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Original Article

Classification variability of ankle fractures between physicians with and without the title of specialist in orthopedics and traumatology (TEOT)

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Abstract

Objective: Evaluate the classification variability of ankle fractures among physicians with and without the title of specialist in orthopedics and traumatology (TEOT) from a reference service.

Method: The study included 40 physicians who informed the year of training, the period they obtained TEOT, and which ankle fracture classification system(s) they use in their clinical practice. The physicians evaluated ten radiographs of five patients with ankle fractures and classified them based on the three classification systems; Lauge-Hansen, AO/OTA, and Danis-Weber.

Result: Most physicians with TEOT between one and five years (n=19, 47.5%), and 15 (48.4%) physicians used the Lauge-Hansen and Danis-Weber classifications. Regarding the radiographs evaluated, most (27.5%) physicians obtained correct answers using the Danis-Weber classification. It was also observed that the physicians with the lowest rates of correct answers in the classifications were those without TEOT (44.4%).

Conclusion: Most physicians adequately classified the five cases of ankle fracture using the Danis-Weber classification. The highest frequency of correct answers was from the physicians with TEOT.

Level of Evidence VI; Observational Descriptive Study.

Keywords: Ankle fractures; Classification; Observer variation.

Introduction

Ankle fractures are among the injuries most attended by orthopedic surgeons and traumatologists, besides presenting high surgical costs and mortality rates[1,2]. In treating any fracture, a classification is a tool that assists in the prognosis and appropriate treatment[3,4]. Several classifications for ankle fractures have been used. They can be based on the trauma mechanism described by Lauge-Hansen, which considers the position of the foot and the direction of the deforming force[5]. The classification described by Danis-Weber considers the topography of the fracture line in the lateral malleolus. The classification of the *Arbeitsgemeinschaft für Osteosynthesefragen* (AO/OTA) group [6] redefines the three types of the Danis-Weber classification[7].

In the literature, some studies evaluate the reproducibility and comparability between the three main classifications mentioned above[8,9]. However, in Brazil, there are still few studies about the influence of time since graduation, the presence and absence of the title of specialist, and the ability to properly classify ankle fractures, relevant information for im-

Study performed at the Hospital Estadual de Urgências de Goiânia (HUGO). Secretaria de Estado da Saúde, Goiânia, GO, Brazil.

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proving teaching techniques during the residency program. The objective of the study is to evaluate the classification variability of ankle fractures among physicians with and without the title of specialist in orthopedics and traumatology (TEOT) from a reference service.

Method

This study was approved by the institution's ethics committee.

Ten radiographs were used from five skeletally mature patients diagnosed with ankle fractures, in anteroposterior and lateral views. The patients were treated in the emergency room of a highly complex hospital and a reference in orthopedics and traumatology in Goiânia, Brazil (Figure 1). The radiographs were performed by a radiology technician, whose x-ray tube was positioned approximately one meter from the injured site, using the standard technique with an internal rotation of 15 degrees.

Forty physicians, among residents and orthopedists, were invited and signed the informed consent form and answered a brief questionnaire with three questions: the year they obtained the title of specialist in orthopedics and traumatology (TEOT) or the year of training (for those who did not have TEOT); which ankle fracture classification system(s); Lauge-Hansen, AO/OTA, and Danis-Weber, *apud* Ramos et al.[9] are used in their clinical practice; and finally, the radiographs were presented, and the physicians were asked to determine which category each of the fractures would belong to according to the classifications below:

Figure 1. Radiographs (A: Case 1; B: Case 2; C: Case 3; D: Case 4 and E: Case 5) presented to the physicians for classification.

- Lauge-Hansen: supination-adduction (SA), supination-external rotation (SER), pronation-abduction (PA), pronation-external rotation (PER) *apud* Ramos et al.[9];
- Danis-Weber: infrasyndesmotic (A), transsyndesmotic (B), and suprasyndesmotic (C) *apud* Ramos et al.[9];
- AO/OTA: infrasyndesmotic – isolated (A1), with medial malleolus (A2), or with postmedial fracture (A3); transsyndesmotic – isolated (B1), with medial injury (B2), or with medial injury and posterolateral injury (B3); and suprasyndesmotic – simple (C1), multifragmentary fracture (C2), or proximal fibula fracture (C3)[6].

