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EPIDEMIOLOGY AND TREATMENT OF DISTAL FEMORAL FRACTURES IN ADULTS

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Fractures of the distal femur comprise 4 per cent of all femoral fractures. The records of a consecutive series, from 1969 to 1976, of 135 adult patients with 137 fractures, not caused by malignant disease, were reviewed for age, sex, previous disease, type of fracture, treatment and end-result. Eighty-four per cent of the patients were over 50 years of age, 19 per cent had other general factors predisposing them to fracture, and 42 per cent had previous or current disease of the fractured leg.

Eighty-three fractures were caused by moderate and 52 by severe trauma. Unicondylar fractures were separated into lateral or medial type. Ten fractures were open and 45 were operated on primarily, mostly using condylar plates, screws or Rush pins.

Satisfactory results (pain-free knee without angular deformity and at least 90° of motion) were achieved in two-thirds of the fractures following both non-surgical and surgical treatment. However, the surgical group was an average of 8 years younger and contained a higher proportion of bicondylar fractures than the non-surgical group. Treatment in traction involved a mean period of 7 weeks for 47 patients. This expensive treatment is no longer used for femoral neck, trochanteric or shaft fractures. In distal femoral fractures the goal should also be early mobilization, if necessary using surgical treatment.

Key words: aetiology; epidemiology; femoral fracture, supracondylar

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Stewart et al. (1966) claimed that "fractures in the distal third of the femur continue to perplex the surgeon. Whether they are transverse, oblique, or comminuted, or supracondylar or intercondylar in a T, Y or V fashion their management still evokes much controversy because of the consistently poor results obtained". This study in adults concerns fractures of the distal third of the femur unsuitable for intramedullary drilling and fixation according to Küntscher. Fractures as a result of malignant bone disease and osteochondral fractures were excluded.

PATIENTS AND METHODS

The investigation was based on all patients over the age of 16 with supracondylar, unicondylar and bicondylar fractures, treated from 1969 to 1976 at the Departments of Orthopaedic Surgery of the University Hospitals in Lund and Malmö.

A total of 194 patients were identified from the WHO data registrations at the hospitals. The radiographic films had been examined by radiologists and were re-examined by the authors and in doubtful cases were discussed again with the radiologist. After excluding patients with primary treatment in other hospitals and patients with missing or incomplete radiographic examinations and records, 55 patients with 56

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distal femoral fractures were included from Lund and 80 patients with 81 fractures from Malmö, making a total of 135 patients with 137 fractures.

Lund is a regional centre and receives patients from other hospitals as well. Malmö is a city of around 250,000 inhabitants and has only one orthopaedic department, which does not receive fractures from outside the city; the fractures in Malmö were therefore used for incidence assessment, as has previously been done for other fractures (Alffram & Bauer 1962, Alffram 1964, Nilsson 1969).

In order to study the characteristics of patients with distal femoral fractures in Malmö and Lund, the materials were classified according to sex, age, side, fracture type (supracondylar, unicondylar and bicondylar), previous diseases (local and general), moderate and severe trauma, treatment and final result.

The degree of violence was assessed as severe or moderate according to Alffram & Bauer (1962). *Severe trauma* was defined as that resulting from a fall more severe than one from a standing position. Thus all traffic accidents, falls on stairs or falls from standing on a chair were considered severe. Two patients who had sustained fractures when their knee hit the rink while skating were also classified as severe. Falls on the ground or from sitting in a chair or from lying in bed were classified as *moderate*.

Optimal treatment chould completely restore the position and function of the leg within a short time, preferably without complications and undue costs. A detailed preoperative assessment of limb function, as is obtained before hip and knee replacements, is unfortunately not available when judging the outcome of fracture treatment. This material comprises elderly patients with a high percentage of previous diseases in the fractured leg, and sometimes in the contralateral leg as well, and in some cases with various other disabilities, making the prefracture state more difficult to evaluate than in previously healthy patients. The information concerning the final results in the records was insufficient in some patients and we therefore excluded 13 patients in the non-surgical and four in the surgical group. Three patients who died shortly after sustaining the fracture and before healing were also not included. We assessed the results, using the guidelines given in Table 1.

The results were classified as "good" rather than "excellent" if one of the criteria for "good" was fulfilled, and so on. The grading of the results is a slight modification of the grading of Stewart et al. (1966) for pain, angular deformity and shortening. Because of the shorter observation time and the number of elderly patients with previous diseases and only limited needs as regards function, we have accepted further limitations in range of motion. Some patients use sticks or crutches and the reason is not always apparent in this age group. This classification criterion was therefore avoided. Patients operated on for non-union were considered failures and the results classified as poor. In this assessment the known preoperative function was taken into consideration, i.e. a patient who had been using a wheelchair before fracturing his leg was classified as excellent if he was sitting comfortably and without pain, even if the fracture had healed with slight deformity or some shortening. "Excellent" and "good" were summarized as *satisfactory* and "fair" and "poor" as *unsatisfactory*.

