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Chapter 3

The comparison of two classifications for trochanteric femur fractures: the AO/ASIF classification and the Jensen classification

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ABSTRACT

Aim

This study compares the reproducibility of two classifications for trochanteric femur fractures: the Jensen classification and the AO/ASIF classification. Furthermore we evaluated the agreement on fracture stability, choice of osteosynthesis, fracture reduction and the accuracy of implant positioning.

Methods

In order to calculate the inter-, and intra-observer variability ten observers classified 50 trochanteric fractures.

Results

The inter-observer agreement of the AO/ASIF classification and the Jensen classification was κ0.40 and κ0.48. The kappa coefficient of the intra-observer reliability of the AO/ASIF classification was κ0.43 and κ0.56 for the Jensen classification.

Preoperative agreement on fracture stability and type of implant showed kappa values of κ0.39 and κ0.65. The postoperative agreement on choice of implant, fracture reduction and position of the implant was κ0.17, κ0.29 and κ0.22, respectively.

Conclusion

Both classifications showed poor reproducibility. This study suggests that the definition of stability of trochanteric fractures remains controversial, which possibly complicates the choice of osteosynthesis.

INTRODUCTION

An ideal fracture classification system should provide information on fracture stability, and, more importantly, it should guide the choice of treatment and the classification should have a high degree of reproducibility.

Trochanteric femoral fracture treatment is considered to be common practise and the fractures account for approximately half of all hip fractures.[1] The reliability of the two most frequently used classifications, the Jensen modification of Evans' classification[2] and the AO/ASIF classification, have been assessed in a limited number of studies.[3-8] It is not well known whether or not surgeons agree on the definition of stability of these fractures or the choice of fixation.

The Evans' classification (1945 [9]), modified by Jensen (1980 [2]), describes the location of the fracture line and the stability of the fracture. The more recently developed AO/ASIF classification[10] is designed to provide prognostic information on achieving and maintaining reduction of the fracture.

The goal of this study was to assess the inter-observer reliability and intra-observer reproducibility of two frequently used classifications for trochanteric femur fractures, the Jensen modification of the Evans' classification and the AO/ASIF classification. Furthermore, the agreement among observers on fracture stability, choice of osteosynthesis, fracture reduction, and position of the implant was evaluated.

PATIENTS AND METHODS

We randomly selected 50 anterior-posterior (AP) and lateral view preoperative radiographs of patients that were admitted from June 2006 to April 2007 with a fracture of the trochanteric region in our level 1 trauma centre. The quality of all radiographs was representative and initial choice of treatment was based on these radiographs.

The observers' group consisted of five trauma surgeons and five surgical residents with special interest for orthopaedic trauma. The observers were asked to classify independently the fractures according to the Jensen modification of the Evans' classification and the AO/ASIF classification. All participants were familiar with both classifications and each questionnaire was provided with a diagram of the different types of fractures.

The Jensen modification of the Evans' classification (Figure 1) consists of five subtypes: type 1: undisplaced 2-part fracture, type 2: displaced 2-part fracture, type 3: 3-part fracture without posterolateral support due to dislocated of the greater trochanter fragment, type 4: 3-part fracture without medial support due to a dislocated lesser trochanter fragment and type 5: 4-part fracture without posterolateral and medial support.

The AO/ASIF classification for trochanteric femur fractures (Müller, 1980 [10]) is build up