The physicians were accompanied separately to a room where the radiographs of each case were evaluated for a maximum of three minutes, timed by an observer, and completed a form with the responses according to the three classifications. The physicians had prior knowledge of the classifications and could consult printed material detailing the three classifications. The highest agreement or not of the classifications was evaluated in relation to the standard response elaborated by a team composed of five orthopedists and traumatologists of a reference hospital. The physicians were divided into two groups to evaluate the results: without TEOT and with TEOT. The first group included the physicians who reported not having TEOT yet, and the second group included those who already had TEOT.

The data collected were evaluated in Microsoft Excel® 2007 (Microsoft Corporation, Redmond, Washington, USA) and SPSS, Statistical Package for the Social Science, version 16.0 (IBM Corp., Armonk, New York, USA). First, the correct answers for each classification were calculated according to the case presented and the period they have TEOT. Next, the normality of the sample was assessed using the Shapiro-Wilk test. Then, Fisher's exact test was used to detect differences between the TEOT period and the number of correct answers using the three classifications. Finally, the Student t-test for paired samples was applied to verify whether there was a significant difference in the degree of interobserver agreement between the classifications. A p-value<0.05 was considered statistically significant.

Results

Of the physicians participating in the research (n=40), 19 (47.5%) already had TEOT for between one and five years, 12 (30%) had TEOT for more than five years, and nine (n=22.5%) physicians had not yet obtained TEOT.

When asked about the classification used in their clinical practice (Figure 2), most reported using two classifications, Lauge-Hansen and Danis-Weber (n=15, 48.4%), followed by only one classification, Lauge-Hansen or Danis-Weber, equally used (n=10, 32.2%).

The highest mean of correct answers in all classifications was for physicians with TEOT (Table 1).

Regarding the classifications, the highest frequency of correct answers was for the Danis-Weber, with 11 physicians (27.5%) getting the classification right in all five cases (Table 2). Most of the correct answers for this classification were from physicians with TEOT with five years or less (n=8, 42.1%). No significant differences were observed in the TEOT period and the absence of the title in relation to the number of correct answers of the three classifications (p>0.05).

When comparing the period the physicians have TEOT between the groups, one with up to five years and the other with six years or more, a significant difference was observed only for the AO/OTA, in which orthopedists and traumatologists with up to five years with TEOT had more correct answers when evaluating the radiographs using this classification (p<0.016). No significant differences were observed between the TEOT period and the correct answers for the other classifications.

When the mean score of the 40 physicians and the different classifications were compared (Table 3), a significant difference (p<0.05) was observed between all classifications for the group without TEOT. However, physicians without TEOT and with TEOT for up to five years differed in the number of correct answers when using the Lauge-Hansen vs. AO/OTA.

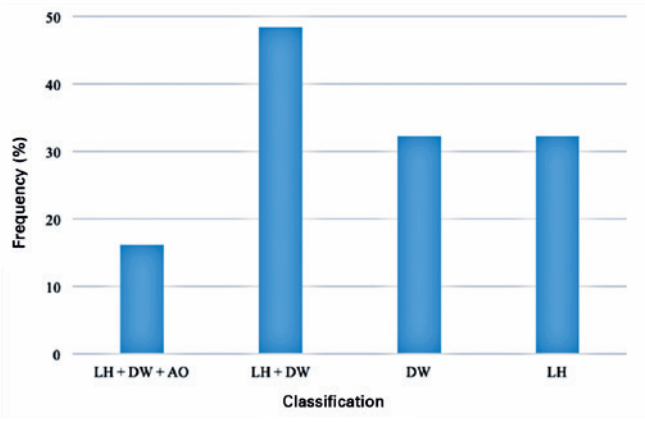

Figure 2. Most used classification systems by the physicians participating in the research.
LH: Lauge-Hansen classification; AO/OTA: *Arbeitsgemeinschaft für Osteosynthesefragenclassification*; DW: Danis-Weber classification; TEOT: Title of specialist in orthopedics and traumatology.

