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ORIGINAL ARTICLE

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Reproducibility assessment of the Lauge-Hansen classification for ankle fractures

Avaliação de reprodutibilidade da classificação de Lauge-Hansen para as fraturas de tornozelo

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ABSTRACT

Objective: To evaluate the reproducibility, among orthopaedists, of the Lauge-Hansen classification performed at two different times, with an understanding of the trauma mechanism in each type of fracture.

Methods: Thirty radiographs of ankle fractures were selected for assessment by five orthopaedists from our service, two of whom were already trained and three of whom were undergoing orthopaedic residency training.

Results: The results were tabulated and plotted, and in a second assessment after 1 week, 66% correct answers and 34% errors were found. In the first assessment, the percentage of correct answers was 61.33%.

Conclusion: Management of the classification makes the orthopaedists habituated to using it routinely, facilitating the understanding by other professionals in the field and reducing disagreement among observers.

Level of Evidence III; Retrospective Comparative Study.

Keywords: Ankle injuries; Ankle fractures; Classification.

RESUMO

Objetivo: Avaliar a reprodutibilidade da classificação de Lauge-Hansen entre ortopedistas, realizada em 2 momentos, entendendo o mecanismo de trauma em cada tipo.

Métodos: Foram selecionadas trinta radiografias de fraturas de tornozelo para 5 ortopedistas do nosso serviço avaliarem, 2 já formados e 3 em formação pela residência de ortopedia.

Resultados: Os resultados foram colocados em tabelas e gráficos, nos quais se constataram, numa segunda avaliação, após 1 semana, 66% de acertos e 34% de erros, sendo que na primeira avaliação o percentual de acertos foi de 61,33%.

Conclusão: O manejo das classificações faz com que os médicos se habituem a usá-la de forma rotineira, facilitando o entendimento por outros profissionais da área, diminuindo a discordância entre os observadores.

Nível de Evidência III; Estudo Retrospectivo Comparativo.

Descritores: Traumatismos do tornozelo; Fraturas do tornozelo; Classificação.

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INTRODUCTION

The tibiotarsal joint, one of the major joints of the lower limb, plays important roles in body statics and dynamics. Any change in this region modifies the static and dynamic characteristics of the limb. Ankle fractures are one of the most frequent injuries affecting this region. Typically, they result from low-energy torsional trauma, but as the number of traffic accidents has increased, the severity of the fractures and the trauma energy have increased steadily[1-5].

The first ankle fracture classification, credited to Percival Pott, described three types of fracture based on the number of malleoli involved: unimalleolar, bimalleolar and trimalleolar. Despite its ease of use and reproducibility, the classification failed to differentiate between stable and unstable injuries[6].

The diagnosis of ankle fractures is usually simple and based on clinical history, physical examination and imaging. Approximately 50% of ankle radiographs requested in the emergency room are unnecessary[7]; currently, the decision to use radiography follows the rules developed at the University of Ottawa[8].

In cases of suspicious fracture, radiographic evaluation may be simply based on three views: AP (anteroposterior), true AP and P (profile)[9]. Tenório et al. compared the Danis-Weber and Lauge-Hansen ankle fracture classification systems and found that the former has greater reproducibility, being statistically similar among professionals at different stages of training, while the latter showed moderate agreement[10].

In 1949, Lauge-Hansen conducted experimental studies on cadavers and proposed a classification system correlating the features of ankle fractures with trauma mechanisms: supination-adduction, supination-eversion, pronation-eversion and pronation-abduction. In this system, the first term indicates the position of the foot at the time of trauma, while the second term indicates the direction of the deforming force. The advantages of this classification are the in-depth understanding of the injury's mechanical pattern and the visualization of the inverse of the driving force, which helps the physician achieve a more anatomical closed reduction[11].

The aim of this study is to evaluate the reproducibility of the Lauge-Hansen classification among orthopaedists in training and those with more experience.

METHODS

The study was approved by the Research Ethics Committee and was registered in the Brazil Platform under the CAAE number 78934817.0.0000.0066.

The inclusion criteria were ankle fractures with adequate radiographs taken in AP, true AP and P views; individual analysis of each radiograph by the physicians; and ankle fractures without other associated fractures. The exclusion criteria were associated fractures, radiographs with only one view and patients who were not followed up at the outpatient clinic.

