COMPREHENSION AND REPRODUCIBILITY OF THE JUDET AND LETOURNEL CLASSIFICATION

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ABSTRACT

Objective: To evaluate the effectiveness of the method of radiographic interpretation of acetabular fractures, according to the classification of Judet and Letournel, used by a group of residents of Orthopedics at a university hospital. Methods: We selected ten orthopedic residents, who were divided into two groups; one group received training in a methodology for the classification of acetabular fractures, which involves transposing the radiographic images to a graphic two-dimensional representation. We classified fifty cases of acetabular fracture on two separate occasions, and determined the intraobserver and interobserver agreement. Result: The success rate was 16.2% (10-26%) for the trained group and 22.8% (10-36%) for the untrained group. The mean kappa coefficients for interobserver and intraobserver agreement in the trained group were 0.08 and 0.12, respectively, and for the untrained group, 0.14 and 0.29. Conclusion: Training in the method of radiographic interpretation of acetabular fractures was not effective for assisting in the classification of acetabular fractures. ***Level of evidence I, Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference "gold" standard).***

Keywords: Acetabulum. Fracture fixation. Fracture fixation, internal. Radiography. Classification.

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INTRODUCTION

When orthopedists come across a diaphyseal fracture of a long bone, such as the femur, they request orthogonal radiographs (anteroposterior and lateral) of the affected region to understand the fracture lines and for preoperative planning. In the case of an acetabular fracture, this is not possible since the lateral radiograph is useless for viewing the fracture due to the considerable overlap of images.

The treatment of acetabular fractures is one of the most complex subjects in orthopedics. It involves great technical difficulty due to the involvement of a weight-bearing joint, profound and surrounded by neurovascular structures; due to the progressive increase in the number of cases, resulting from high-energy accidents; and due to the improvement of rescue systems, which are able to save the life of the polytrauma patient.[1-3]

Until early in this century closed reduction was the recommended treatment, and patients rarely resumed functional activities at an early stage.[1] The anatomical complexity of the region hinders not only the understanding of the fracture lines and deviations, but also the planning of the surgical approach.

In 1964, Judet et al.[4] published a classification of this type of fracture based on three radiographic views, thus allowing the determination of the type of fracture and its treatment. Other classifications used are: anatomical; that of the AO group; and universal based on the Judet and Letournel classification.

The AO group classification maintains its alphanumeric pattern, where the acetabular fracture is a type 62 fracture with its modifiers A, B and C as the complexity increases and the prognosis of the injury becomes worse.

The most widely used and accepted classification continues to be that of Judet and Letournel, yet there is controversy regarding the accuracy and intra- and interobserver concordance in the classification of these fractures.

OBJECTIVE

The objective of this study consists of evaluating the efficacy of a method of radiographic interpretation of acetabular fractures, according to the classification of Judet and Letournel, used by a group of Orthopedic and Traumatology residents from a university hospital.

MATERIALS AND METHODS

With the approval of the Ethics Committee of the institution we randomly selected 10 residents, out of a total of 20 first-year residents in the Department of Orthopedics and Traumatology of Irmandade da Santa Casa de São Paulo "Pavilhão Fernan-

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dinho Simonsen", and divided them into two distinct groups of five residents: A and B.
Both groups, already familiar with the Judet and Letournel classification system for acetabular fractures, received a spreadsheet with descriptive images of all the subtypes. (Figure 1)
Group A received thirty minutes of training, with the presentation of a methodology for the classification of acetabular fractures guided by the authors.