Table 1. Mean correct answers according to the Lauge-Hansen, AO/OTA, and Danis-Weber classifications

Classifications*	Without TEOT (n=9, 22.5%)	With TEOT (n=31, 77.5%)	p**
Lauge-Hansen	1.89±1.36	2.55±1.21	0.168
AO/OTA	1.11±1.54	1.74±1.61	0.303
Danis-Weber	3.67±0.87	4.03±0.75	0.221

* Values expressed as mean±standard deviation; ** Student t-test Statistical significance p<0.05. AO/OTA: *Arbeitsgemeinschaft für Osteosynthesefragenclassification*; TEOT: Title of specialist in orthopedics and traumatology.

Table 2. Frequency of correct classifications (correct answers) according to the Lauge-Hansen, AO/OTA, and Danis-Weber classifications

Classifications	Correct answers	TEOT period			p**
		Without TEOT (n=9, 22.5%)	≤ 5 years (n=19, 47.5%)	> 5 years (n=12, 30%)	
Lauge-Hansen	4 to 5	1 (11.1%)	5 (26.4%)	1 (8.3%)	
	3 to 2	5 (55.5%)	12 (63.2%)	9 (25.1%)	0.156
	1 to 0	3 (11.1%)	2 (10.4%)	2 (8.3%)	
AO/OTA	4 to 5	1 (11.1%)	4 (21.1%)	1 (8.3%)	0.020
	3 to 2	2 (22.2%)	10 (52.5%)	3 (25%)	
	1 to 0	6 (66.7%)	5 (26.4%)	8 (66.7%)	
Danis-Weber	4 to 5	6 (66.7%)	14 (53.7%)	17 (75%)	0.254
	3 to 2	3 (33.3%)	5 (26.3%)	3 (25%)	
	1 to 0	0	0	0	

Values expressed in n (%); ** ANOVA. Statistical significance p<0.05.
AO/OTA: *Arbeitsgemeinschaft für Osteosynthesefragenclassification*; TEOT: Title of specialist in orthopedics and traumatology.

Table 3. Level of agreement between the Lauge-Hansen, AO/OTA, and Danis-Weber classifications in relation to the period of TEOT

Sample	System	Mean±SD	Pairs of classification systems	p*
Total (n=40)	Lauge-Hansen	2.40±1.26	LH vs. AO/OTA	0.015
	AO/OTA	1.60±1.60	LH vs. DW	<0.0001
	Danis-Weber	3.95±0.78	AO vs. DW	<0.0001
Without TEOT (n=09)	Lauge-Hansen	1.89±1.36	LH vs. AO/OTA	0.272
	AO/OTA	1.11±1.54	LH vs. DW	0.0007
	Danis-Weber	3.67±0.87	AO vs. DW	0.0007
≤ 5 years of TEOT (n=19)	Lauge-Hansen	2.79±1.27	LH vs. AO/OTA	0.260
	AO/OTA	2.32±1.53	LH vs. DW	0.0003
	Danis-Weber	4.16±0.83	AO vs. DW	<0.001
> 5 years of TEOT (n=12)	Lauge-Hansen	2.17±1.03	LH vs. AO/OTA	0.0388
	AO/OTA	0.83±1.34	LH vs. DW	<0.0001
	Danis-Weber	3.83±0.58	AO vs. DW	<0.0001

* Student's t-test for paired samples; Statistical significance p<0.05.
SD: Standard deviation; LH: Lauge-Hansen classification; AO/OTA: *Arbeitsgemeinschaft für Osteosynthesefragenclassification*; DW: Danis-Weber classification; TEOT: Title of specialist in orthopedics and traumatology.

Regarding the overall correct answers (Figure 3), physicians with TEOT, regardless of the period, presented 25.9% more correct answers than those without TEOT (44.4%), being above the overall proportion of correct answers of the entire sample (53.3%).

Discussion

The Danis-Weber and the Lauge-Hansen systems were the most used in the analyzed sample (Figure 2). However, there are more correct answers using the Danis-Weber classification, with no statistically significant difference in relation to having TEOT or not (Table 2). This result is also found when analyzing the correct classifications overall, whose highest rate of correct answers was for the Danis-Weber, differing significantly from the Lauge-Hansen and AO/OTA in relation to the TEOT period and the number of correct answers (Table 3).

