requiring radiographic examination and generating a 30% reduction in the total of requested exams.

## Discussion

Torsional ankle traumas represent a large part of the care in orthopedic emergency and urgency services, and their evaluation should seek to identify the ligament injuries and fractures that require immediate treatment.

It is known that the initial number of traumas of the tibial tarsal joint incur fractures in only 15% of the cases, so the difficulty lies in the differentiation between patients who present injury or not and which of them require a supplementary assessment.

The initial care of these patients is attended with a routine foot and ankle radiographic evaluation, a conduct that is unnecessary in most situations.

In view of the spare expenses<sup>6</sup> with unnecessary radiographs, the increase in the time detached in care and the amount of radiation to which the patient is exposed, Stiehl et al.<sup>3</sup> created and validated Ottawa rules, which, due to their practicality and effectiveness, have become a valuable tool in attending ankle trauma.

Bachmann et al.<sup>7</sup> conducted a meta-analysis of 27 studies including about 15,000 patients and found data proving that the protocol is a valid clinical instrument for the exclusion of fractures of the ankle and medial foot. Statistical analyses showed sensitivity of 100%, and a possibility of reducing the number of radiographs requested by 30 to 40% of the total.

Rodrigues et al.<sup>8</sup> validated the Ottawa Protocol for Portuguese in 2011, in Portugal, evaluating 123 patients demonstrating a sensitivity and NPV of 100% for the detection of

fractures with the criteria adopted by the Protocol and presents a potential reduction of the number of radiographs requested in emergency care of about 50%. In a study conducted by Brazilian researchers, Pires et al.<sup>9</sup> concluded that the inability to bear weight in ambulation was the item of the protocol with higher reliability, presenting 69.4% sensitivity, 61.6% specificity, 63.1% accuracy, 21.9% positive predictive value and 93% negative predictive value.

Stiehl et al.<sup>10</sup> and Ashurst et al.<sup>11</sup> concluded that the application of the Ottawa Protocol in emergency care resulted in a shorter time of care for these patients in relation to those who underwent radiography (80 min/116 min according to Stiehl). Both studies also conclude that there was no significant difference in the degree of satisfaction of patients when not submitted to imaging tests.

Contrasting numerous publications in the world literature on the theme, Kelly et al.<sup>12</sup> present divergent results on the reliability of the evaluation by the Ottawa protocol. In an evaluation of a total of 350 patients in a multicentric study, 75 fractures were found, 5 not evidenced by the clinical decision rule: an unstable fracture of the ankle, a fracture of the talus, a calcaneus fracture, and a cuboid and navicular fracture. This shows that protocol rules should be associated with a careful and detailed physical examination for soft tissue conditions, such as edema or other suggestive clinical signs, and the importance of ambulation witnessed by the on-call physician in order to ward off severe lesions of the tibiotalar and foot region.

In our results, we found an index of interobserver agreement considered moderate between medical students and residents in specific evaluation issues, however this difference does not change the sensitivity and NPV values that remained high for both evidencing a protocol whose false negative rate was null.

In the evaluation between the on-call orthopedist and the foot and ankle specialist, an interobserver agreement index considered perfect was obtained, and the possible lesions indicated by the protocol were diagnosed similarly, both in the emergency and in the evaluation by the specialist.

Although the good results demonstrated in our study and proven in the literature indicate the feasibility of using Ottawa ankle rules, we find some limitations in clinical applicability in our country, such as patient pressure to perform radiographic examinations and the demand for secondary gains.

The application of Ottawa ankle rules for medical students and orthopedic residents proved to be valid in our study, once the results obtained corroborated those already present in the literature, sensitivity and 100% NPV for both groups.

## Conclusions

The application of the Ottawa protocol in the initial care of torsional ankle trauma safely dispenses the request for radiographic examinations when negative for all studied criteria, resulting in a potential reduction between 30 and 50%.

The results showed an applicability and agreement between academics and residents that allows the validation of the Ottawa protocol for both groups in urgency and emergency care in Brazil.

Our data are in accordance with the current literature, which directs us to implement the protocol in our clinical practice, although new studies are needed to assess the socioeconomic and cultural impact.

### Conflict of Interests

The authors have no conflicts of interests to declare.

## References

- 1 Wang X, Chang SM, Yu GR, Rao ZT. Clinical value of the Ottawa ankle rules for diagnosis of fractures in acute ankle injuries. *PLoS One* 2013;8(04):e63228
- 2 Waterman BR, Belmont PJ Jr, Cameron KL, Deberardino TM, Owens BD. Epidemiology of ankle sprain at the United States Military Academy. *Am J Sports Med* 2010;38(04):797–803
- 3 Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. *Ann Emerg Med* 1992;21(04):384–390
- 4 Barros MV, Reis RS, Hallal PC. *Análise de Dados em Saúde*. 3rd ed. Londrina: Midiograf; 2012
- 5 Jekel JF, Elmore JG, Katz DL. *Introdução à medicina preventiva*. In: Jekel JF, Elmore JG, Katz DL, editores. *Epidemiologia bioestatística e medicina preventiva*. Porto Alegre: Artmed; 1999:203–209
- 6 Anis AH, Stiell IG, Stewart DG, Laupacis A. Cost-effectiveness analysis of the Ottawa Ankle Rules. *Ann Emerg Med* 1995;26(04):422–428
- 7 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
- 8 Rodrigues P, Rosa I, Campagnolo JL. [Validation of the Ottawa rules for the Portuguese population: a prospective study]. *Acta Med Port* 2011;24(05):713–718
- 9 Pires R, Pereira A, Abreu-E-Silva G, 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(03):432–435
- 10 Stiell IG, McKnight RD, Greenberg GH, et al. Implementation of the Ottawa ankle rules. *JAMA* 1994;271(11):827–832
- 11 Ashurst JV, Nappé T, Digiambattista S, et al. Effect of triage-based use of the Ottawa foot and ankle rules on the number of orders for radiographic imaging. *J Am Osteopath Assoc* 2014;114(12):890–897
- 12 Kelly AM, Richards D, Kerr L, et al. Failed validation of a clinical decision rule for the use of radiography in acute ankle injury. *N Z Med J* 1994;107(982):294–295