Training method

It is understood that the planning and the treatment of a fracture requires radiographs taken in the orthogonal planes (anteroposterior and lateral).
This is not possible in the acetabulum. Absolute lateral radiographs of the hip are useless for viewing this fracture, as there is excessive image overlap. (Figure 2)
Judet et al.[4] described the radiographic evaluation of acetabular fractures with the use of anteroposterior (front), alar and foraminal (oblique) views in the radiographs taken with the hip tilted at a 45° angle to the film, both to the right and to the left.
In the anterioposterior view we observe the following radiographic parameters (lines): ilioischial line, iliopectineal line, acetabular roof, edge of anterior wall, edge of posterior wall and the teardrop; in the alar view we observe: acetabular roof, edge of anterior wall, edge of posterior wall, greater sciatic notch and quadrilateral surface; while in the foraminal view we observe the acetabular roof, iliopectineal line, edge of anterior wall and edge of posterior wall.[5]
An important point in the understanding of these fractures is the concept of what makes up the acetabular columns. They are two bone massifs, one anterior, which extends from the anterior portion of the iliac crest to the pubic symphysis, and a posterior massif that contains the ischium, extending up to the angle of the greater sciatic notch.[5] (Figure 3)
Another important concept is that Judet and Letournel classified fractures as simple or elementary, and complex or associated.[5] (Table 1) Simple fractures owe their name to the fact that they have only two fragments, while complex fractures present more than two fragments. This classification does not cover all the possible types of fracture, as there are transitional forms between the types described that are not as common.[6]
As it is impossible to see the fracture lines in the absolute lateral radiograph of the hip,[7] we used a schematic diagram