The analysis was based on the Lauge-Hansen classification and its different lesion types[12], which are based on the position of the foot and the force exerted at the time of the trauma[13].

The Lauge-Hansen classification has been used since 1970. It is considered the most complete because, in addition to describing the bone lesions, it allows deducing the associated ligament lesions. The fractures are staged, and the progression of these stages implies greater lesion severity. The Lauge-Hansen classification has been used primarily in the conservative treatment of fractures to indicate the reduction manoeuvres required. Currently, it is useful for indicating the techniques to be used in surgical treatment. The Danis-Weber classification, similar to the AO classification, is based on distal tibiofibular syndesmosis. Although different, these classification systems are not mutually exclusive because both are based on the level of the fibular fracture[14].

The evaluators were five professionals in the field of orthopaedics from our service and included three residents and two already trained orthopaedic surgeons (one with under 10 years of training and another with over 10 years of experience in the field). The professionals performed first analyses of 30 ankle fracture radiographs and classified them; after 1 week, new assessments by the same physicians were requested. The radiographs were shown without patient names or anything that could identify them (Figure 1). The classifications were subsequently analysed based on an analysis of the support material for classification that had been previously delivered to each individual, and a consensus classification was then arrived at by all.

Categorical variables were analysed using the Chi-square test or Fisher's exact test. The level of significance adopted was 5% ($p<0.05$).

RESULTS

The professionals were asked to analyse the radiographs of 30 patients with ankle fractures. The classifications are presented in Table 1 according to the trauma mechanism. The table shows that supination-external rotation was the most frequent classification made by the profes-

sionals. Disagreements did not occur in all radiographic views, only in the anteroposterior views.

However, in the second stage of analysis of the radiographs performed after 1 week, it was found that four professionals classified most fractures as pronation-abduction, while one professional, the physician with less than 10 years at the institution, classified the majority of the fractures as supination-adduction (Table 2).

Regarding the number of disagreements after the first and second stages of analysis of the radiographs, it was found that residents presented greater disagreement compared with the physicians. Additionally, according to Table 3, resident R1 had a greater total number of disagreements in the two analyses, and the physician with more than 10 years of experience had a lower number of disagreements. Regarding the correct answers, resident R3, the physician with less than 10 years of experience, and the physician with more than 10 years of experience had a higher number of correct answers in the second stage of analysis relative to the first (Table 3).

Figure 1. Examples of evaluated radiographs.
Source: Author's personal archive.

Table 1. Distribution of fracture types according to the physicians' responses after the first radiographic analysis

Response	R1	R2	R3	Physician < 10 years	Physician > 10 years
Supination-adduction	7 (23.3%)	7 (23.3%)	5 (16.7%)	7 (23.3%)	7 (23.3%)
Supination- external rotation	11 (36.7%)	12 (40%)	14 (46.7%)	10 (33.3%)	9 (30%)
Pronation-abduction	4 (13.3%)	7 (23.3%)	4 (13.3%)	7 (23.3%)	7 (23.3%)
Pronation- external rotation	7 (23.3%)	4 (13.3%)	7 (23.3%)	6 (20%)	7 (23.3%)
TOTAL	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)

Table 2. Distribution of fracture types according to the physicians' responses to the second radiographic analysis

Response	R1	R2	R3	Physician < 10 years	Physician > 10 years
Supination-adduction	6 (20%)	8 (26.7%)	7 (23.3%)	9 (30%)	7 (23.3%)
Supination- external rotation	10 (33.3%)	5 (16.7%)	7 (23.3%)	7 (23.3%)	7 (23.3%)
Pronation-abduction	11 (36.7%)	11 (36.7%)	9 (30%)	8 (26.7%)	9 (30%)
Pronation- external rotation	3 (10%)	6 (20%)	7 (23.3%)	6 (20%)	7 (23.3%)
TOTAL	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)

