Chapter 4

The reliability of a simplified Garden classification for intra-capsular hip fractures

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ABSTRACT

Aim

The Garden classification is used to classify intra-capsular proximal femur fractures. The reliability of this classification is poor and several authors advise a simplified classification of intra-capsular hip fractures into non-displaced and displaced fractures. However, this proposed simplified classification has never been tested for its reliability.
We estimate that simplifying the classification of femoral neck fractures will lead to a higher inter-observer agreement.

Material and Methods

Ten observers, trauma surgeons and residents, from two different institutes classified 100 intra-capsular femoral neck fractures. The inter-observer agreements were calculated using the multi-rater Fleiss' kappa.

Results

The inter-observer kappa for the Garden classification was 0.31. An agreement of κ0.52 was observed if the Garden classification was simplified and the fractures were classified by our observers as 'non-displaced' or 'displaced'. No difference in reliability was seen for the use of the four-grade Garden classification as well as the simplified classification between trauma surgeons and residents.

Conclusion

Classification of intra-capsular hip fractures according to the four-grade Garden classification is unreliable. The reliability of classification improves when the Garden classification is simplified in a classification using the terms: 'non-displaced' or 'displaced'.

INTRODUCTION

The Garden-classification[1] is used frequently to classify femoral neck fractures. Several studies have investigated the reliability of the four-grade Garden classification and showed poor reliability, caused by difficult radiological distinction between different grades, especially grade I and II, and a limited clinical relevance in terms of predicting the likelihood of malunion or avascular necrosis. [2-12]

Several authors have recommended a simplified classification being 'non-displaced' and 'displaced' fractures.[3, 8, 9] However, this proposed simplified classification, has never been tested for its reliability and applicability in clinical practise. In this study we assess the agreement of two classification systems for femoral neck fractures, the four-category Garden classification and we investigate the reliability of a simplified classification of femoral neck fractures into 'non-displaced' and 'displaced' fractures.

PATIENTS AND METHODS

Patients

We retrospectively selected 100 anterior-posterior (AP) and lateral view preoperative radiographs in a period from December 2005 until February 2007 of patients that had been admitted with a femoral neck fracture, in the Medisch Centrum Haaglanden, The Hague, The Netherlands. The radiographs were selected randomly selected by date and the radiographs were numbered. In the radiographs name of the patient was printed in very small print. Since the selected radiographs were from a group of patients that was treated for a femoral neck fracture at least three years ago and the results of this study were not likely to be influenced by this fact, it was not considered a disadvantage. The quality of all radiographs was representative and initial decision on treatment had been made based on these radiographs.

Methods

The observers' group consisted of five trauma surgeons and five surgical residents with special interest for orthopaedic trauma from two different medical centres in Europe. (Medisch Centrum Haaglanden, The Hague, The Netherlands and the Kardinal Schwarzenberg'sches Krankenhaus, Schwarzach, Austria). Half of the observers' group was from the Medisch Centrum Haaglanden, in The Netherlands and the other half were from the Kardinal Schwarzenberg'sches Krankenhaus, in Austria. The observers were provided as much time as needed for accurate assessment. They were asked to classify the 100 fractures independently according to the Garden classification. The Garden classification[1] (Figure 1) consists of four subtypes: Garden grade I is an incomplete femoral

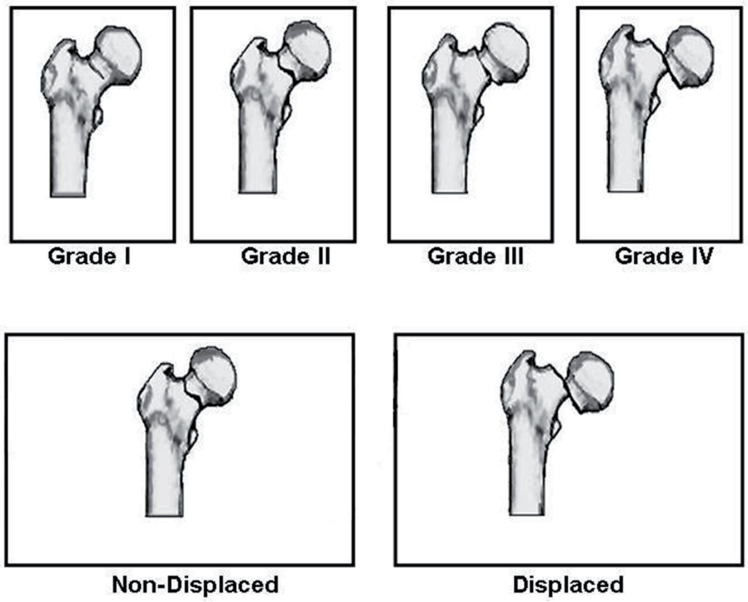

Figure 1

Top: The four-grade Garden classification, questionnaire of the observers
Bottom: Classification: 'non-displaced' and 'displaced'.

neck fracture, with valgus impaction; Garden grade II is a complete but non-displaced fracture; Garden grade III fracture is a complete and partially displaced fracture with alignment of the femoral neck relative to the neck in varus deformity and Garden grade IV is a complete fracture with complete displacement.