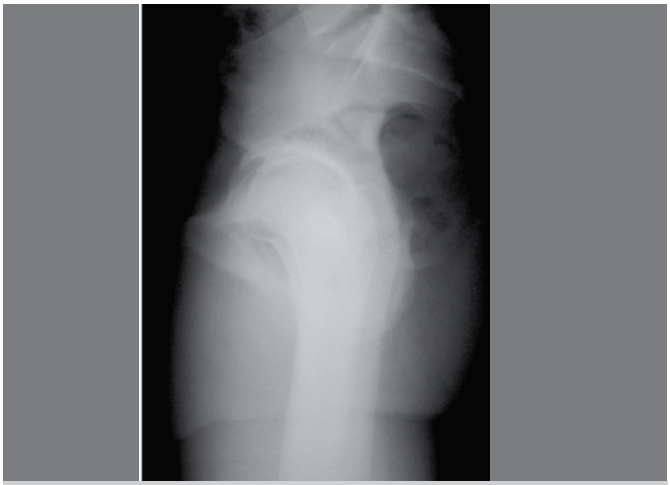

Figure 2. *Absolute lateral radiograph of the hip.*

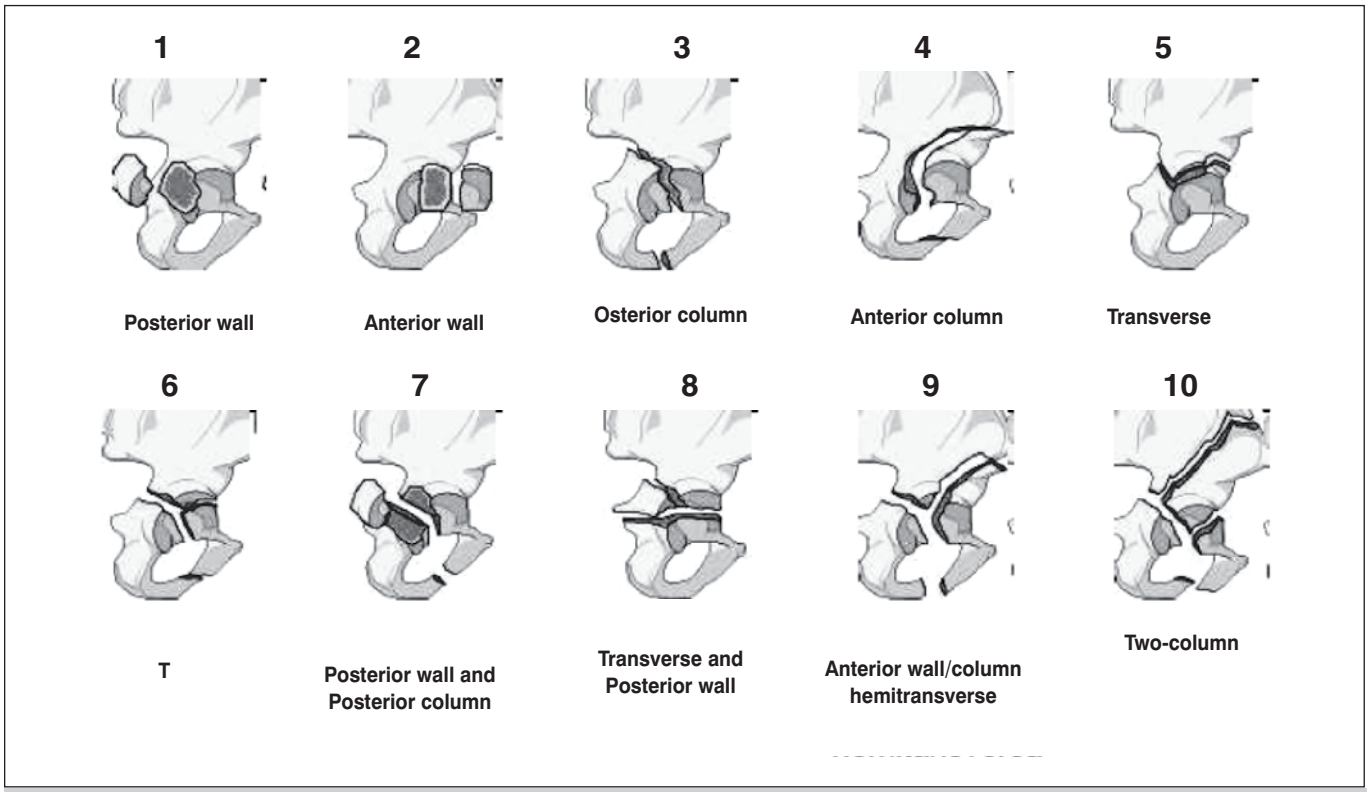

Figure 1. *Classification of Judet and Letournel.*

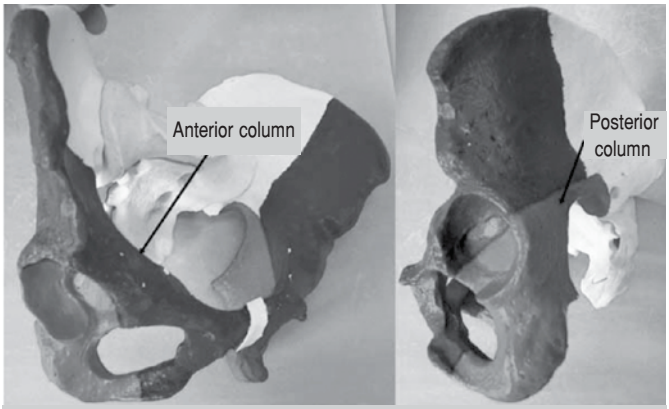

Figure 3. *Anterior and posterior acetabular columns.*

Table 1. *Classification of acetabular fractures according to Judet and Letournel.*[4,5,7]

Elementary fractures	Associated fractures
Posterior wall	T-shaped
Anterior wall	Posterior wall and posterior column
Posterior column	Posterior wall and transverse
Anterior column	Posterior hemitransverse and anterior column
Transverse	Two-column

showing a hip in this radiographic view. Thus as we observe the oblique radiographs of the hip, we sequentially transfer to the drawing the fractures in the walls, in the columns and of the columns. (Figure 4) As a result it is possible to see the lines and the "format" of the fracture, which allows it to be more easily understood.

We would be transforming information from the radiographs into information from the drawing, creating the lateral view and thus managing to perceive the location of the lines of the fracture, being able to classify it.

