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Surgical Clinic and X-ray Department, University Central Hospital, Turku, Finland.

CLASSIFICATION OF MEDIAL FRACTURES OF THE FEMORAL NECK

SEPPO NIEMINEN & KAUKO SATOKARI

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The first classification of femoral neck fractures was undertaken by Cooper (1823), who divided them into intracapsular and extracapsular fractures. His division was based on the various prognoses for recovery in this type of fracture. It was later observed that it was possible to distinguish different basic types of intracapsular or medial fractures. In the first classification, such fractures were called "subcapital" or "most lateral", depending on where the line of fracture ran (Kocher 1896, Faltin 1924, Anschütz & Portwich 1927). On a somewhat different basis, medial fractures of the femoral neck have also been divided according to the manner of dislocation, into abduction fractures and adduction froctures (Waldenström 1924, Cotton 1927, Böhler & Jeschke 1938). Nyström (1938) called these fractures valgus and varus fractures. Watson-Jones (1955) made an original division based upon the age of the patient and he concluded that a certain type of fracture was typical for certain age groups.

It has been observed that there are considerable prognostic differences between different types of medial fractures of the femoral neck and this has been considered to be due to the position of the fracture in the femoral neck. The steeper the angle of fracture, the worse the bone union prognosis (Löfberg 1924, Howard & Christophe 1934, Nyström 1935, Lehmann 1936, Böhler & Jeschke 1938). The best-known work on the subject is that published by Pauwels (1935), who divides medial fractures into three groups according to the angle formed between the line of fracture and the horizontal. His groups are as follows:

1) angle 0°–30°
2) angle 30°–50°
3) angle over 50°

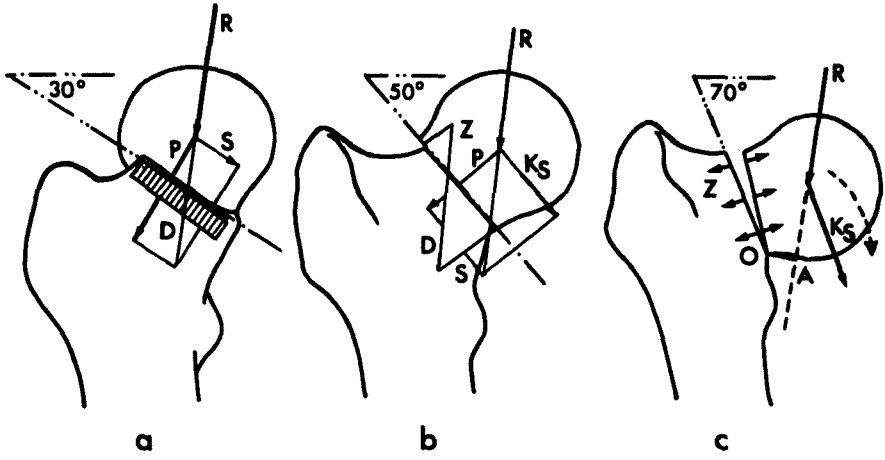

Figure 1. Pauwels' classification of medial fractures of the femoral neck.

The classification by Pauwels has also been completed by adding a so-called "fourth" group in which, on the angled line of fracture there is, in the lower part of the femoral neck a tonguelike "basal-sporn" formation, running distally (Leitz 1966). In the Pauwels' scheme, this form is the most unstable of all.

The prognostic significance of Pauwels' angle has been considered unsatisfactory (Spotoft 1944, Linton 1944, 1949, Nieminen 1974). It has also been difficult to define the angle required for classification (Garden 1961). Recently it has been thought that in the case of medial fracture it is the degree of primary dislocation that correlates with the prognosis of recovery (Linton 1949, Spotoft 1949, Backman 1957, Fielding et al. 1962).

On this basis, Garden (1961) made a classification of medial fractures of the femoral neck which has been widely adopted in English and American studies of the subject. On the basis of primary X-ray findings, he divided fractures as follows:

Stage 1: incomplete fracture. (This group consists principally of impacted valgus fractures).
Stage 2: complete fracture without displacement.
Stage 3: complete fracture with partial displacement. (In this type the posterior capsule of the joint has remained intact).
Stage 4: complete fracture with full displacement.

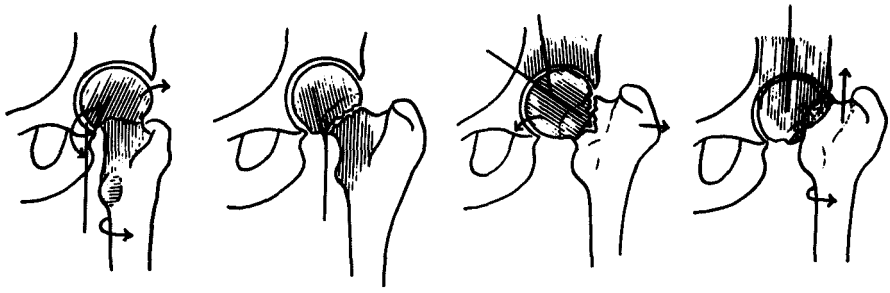

Figure 2. Garden's classification of medial fractures of the femoral neck. (After DePalma 1970).

Studies of clinical series in which medial fractures have been divided according to the above classification have been made by Garden (1961), Brown & Abrami (1964), Graham (1968) and Barr (1973). In his manual on fractures, DePalma (1970) adopts Garden's classification.

