

# FEMORAL SHAFT FRACTURE: REPRODUCIBILITY OF AO-ASIF AND WINQUIST CLASSIFICATIONS

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## ABSTRACT

**Objective:** To evaluate inter-observer reproducibility of AO / ASIF and Winquist-Hansen classifications for shaft fractures of the femur in adults. **Methods:** 50 anterior-posterior and lateral radiographs were randomly selected, of adult patients with diaphyseal fracture of the femur. The radiographs were analyzed by 5 observers—a member of the Brazilian Society of Orthopedic Trauma, a radiologist and 3 residents. To assess the concordance between these classifications, we used the statistical index

Kappa (K). **Results:** In all analyses, we observed a statistically significant correlation coefficient between observers ( $p < 0.05$ ) and according to the criteria of Landis and Koch, they were ranked as good (values of 0.61 to 0.80) or very good (values above 0.80). **Conclusion:** The AO rating and Winquist present a high rate of concordance between observers for shaft fractures of the femur in adults.

**Keywords:** Classification. Reproducibility of results. Femoral fractures.

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## INTRODUCTION

The largest and strongest bone in the human body, the femur has a well-vascularized muscular wrapping that promotes the consolidation of most fractures. Fractures of the shaft of the femur are severe injuries, resulting from violent forces, often associated with impairment of other organs, and that can determine deformities and sequela for the patient, due to immediate or late-onset complications.

The treatment of femoral shaft fractures is eminently surgical.

The increasing occurrence of high-energy traumas, in which there is considerable dissipation of kinetic energy, has led to the appearance of femoral shaft fractures that are more and more severe and difficult to treat.

For the treatment to be established, it is necessary to have adequate preoperative planning, with correct interpretation of the fracture classification, which should be simple, reproducible, indicate prognosis, and provide a treatment guideline.

The aim of this study is to evaluate inter-observer reproducibility of AO/ASIF and Winquist classifications for shaft fractures of the femur.

## MATERIAL AND METHOD

Fifty AP and lateral radiographs of femoral shaft fracture in adult patients were selected randomly in our service. The radiographs were photographed with a 3.2 megapixel digital camera and the images were recorded in a CD-ROM, together with illustrations and detailed explanations about AO/ASIF and Winquist classifications. Radiographs of femoral shaft fractures in children were not included in the study.

These images were analyzed by 5 observers, a member of the Brazilian Orthopedic Trauma Society, a radiologist and 3 residents in Orthopedics and Traumatology (1 a first-year, 1 a second-year and 1 a third-year resident). There was no time limit guide for classification of the fractures.

The calculation of the sample size was performed according to statistical parameters and based on previous studies.

To evaluate inter-observer reproducibility the participants used the Kappa Index (K) stratified by Landis and Koch<sup>1</sup>. (Table 1) They adopted the significance level of 0.05 (5%), and results lower than this were considered statistically significant.

The performance of the study was approved by the Committee of Ethics in Research of our institution.

All the authors declare that there is no potential conflict of interest referring to this article.

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**Table 1** –Kappa index stratified by Landis and Koch.

Value of Kappa concordance coefficient	Classification
<0.20	Poor
0.21 to 0.40	Weak
0.41 to 0.60	Moderate
0.61 to 0.80	Good
>0.80	Very good

## RESULTS

All 50 radiographs were classified by the 5 observers, who considered the quality of the images sufficient for the classification task. A statistically significant ( $p < 0.05$ ) inter-observer concordance coefficient was observed in all the analyses and classified as good (values from 0.61 to 0.80) or very good (values above 0.80).

In the analysis of association between the AO and Winquist scales, a  $p$  value of 0.0000 was found for all the observers and for the analysis of the general result. Such result indicates that there is a statistically significant association between the two scales analyzed.

There was no greater concordance between the specialists (radiologist and traumatologist) in comparison with the group of residents in any of the classifications.

## DISCUSSION

Femoral shaft fractures in adults generally involve young adults and occur due to high-energy trauma. They are potentially severe, and may lead to systemic complications such as fat embolism or local complications such as pseudarthrosis, defective consolidation and osteomyelitis.

The most common lesions associated with femoral shaft fractures are fractures of the hip, knee ligament injuries and tibia fracture (floating knee).

Treatment is eminently surgical and the configuration of the fracture line is an essential parameter for preoperative planning.

In a cross-sectional study on the treatment of femoral shaft fractures in Brazil, Pires et al.<sup>2</sup> observed that 91% of Brazilian orthopedists use some classification for these fractures in adults. Of these, 84% use the AO-ASIF and 16% the Winquist classification.

The Winquist has the degree of comminution as a parameter. Type I (fracture with simple line or minimum comminution); Type II (circumferential comminution of up to 50% of the shaft diameter); Type III (comminution from 50 to 100%) and Type IV (circumferential comminution of the shaft, without contact between the two larger fragments after reduction).

Now the AO classification is comprised of an alphanumeric coding system based on the fracture site (proximal, medial or distal) and on the fracture line.