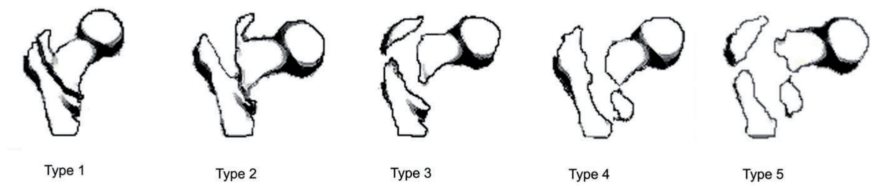

Figure 1

Jensen's modification of the Evans classification

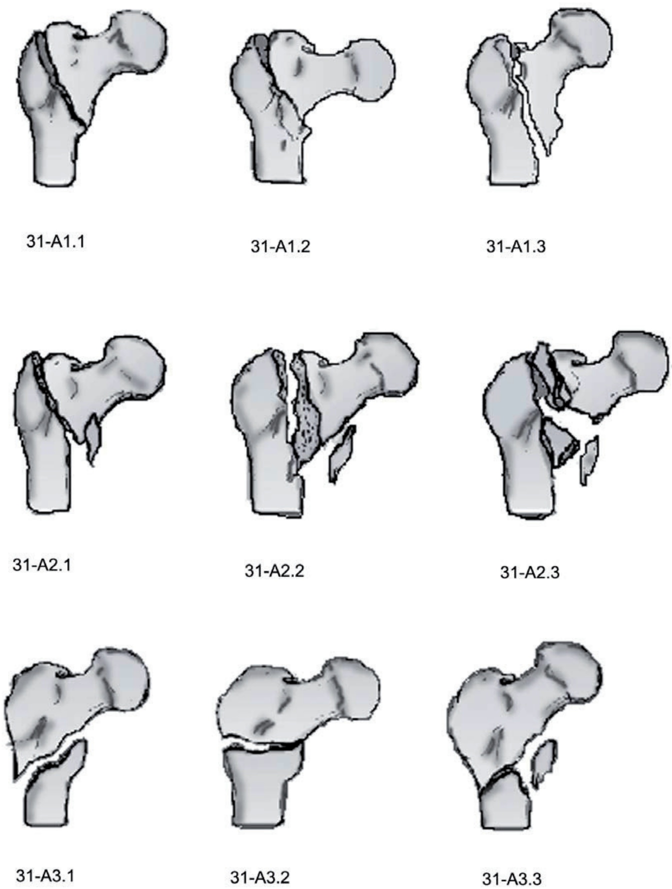

Figure 2

The AO/ASIF classification for trochanteric femur fractures, proposed by Müller et al by three groups of possible types of fractures and then according to increasing fracture severity divided in the subgroups A, B or C. (Figure 2)

The observers were provided as much time as needed for accurate assessment. The participants were not allowed to discuss their findings with others and they were not informed about the re-assessment of the radiographs. Three months after the initial assessment, each observer was asked to assess the same set of radiographs in a different order.

In both sessions the observers were asked whether they considered the trochanteric fracture as 'stable' or 'unstable', without providing them a definition. In the first session the preferred type of implant was determined. The observers could choose between a Dynamic Hip Screw or intramedullary device such as the Gamma-Nail In the second session we provided the observers with postoperative radiographs of the same fractures as shown in both sessions. The observers were asked whether they would have used the type of osteosynthesis as shown on the postoperative radiograph and, whether they considered the fracture reduction and the position of the implant adequate.

Statistical analysis was performed by calculating the Cohen kappa value using SPSS 14.0 statistical software for intra-observer reliability. In order to calculate the multi-rater kappa for the inter-observer agreement the statistical method of Fleiss' was used.[11] We interpreted the kappa value coefficient according to the guidelines proposed by Landis and Koch: less than 0.00 poor reliability, 0.00 to 0.20 slight reliability, 0.21 to 0.40 fair reliability, 0.41 to 0.60 moderate reliability, 0.61 to 0.80 substantial agreement and 0.81 to 1.00 almost perfect agreement.[12] The Student's T-test was used to compare mean kappa coefficients between the trauma surgeons and residents.

RESULTS

The mean age of the 50 subjects was 80 (SD 12.7). Thirteen patients were male and 37 female. Table 1 shows the fractures classified by the authors using the AO/ASIF classification and Jensen classification.

The intra-, and inter-observer agreement on both classifications was not significantly different between the trauma surgeons and residents ($p>0.05$). The kappa values are depicted in table 2 and 3.

