Facts and fiction in hip fracture treatment

Embden, Daphne van

Chapter 5

The Pauwels classification for intra-capsular hip fractures: is it reliable?

Daphne van Embden*
Gert R. Roukema*
Steven J. Rhemrev
Franklin Genelin
Sven A.G. Meylaerts
* Both authors made an equal contribution

Injury. 2011 Nov;42(11):1238-40.

ABSTRACT

Aim

The Pauwels classification for the femoral neck fracture is still broadly used in literature and clinical practise. However, this classification has never been tested for its reliability in terms of inter-observer agreement. We assessed whether or not it is reliable to use the Pauwels classification in pre-operative planning.

Methods

Ten observers classified 100 intra-capsular femur fractures. The inter-observer agreement was calculated using the multi-rater Fleiss' kappa.

Results

The Pauwels classification showed an inter-observer agreement of κ0.31 (0.01).

Conclusion

Classification of intra-capsular hip fractures according to the Pauwels classification using the Pauwels angle is unreliable and its use should be avoided.

INTRODUCTION

The Pauwels classification (1935)[1] was the first biomechanical classification of femoral neck fractures. In the Pauwels classification the fracture line angle is used to identify three groups of femoral neck fractures. It relates the shearing angle of the fracture line of the distal fragment. It was suggested by Pauwels that a greater vertical shear is related to an increase of the incidence of non-union or malunion in femoral neck fractures. The Pauwels grading consists of three grades. (Figure 1)

The Pauwels angle is still broadly used in literature and for pre-operative planning. For example, in the Dutch guideline for the treatment of intracapsular fractures, it is advised, to treat a type III fracture with a Dynamic Hip Screw (DHS) and the type I and type II fractures by Cannulated Screw Fixating.[2]

Despite its frequent use, studies have never investigated the reliability of a classification, such as the Pauwels classification that uses the inclination of the fracture line. This study investigates whether or not it is reliable to use this classification in pre-operative planning.

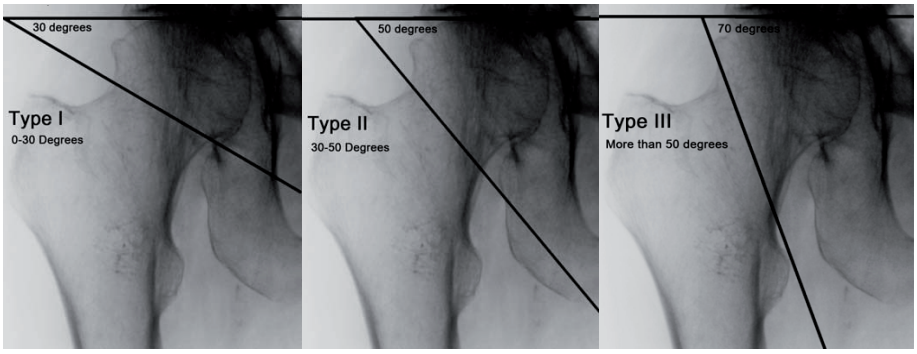

Figure 1

Pauwels classification

METHODS

We randomly selected 100 anterior-posterior (AP) and lateral view preoperative radiographs of patients that had been admitted with a femoral neck fracture from January 2008 to February 2009, in the Medisch Centrum Haaglanden, The Hague, The Netherlands. The quality of all radiographs was representative and initial decision on treatment had been made based on these radiographs.

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 Pauwels classification. All participants were already familiar with the classification and each questionnaire was provided with an overview of the three different types of fractures.

The following definitions were used (Figure 1): [1, 3]

- Type I: Up to 30 degrees. The compressive forces are predominant.
- Type II: 30 to 50 degrees. The shearing stress is present and may have a negative effect on the bone healing.
- Type III: 50 degrees and more. The shearing stress dominates and is associated with a significant varus force. This results in fracture displacement and varus collapse.

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.[4] 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.[5]

RESULTS

The mean age of the 100 subjects was 81.4 (SD 9.9). Twenty-seven patients were male and 74 female. The Pauwels classification showed an inter-observer agreement of κ0.31 (0.01) for all observers, κ 0.38 (0.04) for the surgeons and κ 0.27 (0.02) for the residents.

DISCUSSION

We have assessed the reliability of the Pauwels classification and we found it to be fairly reliable (κ0.31). This first fracture classification system for femoral neck fractures, that is related to the shearing angle of the fracture line is still frequently mentioned in literature. No other study has investigated the inter-observer variability of the classification as tool in preoperative planning before.