The correct classification of a fracture is essential for surgical indication. However, it is necessary for the system to be easily interpretable and reproducible among different observers.

Several authors have investigated the rate of inter- and intra-observer concordance of classification systems in the traumatology field.<sup>3-5</sup>

Matos et al.<sup>6</sup> in a study on inter-observer reproducibility of Tile's classification for acetabular fractures, observed that this classification has moderate concordance and that there is no statistically significant difference in relation to residents and specialists.

Beaule et al.<sup>7</sup> encountered substantial reproducibility (Kappa 0.70) for Letournel's classification of acetabular fractures. Computed tomography proved useful to identify joint impaction, but does not appear essential for the classification of these fractures.

Pretisor et al.<sup>8</sup> demonstrated that the reproducibility of the Letournel classification for acetabular fractures was not higher when the AP radiography was supplemented by Judet's oblique views.

Mandarino et al.<sup>9</sup> observed that the Schatzker classification for tibial plateau fractures is moderately reproducible between observers.

Schwartzmann et al.<sup>10</sup> while investigating the reproducibility of the AO classification for transtrochanteric fractures of the femur, demonstrated that, when complete (with nine subtypes), this classification presents unacceptable rates of reproducibility (Kappa 0.34). However, when simplified (three subtypes), it is considered good or substantial.

The Garden classification for femoral neck fractures demonstrated poor inter-observer reproducibility in the study by Gusmão et al.<sup>11</sup> Wainwright et al.,<sup>12</sup> in a study on inter- and intra-observer reproducibility for distal humeral fractures, observed that the classification of Riseborough and Radin presented moderate concordance, but half of the fractures could not be classified by this method. Now the complete AO classification presented slight concordance (Kappa 0.343). When incomplete (only 3 subtypes), its concordance was moderate (Kappa 0.52).

Brady et al.<sup>13</sup> demonstrated that the Vancouver classification for periprosthetic fractures of the femur presents good reproducibility (Kappa 0.78). The AO/ASIF classification, also in relation to periprosthetic fractures of the femur, demonstrated low inter-observer reproducibility when complete (Kappa 0.33).

For proximal humerus fractures, Siebenrock and Gerber<sup>14</sup> demonstrated that both the Neer and the AO/ASIF classification are not reproducible.

Martin et al.<sup>15</sup> demonstrated that the AO/ASIF classification for distal tibial fractures presents good inter-observer concordance when incomplete (only analyzing types A, B and C), but poor concordance when all the subtypes are analyzed. The computed tomography did not increase concordance in relation to the classification, but increased concordance in relation to impairment of the joint surface.

Lauder et al.<sup>16</sup> analyzing for reproducibility of the Sanders (Kappa 0.57) and Crozby-Fitzgibbons (Kappa 0.74) tomographic classifications for intra-articular calcaneal fractures, demonstrated that the second system presents greater inter-observer concordance.

Illarramendi et al.<sup>17</sup> encountered questionable reproducibility in the Frykman and AO classifications for distal radius fractures and do not recommend these systems in clinical application.

Andersen et al.<sup>18</sup> also investigating the reproducibility of four classifications for distal radius fractures, found moderate reproducibility just in the Mayo classification. The systems of Frykman, AO and Melone presented a low rate of reproducibility.

Oliveira Filho et al.<sup>19</sup> also found questionable inter-observer reproducibility between AO, Frykman and Universal classifications for distal radius fractures.

As regards transtrochanteric fractures, Jin et al.<sup>20</sup> demonstrated that the AO classification, when incomplete (only analyzing types A, B and C), presents greater reproducibility than the systems of Evans, Kyle and Boyd. However, when complete, the AO classification showed poor reproducibility for these fractures.

Tenório et al.<sup>21</sup> observed that the analysis of intra- and inter-observer reproducibility is higher in the classification of Danis-Weber when compared with that of Lauge-Hansen for ankle fractures. The observer's experience did not influence the degree of reproducibility.

This study demonstrates that both the use of the complete AO classification (with the nine subtypes) and that of Winquist have inter-observer reproducibility ranging from good to very good, which facilitates the exchange of information among colleagues in relation to the choice of management and prognosis, also allowing comparison among different studies on femoral shaft fractures.

Another factor to be emphasized is that, in all the abovementioned

studies in which the AO classification was tested, questionable reproducibility was observed with the complete AO classification (with the 9 subtypes). The results presented in this study demonstrate that the AO classification, even complete, presented a high rate of reproducibility when applied to the femoral shaft. A possible explanation would be the greater ease of application of this classification in shaft fractures and the routine of the service where the study was conducted, which follows the line of the AO philosophy.

## CONCLUSION

This study demonstrates that the complete AO and Winquist classifications are inter-observer reproducible. There was no statistically significant difference in the rate of reproducibility between specialists and residents. Due to their high rate of concordance, they can be recommended in the clinical practice of orthopedists and radiologists, and serve as parameters for comparison of groups in scientific research.

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