As a presentation of a clinical example we have the images of an acetabular fracture in the anteroposterior, alar and obturator views. In the anteroposterior image (Figure 5) we did not manage to clearly define the fracture lines. When studying the oblique images we managed to visualize that there is interruption of the iliopectineal lines and of the ischiopubic ramus in the foraminal view and we transported these fracture lines to the diagram. In the alar view we observed the fracture line on the iliopubic line and transported it to the diagram. At the end we have the absolute lateral view of the hip drawn and can now clearly observe the type of fracture. In the example it is a T-fracture. (Figure 6)

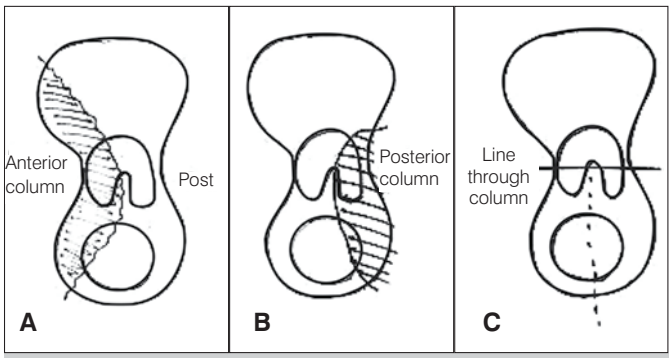

Figure 4. *Drawings representing acetabular fractures. (A) Anterior column, (B) Posterior column, (C) T-shaped.*

Figure 5. *Anteroposterior pelvis.*

We selected 50 cases of acetabular fracture treated by the Hip Disorder Group of the Department of Orthopedics and Traumatology of Irmandade da Santa Casa de São Paulo, in the period from 2000 to 2010, and scanned the anteroposterior and oblique views of the pelvis (alar and foraminal), totaling 150 images. The radiographic films were photographed with a Sony Cyber-shot DSC-W320 camera, always by the same person, and diagrammed in a slide presentation, with the identifications concealed.

We selected eight posterior wall, four anterior wall, five posterior column, four anterior column, three transverse, five column and posterior wall, five anterior column and hemitransverse, five transverse and posterior wall, six two-column, and five T-fracture cases. (Table 2). All the cases were analyzed and classified by each individual from the two groups simultaneously, in five 30-minute sessions, and were reevaluated three weeks afterwards in a new order of presentation.

A statistical analysis was carried out describing the successes and errors of each evaluator in each measurement, and we verified the intraobserver concordance in the classification of the 10 possible types of fracture using the kappa coefficient.[8] To verify the intraobserver concordances in the classification of fractures as simple or complex we calculated the kappa coefficients, and to verify the interobserver concordance we calculated the overall kappa coefficients of the five trained residents and of the five untrained residents.

According to Landis and Koch[9] the concordance interval is given according to the kappa coefficient, as follows: below zero - weak concordance; 0 to 0.20 - slight concordance; 0.21 to 0.40 - reasonable concordance; 0.41 to 0.60 – moderate concordance; 0.61 to 0.8 - substantial concordance; 0.81 to 1 - excellent concordance.

RESULT

After the sessions of evaluation of the radiographs by the residents, from the 50 cases presented, we obtained the following results:

For the group of trained residents we have the number and the percentage of successes obtained in Table 3.

The group of untrained residents achieved the performance described in Table 4.

The concordance evaluation using the intraobserver kappa coefficient is shown in Table 5. The concordance in the intraobserver classifications was low for all the residents. The residents presenting the best concordance were residents 6 and 9 (both from the untrained group) with a coefficient of 0.251 and of 0.296, classified as reasonable concordance.

In the classification of fractures as simple and associated we obtained the results described in Table 6.

The untrained residents obtained a better result. With the exception of resident 6, they all obtained a kappa coefficient between 0.21 and 0.40 (reasonable concordance); while in the trained group only resident 5 obtained a coefficient between 0.21 and 0.4 (reasonable concordance), with the rest having presented a coefficient between 0 and 0.2 (slight concordance).