In order to obtain a practical and coherent classification of medial fractures of the femoral neck, the present authors undertook a comparative study which fell midway between Pauwels' scheme, in which the criterion was the direction of the line of fracture and Garden's scheme in which classification was based on the degree of primary dislocation. The guiding criterion for comparison was the prognosis for recovery.

MATERIALS AND METHODS

The series of patients comprised all those who were treated for medial fractures of the femoral neck between the years 1964 and 1971 in the city of Turku, Finland (The University Hospital in Turku and also the Municipal Hospital of Turku). Cases of pathological fracture were not included in the study. The study deals with 446 medial fractures of the femoral neck in a total of 436 patients. This was 56.3 per cent of all recorded cases of fracture of the proximal end of the femur. In the retrospective study, medial fractures were classified according to the scheme of Garden (1961) and Pauwels (Leitz 1966) and, on the basis of the most recent X-ray photographs available, bone union and failure were classified, as well as cases where there was necrosis of the femoral head. Necrosis was considered to exist when there was late segmental collapse of the femoral head (Barnes 1962, Bohr & Larsen 1965, Catto 1965). Progress of recovery was classified on the basis of the above fracture groups.

Table 1. Distribution of fracture cases according to the classifications of Garden and Pauwels.

Garden	Pauwels 1	2	3	4	Together
1	5 (1)	49 (11)	14 (3)	1	69 (16)
2	– – –	5 (1)	4 (1)	– – –	9 (2)
3	– – –	18 (4)	21 (5)	1	40 (9)
4	7 (2)	180 (40)	127 (29)	12 (3)	326 (73)
Together	12 (3)	252 (57)	166 (37)	14 (3)	444 (100)

In brackets, percentage of all cases.

Table 2. Progress of healing grouped according to the distribution of fractures by Garden and Pauwels.

Garden / Pauwels		1 / 1	2 / 2	3 / 3	4 / 4
Bone union	per cent	86 / 60	75 / 63	61 / 51	51 / 46
Failed	per cent	3 / 20	13 / 16	29 / 30	26 / 46
LSC	per cent	11 / 20	20 / 24	18 / 17	25 / 13

LSC = Late segmental collapse of the femoral head.

FINDINGS

Out of the 446 medial fractures considered in this study, it was possible in the case of all but two to make definitions according to the classifications of Garden and Pauwels. The distribution of fracture cases according to these classifications will be seen in Table 1.

Table 2 shows the retrospective evaluation of progress of healing in fracture cases, grouped according to the type of fracture. Necroses of the femoral head were calculated on the basis of fracture cases where there had been a follow-up of at least 1 year. Garden's division proved to be more logical than that of Pauwels. Particularly in the analysis of stable and non-dislocated fractures there was a statistically significant difference ($P < 0.01$) and in the case of failures a highly significant ($P < 0.001$) difference as far as bone union was concerned, compared to the results when Pauwels' division was analysed. It was impossible to show any statistical connection between the number of cases where there was necrosis of the femoral head and the classification of fractures used.

DISCUSSION

In the present study, cases of medial fracture were divided in a similar manner to that of previous studies (Brown & Abrami 1964, Bähr et al. 1971, Massie 1973). In the studies made by Garden (1961, 1971) and Graham (1968), Garden's 3rd degree fractures were considerably more common. As Brown & Abrami (1964) emphasized, distinguishing between the 3rd and 4th degrees is difficult and to some extent a question of interpretation and for this reason, these degrees are often dealt with as a single group. No clear correlation could be observed between the different classifications. It may be possible to explain this lack of correlation by the fact that definitions of stability (Pauwels' angle) were made from X-rays on the frontal view and that the level and direction of the fracture seen on the lateral view were not taken into account. As a criterion for the determination of stability, the aforementioned view is just as important as the frontal view (Backman 1957). In the Pauwels' classification this is, however, not taken into account.

Evaluated on the basis of Table 2, Garden's division shows itself to be much more logical and from the point of view of both bone union and failure prognostically more reliable. Spotoft (1949) and Massie (1973) have also considered the degree of primary dislocation in medial fractures a prognostically superior system of calculation to that of Pauwels. In practice the Pauwels' angle is difficult to measure, its value is dependent upon the degree of rotation of the femur and the angle changes on account of impaction. The fracture can often be classified in different groups before and after nailing (Garden 1961) and the value of the classification has been considered unsatisfactory from the point of view of prognosis of recovery (Spotoft 1944, Linton 1944, 1949). Because of its simplicity and because determinations can be made without measurements and also because of its prognostic reliability for bone union, Garden's division of medial fractures of the femoral neck can be recommended as the basic classification for clinical work.

SUMMARY

In this study 444 consecutive cases of medial fracture of the femoral neck treated in the city of Turku are considered on the basis of the proposals of Garden (1961) and Pauwels (Leitz 1966) for the classification of fracture types. In order to find out what kind of classifica-

tion is most practical and coherent a retrospective comparison of the progress of healing was made on the basis of the aforementioned classifications of fracture. Garden's classification proved to be far more logical and was much more reliable for the prognosis of recovery. For this reason and also because of the ease with which his criteria can be applied, the present authors recommend the general use of Garden's classification.

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Correspondence to:

Seppo Nieminen, M.D.
Surgical Clinic
University Central Hospital, Turku
20520 Turku 52
Suomi – Finland