All participants were familiar with the classification and each questionnaire was provided with an overview of the four different types of fractures. Furthermore, we asked the observers to classify the fractures as 'non-displaced' and 'displaced'. In order to mimic the clinical situation best, we did not provide the observers with a definition in terms of a description or figure.

The inter-observer reliability of the four-grade Garden classification and the simplified classification of femoral neck fractures into 'non-displaced' and 'displaced' fractures was calculated.

We also calculated the 'expected' inter-observer variability of the simplified two- grade Garden classification. In order to calculate this kappa-value, we used data of the classified fractures according to the four- grade Garden classification by the ten observers and paired the Garden grades I and II ('non-displaced') and the Garden grade III and IV ('displaced') together.

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.[13] 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.[14]

RESULTS

The mean age of the 100 subjects was 81.4 (42-98, SD 9.9). Twenty-six patients were male and 74 female. The inter-observer agreement of the fractures classified by all observers using the four-grade Garden classification and the inter-observer kappa of the fractures that were classified according 'non-displaced' and 'displaced' for both trauma surgeons and residents, are presented in Table 1. No difference was seen between the trauma surgeons and residents as the four-grade Garden classification and the simplified classification ('non-displaced' and 'displaced') showed respectively for both type of observers 'fair' and 'moderate' agreement. The inter-observer reliability of the created two groups (Garden grade I and II fractures and Garden grade III and IV fractures together) based on the four-grade Garden classification was κ0.72. There was a higher agreement value if we calculated the 'expected' agreement based on the four-grade Garden classification. We statistically grouped the Garden grade I and II fractures and grade III and IV fractures together and found an 'expected' two-grade Kappa value of κ0.72, SE 0.04). In Table I you find the Kappa-values of the four-grade Garden classification and the Kappa-values of the 'measured' non-displaced and displaced classification.

Table 1

Inter-observer variability

	Kappa	**SE**
Four-grade Garden classification	**0.31**	0.01
Trauma surgeons	0.32	0.02
Residents	0.37	0.04
Two-grade Garden classification 'measured' (non-displaced and displaced)	**0.52**	0.06
Trauma surgeons	0.59	0.12
Residents	0.55	0.07
Two-grade Garden classification 'expected'	**0.72**	0.04
Trauma surgeons	0.85	0.07
Residents	0.61	0.06

The observers classified a total of 230 fractures as Garden I or II. Nevertheless, there was a wide range of 39% to a 100% among observers classifying these as 'non-displaced'.

DISCUSSION

A reliable fracture classification for the femoral neck fractures should have a high degree of inter-observer agreement, provide information on the likelihood of complications such as non-union or avascular necrosis and should guide implant choice. The use of a simple 'non-displaced' and 'displaced' classification was suggested by several authors because of the low reliability of the four-grade Garden classification and was never tested for its inter-observer agreement. The classification of femoral neck fractures into 'non-dipslaced' and 'displaced' is believed to be of clinical relevance as it is incorporated in several treatment guidelines. In this study we confirm 'fair' reliability of the four-grade Garden classification and its use in clinical practise should be avoided.[3-5;7-12] The inter-observer reliability of the simplified classification of the fractures into 'non-dipslaced' and 'displaced' was 'moderate'.

Remarkably, we found higher agreement values if we calculated the 'expected' agreement based on the four-grade Garden classification, statistically grouping the Garden grade I and II fractures and grade III and IV fractures together. It seems that a distinct description on when to consider a fracture 'non-displaced' lacks, as some observers only classified 39% of the Garden grade I and II fractures as 'non-displaced'. Thus, simplified classifications may be more practical but clear definitions should be at hand for use to render it more reliable. Furthermore, as this is a reliability study simply performed by using preoperative radiographs, it should be taken into account that ideally, in the clinical situation, intra-operative radiographs should be used to classify fractures. Although intra-operative radiographs should be considered as 'gold standard' for logistical reasons and patient benefit it is very valuable to be able to classify and make up a treatment plan before entering the operation room.

Our results can be compared to the results shown by Blundell et al.[15] Their results showed higher inter-observer agreement after simplifying the AO-classification of intracapsular hip fractures of the proximal femur, by classifying the fractures into non-displaced (B1.1, B1.2 and B1.3), basal (B2.1) and displaced (B2.2, B2.3, B3.1, B3.2, B3.3). Another frequently used classification is the Pauwels classifications that consist of three-types of fractures, taking the angle of the fracture line into account. Although, it is used commonly, it has been proven that the Pauwels classification suffers from poor inter-observer reliability.[16]

In this study we assess the reliability of the proposed simplified classification of femoral neck fractures in 'non-displaced and 'displaced' fractures in a number of 100 patients, for the first time. The limitation of this study is regarding the fact that the observers classify-

ing the 'non-displaced' and 'displaced' fractures were not provided with a clear definition or image, so we could not investigate whether the agreement would increase if these were at hand. Despite, our results do suggests that the kappa value of a simple 'non-displaced' and 'displaced' classification of femoral neck fractures could be improved if a clear definition to the observer is provided.

CONCLUSIONS

A poor reliability of the four-category Garden classification was confirmed and for clinical or research purposes this classification should not be used. Better reliability was found for the classification of femoral neck fractures simply as 'non-displaced' or 'displaced'.

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