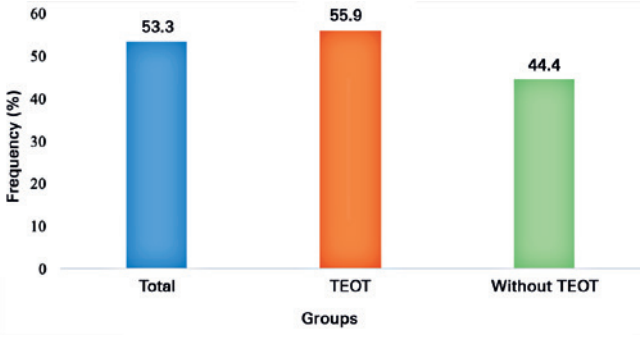

Figure 3. Overall correct answers of physicians with and without the title of specialist in orthopedics and traumatology (TEOT) in relation to the total classifications.

Ramos et al.[9] evaluated the inter-and intraobserver agreement regarding radiographs of 30 patients with ankle fractures evaluated by 11 physicians at different stages of professional training (five residents and six orthopedic surgeons) at two different times. They concluded that the Danis-Weber classification was the most reproducible. Fonseca et al.[10] consider that the Danis-Weber classification has more objective and more easily identifiable criteria for use in common radiographic evaluation, facilitating its application and resulting in greater agreement among physicians.

The Lauge-Hansen and AO/OTA classifications are more complex and require greater effort to acquire competence. The Lauge-Hansen and AO/OTA are similar when considering the fibular fracture. Still, in cases where there are posterior malleolus fractures or comminution of the fracture focus, they can lead less experienced professionals to a higher frequency of errors[11]. The choice of a method with a lower chance of errors may justify the fact that all participants do not use the AO/OTA classification alone[6] in their clinical practice, and there is a greater preference for the Lauge-Hansen and Danis-Weber classifications *apud* Ramos et al.[9] (Figure 2).

The lowest mean of correct answers (consequent higher proportion of errors, Table 1) was for the AO/OTA classification, and the difference was significant when comparing the groups according to the TEOT period (p=0.016). Eight of the 12 physicians (66.7%) with more than five years of TEOT could not correctly classify the five fractures using this classification (Table 2). The TEOT period was a significant fact when comparing the total number of correct answers only for the AO/OTA, in which physicians with more than five years of TEOT and those without TEOT presented a worse performance.

Tenório et al. [12] evaluated the inter-and intraobserver agreement regarding the Lauge-Hansen and Danis Weber classifications and the level of experience of orthopedists and traumatologists. There was greater agreement and reproducibility of the Danis-Weber classification, regardless of professional experience, results similar to our study.

The relevance of continuing medical education and investment in new training to bring physicians closer to knowledge is indisputable to ensure adequate patient management, better surgical results, and lower costs on the health system[13]. Furthermore, to guarantee quality and excellence in the training and performance of physicians, continuing education should be aimed at updating professionals, including tools for evaluating the performance of educational actions continuously and considering the profile of physicians trained in the Brazilian educational system[14].

This study had some limitations, such as the small number of radiographs compared to other studies that addressed the same objectives, the data being counted as correct answers based on the total number of cases, the small number of participants, and the size difference between groups. However, other aspects of extreme relevance to the quality of diagnosis and therapy exposed in the study are the appropriate professional practice, continuous improvement, criterion, and care with the quality of medical residency programs approved by the Ministry of Education and accredited by the Brazilian Society of Orthopedics and Traumatolgists, obtaining TEOT, these will lead to satisfactory experiences in the physician-patient relationship, the main scenario for the birth and development of a professional experience with excellence.

Conclusion

Most physicians adequately classified the five cases of ankle fracture using the Danis-Weber classification. The highest frequency of correct answers was from physicians with TEOT.