The interobserver concordance was weak since all the values were below zero, irrespective of training.

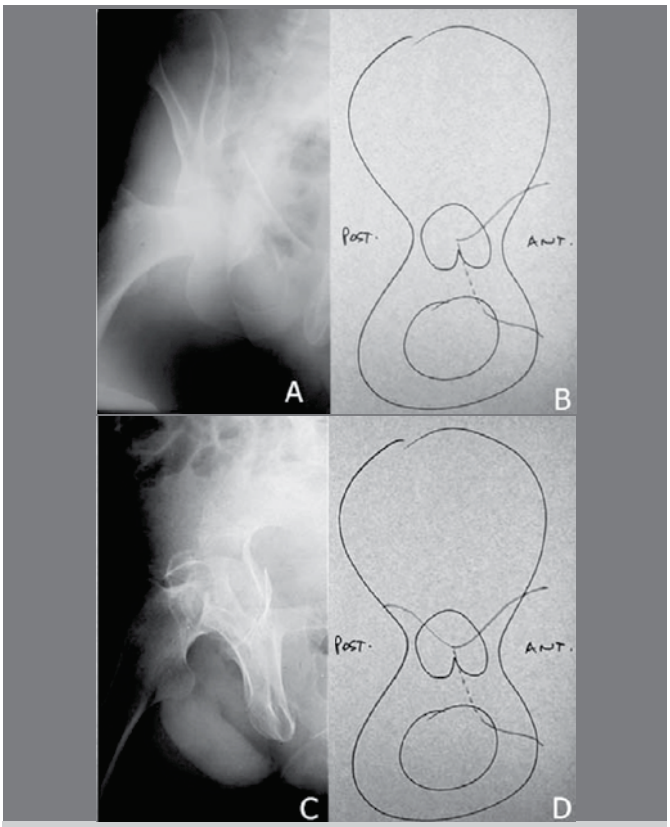

Figure 6. *(A) Foraminal view of the right hip; (B) Diagram displaying the fracture lines in the anterior column and in the ischiopubic ramus; (C) Alar view of the right hip; (D) Diagram displaying the fracture lines in the anterior column and in the ischiopubic ramus and posterior column showing the characteristic T shape.*

Table 2. *Classification of the types of acetabular fractures according to the Judet and Letournel classification, evaluated in this study.*

Type	Cases
Posterior wall	8
Anterior wall	4
Posterior column	5
Anterior column	4
Transverse	3
Column and posterior wall	5
Anterior column and hemitransverse	5
transverse and posterior wall	5
Two-column	6
T	5

Table 3. *Success rate of the group of trained residents, according to the Judet and Letournel classification.*

Resident	First reading		Second reading	
	Successes	Percentage	Successes	Percentage
1	5	10	7	14
2	6	12	13	26
3	6	12	9	18
4	12	24	7	14
5	8	16	8	16

Table 4. *Success rate of the group of untrained residents, according to the Judet and Letournel classification.*

Resident	First reading		Second reading	
	Successes	Percentage	Successes	Percentage
6	17	34	13	26
7	7	14	5	10
8	10	20	11	22
9	8	16	10	20
10	18	36	15	30

Table 5. *Intraobserver coefficient of concordance, according to the Judet and Letournel classification.*

Group	Resident	Kappa coefficient
Trained	1	0.013
	2	0.108
	3	0.038
	4	0.129
	5	0.128
Untrained	6	0.251
	7	0.099
	8	0.032
	9	0.296
	10	0.071

Table 6. *Inter- and intraobserver coefficient of concordance of acetabular fractures, according to the Judet and Letournel classification as simple and associated.*