Table 3. Numbers of correct and incorrect answers by the professionals surveyed

	R1		R2		R3		Physician < 10 years		Physician > 10 years	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
Correct	13 (43.3%)	10 (33.3%)	17 (56.7%)	17 (56.7%)	19 (63.3%)	21 (70%)	20 (66.7%)	26 (86.7%)	23 (76.7%)	25 (83.3%)
Incorrect	17 (56.7%)	20 (66.7%)	13 (43.3%)	13 (43.3%)	11 (36.7%)	9 (30%)	10 (33.3%)	4 (13.3%)	7 (23.3%)	5 (16.7%)
TOTAL	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)	30 (100%)

Regarding the analysis of the radiographs in the two stages, the examination of patient 8 had a greater number of disagreements; that is, all residents and physicians changed their responses; however, all of the professionals agreed on the examination of patient 30 (Figure 2).

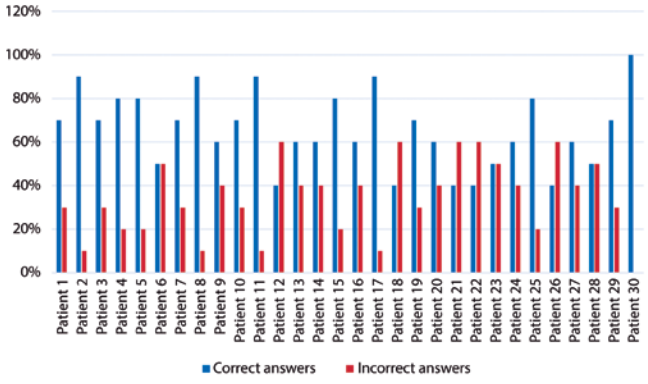

Figure 2. Agreements and disagreements in the radiograph analyses.

DISCUSSION

Ankle fractures are extremely frequent in orthopaedics, but the classification system generates a great deal of divergence among its observers. Support with a good radiographic standard quality is of great importance for classification, and contralateral radiographs are helpful in cases of diagnostic difficulty or uncertainty[15]. Thus, asymmetries or abnormalities in the measurement of radiographic parameters of the ankle are more easily detectable[16].

It is undeniable that the habit of using a classification system, together with the time of use, causes the number of erroneous classifications of ankle fractures according to the trauma mechanism to decrease considerably, given the percentage of correct answers given by the orthopaedists with more years of experience.

The Lauge-Hansen classification system can be subjective; therefore, it may contribute to why radiologists prefer to describe fractures rather than classify them. Although this system describes a series of fractures patterns, some are complicated and do not fit a definitive pattern[17].

The poor interobserver reliability of the Lauge-Hansen, Danis-Weber and AO/OTA classification systems indicates that orthopaedic surgeons interpret these classifications differently, suggesting that these systems are an ineffective means for physician-to-physician communication[18]. According to Gardner et al.[19], in 53% of the cases studied, the Lauge-Hansen classification did not reliably predict ligament injuries according to its classification stages, which is one of its limitations.

Another obstacle of the Lauge-Hansen system is that it was originally described after simulations of traumatic mechanisms in cadavers, a method that is not always as accurate as the mechanism used in living patients[20]. According to a recent study, the Lauge-Hansen classification should be used with caution because it was only able to predict the fracture mechanism reported by the patient in 50% of cases[21].

CONCLUSION

The ease of use of classification systems makes physicians habituated to using them routinely, facilitating the understanding by other professionals in the field. The use of different types of classification systems leads to the belief that all models have shortcomings; therefore, other classification systems are developed to fill in the gaps of the existing systems. The agreement between interpretations increases with the experience of the orthopaedist.

Authors' Contribution: Each author made significant individual contributions to this manuscript: SDSP (https://orcid.org/0000-0002-8677-3981)* has performed surgeries, has interpreted the study results; FF (https://orcid.org/0000-0003-2872-6172)* has conceived and planned the activities that led to the study, has interpreted the study results; MAR (https://orcid.org/0000-0002-7424-9074)* has written the article, participated in the review process and interpreted the study results, has approved the final version; RDS (https://orcid.org/0000-0001-7585-6768)* has participated in the review process and interpreted the study results; FDS (https://orcid.org/0000-0001-8251-319X)* has written the article, has interpreted the study results. *ORCID (Open Researcher and Contributor ID).

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