Authors' contributions: Each author contributed individually and significantly to the development of this article: LCBR *(https://orcid.org/0000-0001-5009-6539) Conceived and planned the activities that led to the study, participated in the review process, participated in the writing of the article, data collection, approved the final version; PMFV *(https://orcid.org/0000-0002-0779-0901) Participated in the review process, formatting of the article, participated in the writing of the article, approved the final version; WWK *(https://orcid.org/0000-0002-2365-3421) Participated in the review process, bibliographic review, survey of the medical records, participated in the writing of the article, approved the final version; JSM *(https://orcid.org/0000-0003-4742-1905), and GTL *(https://orcid.org/0000-0003-3489-9192), and ACMO *(https://orcid.org/0000-0001-8516-444X), and SROJ *(https://orcid.org/0000-0002-7709-2930) Interpreted the results of the study, participated in the review process, participated in the writing of the article, approved the final version; RCA *(https://orcid.org/0000-0002-4996-7242) Participated in the review process, formatting of the article, participated in the writing of the article, approved the final version. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID).

References

1. Silva ARB, Martinez LC, Pinheiro MM, Szejnfeld VL. Low-trauma ankle fractures in Brazil: secular trends in patients over 50 years old from 2004 to 2013. Arch Osteoporos. 2020;15(1):105.
2. Juto H, Nilsson H, Morberg P. Epidemiology of adult ankle fractures: 1756 cases identified in Norrbotten County during 2009-2013 and classified according to AO/OTA. BMC Musculoskelet Disord. 2018; 19(1):441.
3. King CM, Hamilton GA, Cobb M, Carpenter D, Ford LA. Association between ankle fractures and obesity. J Foot Ankle Surg. 2012; 51(5):543-7.
4. Belloti JC, Tamaoki MJ, Franciozi CE, Santos JB, Balbachevsky D, Chap Chap E, et al. Are distal radius fracture classifications reproducible? Intra and interobserver agreement. Sao Paulo Med J. 2008;126(3):180-5.
5. Budny AM, Young BA. Analysis of radiographic classifications for rotational ankle fractures. Clin Podiatr Med Surg. 2008;25(2):139-52.
6. Meinberg EG, Agel J, Roberts CS, Karam MD, Kellam JF. Fracture and Dislocation Classification Compendium-2018. J Orthop Trauma. 2018;32 Suppl 1:S1-S170.
7. Karam FC, Lopes MHI. Orthopedics: historical origin, teaching in Brazil, and methodological studies worldwide. Sci Med Porto Alegre. 2005;15(3):172-8.
8. Logullo P. O mapa das residências médicas em ortopedia no país: a distribuição dos serviços de treinamento é irregular nas regiões do Brasil. J SBOT 2016;127:6-11.
9. Ramos LS, Gonçalves HM, Freitas A, Oliveira MP, Lima DMS, Carmargo WS. Evaluation of the Reproducibility of Lauge-Hansen, Danis-Weber, and AO Classifications for Ankle Fractures. Rev Bras Ortop (Sao Paulo). 2021;56(3):372-8.
10. Fonseca LLD, Nunes IG, Nogueira RR, Martins GEV, Mesencio AC, Kobata SI. Reproducibility of the Lauge-Hansen, Danis-Weber, and AO classifications for ankle fractures. Rev Bras Ortop. 2017 Dec 6;53(1):101-6.
11. Sipahioglu S, Zehir S, Isikan E. Weber C ankle fractures with tibiofibular diastasis: syndesmosis-only fixation. Acta Ortop Bras. 2017;25(3):67-70.
12. Tenório RB, Mattos CA, Araújo LHC, Belangero WD. Analysis of Lauge-Hansen and Danis-Weber ankle fracture classification reproducibility. Rev Bras Ortop 2001;36(11/12):434-7.
13. Balzan NC, Wandercil M. Training doctors: the quality in question. Rev Av Educ Sup (Campinas) [online]. 2019;24(3):744-65. Available from: https://www.scielo.br/j/aval/a/hVdg7JfySM8XWSBSBsJ338g/?lang=pt#ModalArticles
14. Leite MTM, Carlini AL, Ramos MP, Sigulem D. Online continuing medical education: potential and challenges in the Brazilian context. Rev Bras Educ Med. 2010;34(1):141-9.