The *inter*-observer kappa of all observers regarding the fracture stability was 0.39 (SE 0.05) in the first session and 0.56 (SE 0.1) in the second session. The *inter*-observer kappa value of the trauma surgeons was 0.34 (SE 0.08) and 0.76 (SE 0.25). The residents scored 0.44 (SE 0.08) in the first session and 0.52 (SE 0.08) in the second session. The kappa coefficient of the *intra*-observer agreement on the stability of the trochanteric fractures

Table 1

Classification of 50 trochanteric fractures by the authors according the Jensen classification and the AO/ASIF classification

Jensen	**N**	**(%)**
Type 1	7	(14)
Type 2	6	(12)
Type 3	10	(20)
Type 4	7	(14)
Type 5	20	(40)
Total	**50**	
AO/ASIF	**N**	**(%)**
A1.1	6	(12)
A1.2	8	(16)
A1.3	0	(0)
A2.1	2	(4)
A2.2	4	(8)
A2.3	15	(30)
A3.1	2	(4)
A3.2	4	(8)
A3.3	9	(18)
Total	**50**	

Table 2

Inter-observer agreement

	Session 1- Session 2	
	Kappa	SE
AO/ASIF	**0.40 - 0.38**	(0.01)
Trauma surgeons	0.41 -0.35	(0.02)
Residents	0.39 -0.40	(0.02)
AO excluding subgroups	**0.68 - 0.67**	(0.02)
Trauma surgeons	0.71 -0.64	(0.04)
Residents	0.66 -0.63	(0.04)
Jensen classification	**0.48 - 0.45**	(0.02)
Trauma surgeons	0.45 - 0.38	(0.03)
Residents	0.45 - 0.45	(0.03)

Table 3

Intra-observer agreement

Observer	AO/ASIF	(SE)	AO/ASIF	(SE)	Jensen	(SE)
			Excluding subgroups			
All	**0.43**	(0.08)	**0.71**	(0.08)	**0.56**	(0.09)
Trauma surgeons	**0.42**	(0.08)	**0.72**	(0.08)	**0.50**	(0.09)
1	0.35		0.73		0.56	
2	0.49		0.84		0.55	
3	0.38		0.68		0.42	
4	0.64		0.87		0.58	
5	0.26		0.50		0.37	
Residents	**0.43**	(0.08)	**0.69**	(0.08)	**0.61**	(0.08)
1	0.43		0.72		0.66	
2	0.34		0.69		0.65	
3	0.51		0.74		0.59	
4	0.40		0.56		0.53	
5	0.49		0.72		0.63	

was 0.59 (SE 0.1) for all observers. The trauma surgeons scored 0.64 (SE 0.1) and the residents 0.50 (SE 0.1).

The preoperative agreement on the choice of implant showed a kappa value for all observers of 0.65 (SE 0.04). The trauma surgeons showed a kappa coefficient for inter-observer reliability of 0.63 (SE 0.06) and the residents of 0.70 (SE 0.06). Postoperatively the trauma surgeons and residents considered 15% and 18% of the fractures were treated with an inappropriate type of implant, and their agreement showed a kappa value of 0.17 (SE 0.08).

The inter-observer agreement on postoperative fracture reduction showed a kappa coefficient of 0.29 (SE 0.07) and on position of the implant it was 0.22 (SE 0.05).

DISCUSSION

In this study the reliability of two commonly used classifications for trochanteric femur fractures, the AO/ASIF classification and the Jensen classification, was compared. We found a 'poor' reliability for the AO/ASIF classification and only a 'moderate' reliability for the Jensen classification. Furthermore, our study showed that the reproducibility of the AO/ASIF classification improved when subgroups of the classification were not provided.