Group	Resident	Intraobserver	Interobservers 1st. Measurement	Interobservers 2nd Measurement
Trained	1	-0.013	-0.124	-0.077
	2	0.138		
	3	0.118		
	4	0.094		
	5	0.244		
Untrained	6	0.088	-0.169	-0.110
	7	0.247		
	8	0.204		
	9	0.204		
	10	0.256		

DISCUSSION

The treatment of acetabular fractures should be aimed at reconstituting the anatomy of the acetabulum as congruently as possible. The classification of the fracture is necessary for a precise surgical approach.[6,10]

The complexity of the three-dimensional anatomy, generating overlapping of images in radiographs, is a factor that creates difficulty in the interpretation and understanding of acetabular fractures.[4,11,12]

The classification of Judet and Letournel[4] is a classification of topographic characteristics, taking into account the fracture line and the elements involved; it is theoretically easy to understand, since we only have to observe and name the fractured element.

Another method for systematization of the interpretation of the Judet and Letournel classification was proposed to improve the accuracy of the classification. Prevezas et al.[10] used the iliopectineal and ilioischial lines to group fractures according to their integrity and to classify them afterwards according to the classification of Judet and Letournel, yet they failed to demonstrate significant improvement in concordance.

Petrisor et al.[10] carried out a comparative study between orthopedists in training and already graduated. Interobserver concordance of the Judet and Letournel classification was found to increase in direct relation to the surgeon's experience, regardless of the addition of the oblique views.

Hufner et al.[11] demonstrated that there is low concordance in the Judet and Letournel classification among inexperienced evaluators, such as residents. In their study only 11% of success occurred in the inexperienced group (residents and non-hip surgeon orthopedists) compared to 61% of success in the group of hip surgery specialists. In the same study it was observed that in adding computed tomography scans there was an improvement in the success rate, with inexperienced professionals achieving 65% of success and experienced professionals, 83%.[11]

Hufner et al.[11] also evaluated the increase in the success rate related to different diagnostic instruments. The diagnosis was initiated with anteroposterior pelvic radiography, with other subsidiary exams (oblique radiographs, simple tomography, tomography with 3D reconstruction and tomography with suppression of femoral image) presented successively. The success rate was recorded in each stage among evaluators with different levels of experience. The inexperienced professionals achieved only 23% of success in the cases analyzing simple radiographies, while the specialists achieved 76% of success in the cases.[11]

Visutipol et al.[12] and Beule et al.[13] concluded that the classification of Judet and Letournel is reproducible. These studies were based on simple radiographs (pelvis front, alar and foraminal). In adding computed tomography scans of the pelvis there was no improvement in the interobserver and intraobserver concordance.

The factor of greatest relevance in the concordance of the classification of acetabular fractures is the observer's experience,[11,13,14] with better concordance among surgeons who treat acetabular fractures.[11,13]

The more experienced professional predominantly needs radiographs to perform the diagnosis, yet subsidiary exams continue to be useful for surgical planning.[5,11]

With this methodology we intended to facilitate the understanding and the visibilization of acetabular fractures by transposing the fracture lines to a sheet of paper.

The result obtained did not reveal greater concordance among the observers who used this method. We believe that this is due to the inexperience of the observers, since these are physicians in their first year of training in orthopedics.

We identified the following study limitations: the use of an inexperienced group of residents, the small number of residents used, the training time of 30 minutes that may have been insufficient and the large number of cases evaluated in a tight timeframe, which may have caused fatigue in the evaluators. We observed that a larger number of cases would be necessary for statistically significant analysis of the correlation between successes and the type of fracture.

We believe that future studies with the methodology presented are justified, since it has contributed to the understanding of acetabular fractures in our service with the technique of transforming oblique radiographs into an absolute view image. The study design could be modified, using more experienced professionals, a larger number of cases and change in the case evaluation method aiming to reduce fatigue in the evaluators.

CONCLUSION

Training in the acetabular fracture radiography interpretation method did not prove effective for assisting in the classification and understanding of acetabular fractures according to the classification of Judet and Letournel in the group of residents studied.

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