Studies did investigate the value of the Pauwels angle in predicting the likelihood of non-union and showed variable results.

It was suggested that an increase in the fracture line angle is associated with an increase of the incidence in non- or malunion.[6-12] Parker and Dynan[12] investigated the predictive value of the Pauwels angle, and failed to show an increase in non-union in both the non-displaced or displaced fractures. Although, limited due to heterogeneity, other studies[13-17] did not show an increase of the incidence of non- or malunion either. Parker[12] did show a significant association between the Pauwels angle and the Garden classification. He also implies that a more horizontal fracture line would increase the likelihood of fracture impaction and successful non-operative treatment of the Garden I femoral neck fracture. However, a number of studies have shown a unreliability of the Garden classification and its use should be limited to a simple non-displaced or displaced classification.

Another clinical difficulty is, as mentioned by Bartoniceck[3], the frequent misinterpretation of the Pauwels classification and the difficulties of the measurement of the fracture line angle, pre- or after reduction of the fracture due to rotation of the femur. In this study preoperative anterior-posterior and lateral radiographs were provided to the observers. Although, frequently used for pre-operative planning, it is advised to use the Pauwels classification after reduction[18]. Most studies in literature that implement the Pauwels angle use pre-reduction radiographs.

Despite, the lack of evidence for the predictive value of the Pauwels angle it is still used in literature and preoperative planning. As shown in our study the Pauwels classification is unreliable with a low interobserver agreement and therefore its use should be avoided.

REFERENCES

1. Pauwels F. Der Schenkelhalsbruch. Ein mechaizisches Problem. F. Enke, Stuttgart, 1935.
2. Richtlijn Behandeling van de proximale femurfractuur bij de oudere mens, 2e Trache/ Guideline for the treatment of the proximal femorl fracture. Nederlandse Vereniging voor Heelkunde/Dutch Surgical Society. 2007.
3. Bartonícek J. Pauwels' classification of femoral neck fractures: correct interpretation of the original. J Orthop Trauma. 2001 Jun-Jul;15(5):358-60.
4. Fleiss JL. Statistical Methods for Rates and Proportions. John Wiley and Sons, New York 1981.
5. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977; (33): 159-174.
6. Bray TJ. Femoral neck fractures: clinical decision making. Clin Orthop 1997;339:20-31.
7. Bunata RE, Fahey JJ and Drennan DB. Factors influencing stability and necrosis of impacted femoral neck fractures. JAMA 1973;223:41-44.
8. Cassebaum WH and Nugent G. Predictability of bony union in displaced intracapsular fractures of the hip. J Trauma 1963;3:421-424.
9. Crawford HB. Impacted femoral neck fractures. Clin Ortlzop 1969;66:90-93.
10. Eklund J and Eriksson F. Fractures of the femoral neck: with special regard to the treatment and prognosis of stable abduction fractures. Acta Chir Scand 1964;127:315-337.
11. Flatmark AL and Lone T. The prognosis of abduction fractures of the neck of the femur. J Bone Joint Surg [Br] 1962;44-B:324-327.
12. Parker MJ, Dynan Y. Is Pauwels classification still valid? Injury. 1998 Sep;29(7):521-3.
13. Hulth A. The inclination of the fracture surfaces and its relation to the results of healing in femoral neck fractures. Acta Chir Stand 1961;121:309-314.
14. Nilsson LT, Johansson A and Stromqvist B. Factors prediction healing complications in femoral neck fractures: 138 patients followed for 2 years. Acta Orthop Scafzd 1993;64:175-177.
15. Ohman U, Bjiirkegran N and Fahlstrom G. Fracture of the femoral neck, a five-year follow-up. Acta Chir Stand 1969; 135: 27-42.
16. Otremski I, Katz A, Dekel S, Salama R and Newman R J. Natural history of impacted subcapital femoral fractures and its relevance to treatment options. Injury 1990;21:379-381.
17. Raaymakers ELFB and Marti RK. Non-operative treatment of impacted femoral neck fractures: a prospective study of 170 cases. J Bone Joint Surg [Br]. 1991; 73-B:950-954.
18. Garden RS. Low-angle fixation in fractures of the femoral neck. J Bone Joint Surg [Br] 1961;43: 647–663.