These classifications have been studied before in a limited number of studies and showed similar results.[3-8] However, several limitations weakened the available data because these studies were conducted in a smaller number of observers with statistical restrictions. In the present study a SPSS syntax file was used, specially developed to calculate the inter-observer kappa in a larger group of observers.
There are several reasons to explain the disappointing reliability of these classifications. Our results showed a high rate (22%) of reversed oblique fractures, possibly because the study was performed in a level 1 trauma centre and these 'high energy fractures' were more common. The variability coefficient of 0.67 (SE 0.08) for this subgroup for the AO classification showed 'substantial' agreement and possibly implies that this particular fracture has a better understanding of instability than others. Because, trochanteric fractures of the reversed oblique type are not separately classified with the Jensen modification of the Evans' classification, the large number of reversed oblique fractures in our study might have given an underestimated inter-, and intra-observer kappa value for this classification. This type of fracture is regarded as unstable and suffers from high complication rates (26%).[13] We therefore believe that the 'Type R: Reversed' fracture, as originally used in the Evans' grading, should be re-introduced to further improve agreement of this classification.[7]
Besides the poor reliability of the fracture classification systems, the results of this study also showed low agreement on appointing a trochanteric fracture as 'stable' or 'unstable'. Surgeons often refer to trochanteric fractures in these terms but an exact definition lacks. Certain characteristics are generally considered 'unstable' such as the reversed oblique fractures, four-part fractures and all fractures with medial cortical comminution but evidence for these assumptions are absent or weak.[9, 14, 15] Consequently, as shown in this study, there is little agreement on what type of implant to use in the case of an 'unstable' fracture. According to most studies A1-fractures are considered 'stable' and frequently treated with a Dynamic Hip Screw. The A2 and A3 types are considered 'unstable' and usually treated with an intramedullary device. However, at the moment it is still widely questioned what type of implant is best to use in both stable and unstable trochanteric fractures, especially in the types A1.3, A2.1 and A3.[13, 16-19] In this study the observers classified a total of 24 type A1.3 fractures and the proposed implant was a DHS in 10 patients and an intramedullary device in 14 patients. As for the type A2.1 fractures, a DHS was chosen in only 3 out of 24 patients. Better agreement was observed for the reversed oblique fracture, as the observers proposed a DHS for only 2 out of a total of 98 fractures that were classified as type A3. It is of great interest whether these findings also imply that a better clinical outcome could be expected in these specific groups that score highly on agreement. If that is the case we could postulate that the accurate treatment modality has been used. However, to obtain these data further research has to be conducted.

Our results also indicated low agreement on fracture reduction and adequate implant positioning. In this study we found a better post-operative agreement on fracture reduction for fractures treated with a DHS than with an intramedullary device (κ0.39, SE 0.14 vs. κ0.24 SE 0.04), which we cannot explain. The agreement on the position of the DHS was poor (κ0.14, SE 0.18) and slightly better for the intramedullary implant (κ0.22, SE 0.07). These results suggest that at present there is little insight on the biomechanical properties of the trochanteric fracture and that it remains unclear, whether an unstable fracture is likely to lose its reduction and how fixation failure will occur.

This confusion on fracture stability might be explained by contradicting reports in literature. For instance, some established authors provided conflicting advice on whether the medial structural integrity is crucial.[7] More recent studies by Palm[23] and Gotfried[10] imply a key role of an intact lateral wall in the stabilization and fixation of these fractures. Palm suggested that the integrity of the lateral trochanteric wall was an important predictor of re-operation and according to Gotfried[10] fixation failure was also caused by fracture and instability of the lateral wall. These studies suggest that current classifications might focus on less important fracture characteristics and might need to be revised.

In the more complex type of trochanteric fractures adequate radiological evaluation could be the answer to evaluate an adequate treatment plan and reliable fracture classification. The value of computed tomography (CT) has been studied for different type of fractures with complicated fracture patterns such as tibial plateau or calcaneal fractures and proved to be superior to plain radiography.[20-25] However, for trochanteric fractures of higher complexity improvement of the reliability of fracture classifications was never assessed with CT in a clinical study. It is possible that better understanding of the fracture type and improved pre-operative planning will in higher agreement and improved clinical outcome.

The major disadvantage in our study is the relatively large group of surgical residents in the group of reviewers. The low agreement on fracture classification and treatment might be explained by their lack of surgical experience. Other studies investigating the reliability of fracture classifications have used high numbers of residents before and did show experience improves the reliability of a classification.[8, 26, 27] The agreement of our residents on both classifications is lower, but failed to be significant. We have included experienced and less experienced observers because in clinical practise both are involved in fracture classification and treatment. A well designed and reliable classification system should be applicable by both orthopaedic surgeons and surgical residents.

In conclusion, this study demonstrated that none of the widely used classification systems for trochanteric fractures accurately identified those fractures likely to have uneventful healing. Consequently there was no consensus on the choice of treatment in most cases. Moreover, the definition and agreement on a successful operation lacked and further blurred the complete appreciation of these fractures. In order to improve current fracture management, a classification system should be newly developed by obtaining more insight on the fracture characteristics, its biomechanical properties and understanding thereof, and a definition of successful fracture reduction.

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