RESULTS

Fracture incidence. The annual number of distal femoral fractures in Malmö ranged from 6 to 15 with an average of 10.1 ± 6.0 (M ± 2sd), corres-

Table 1. Classification of results after distal femoral fractures

Result	Knee motion	Pain	Angular deformity	Shortening
Satisfactory:				
Excellent	Full extension and 120° flexion	None	None	Less than 1 cm
Good	Full extension and 90° flexion	None or occasionally	Hardly visible	Less than 2 cm
Unsatisfactory:				
Fair	Less than 10° extension deficit more than 60° total range of motion	Slight pain always	Less than 10° varus or valgus	Less than 3 cm
Poor	10° extension deficit. Less than 60° total range of motion	Constant and severe	10° or more varus or valgus	More than 3 cm

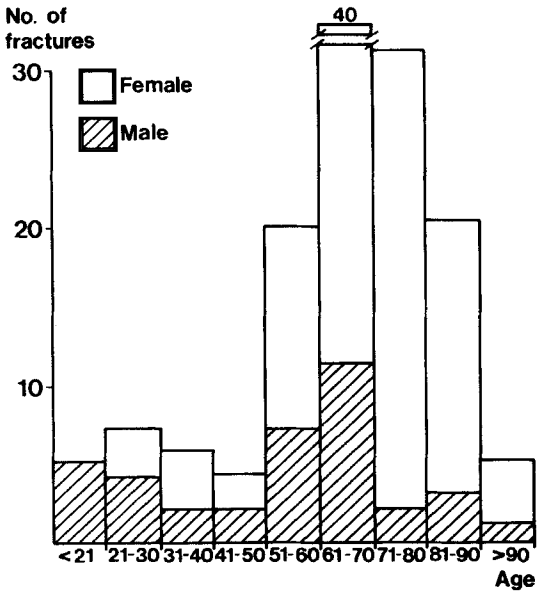

Figure 1. Age and sex distribution of 137 distal femoral fractures. One hundred fractures were female. Mean age 65 years, median 68.

ponding to an annual incidence of 51 per million inhabitants over 16 years of age.

Age and sex distribution (Figure 1). Eighty-four per cent of the fractures occurred in patients over 50 years of age. Males dominated the youngest age groups and females the oldest; only 10 out of 78 fractures occurring after the age of 65 were in males. The age pattern was similar for the various fracture types.

Other predisposing factors. Twenty-six patients previously had impaired function in both legs (Table 2) caused by diseases which probably contributed to the fracture. As the influence on bone strength of diabetes and Parkinson's disease has not been established, these diseases were not taken into consideration. A total of 57 patients had sustained fractures in the same leg in which they had other fractures or diseases (Table 3). Only one patient with a previous hip fracture fractured the healthy, contralateral leg. Thus a highly significant ($P < 0.001$)* proportion of the patients had impaired function, with weakened bone and/or decreased neuromuscular function in the fractured leg. The greatest number of previous fractures was seen in the hips of the elderly. In comparison with the normal population, the incidence of hip fractures was higher ($P < 0.05$)* in patients with distal femoral fractures.

Table 2. Number of patients with impaired function in both legs due to previous fractures or generalized disease

Gonarthrosis (bilateral)	8
Polio	4
Epilepsy	3
Cerebro-vascular disease	3
Stomach resection (Billroth II)	2
Hip fractures (bilateral)	1
Rheumatoid arthritis	1
Coxarthrosis (bilateral)	1
Cortisone treatment (asthma bronchiale)	1
Multiple sclerosis	1
Haemophilia	1
Total	26

Trauma (Table 4). One-third of the fractures were caused by severe trauma and two-thirds by moderate trauma. The proportion of severe trauma fractures (mostly traffic accidents) was highest in the younger age groups. Supracondylar fractures in 33 out of 39 patients were caused by moderate trauma and this was highly significant ($P < 0.001$)* compared to the bicondylar group. The average supracondylar fracture patient was 8 years older ($P < 0.05$)* than the bicondylar and 4 years older than the unicondylar fracture patient.

Table 3. Number of patients with impaired function in the fractured leg due to previous fractures or diseases

Pelvic, femoral neck and trochanteric fractures	24
Other fractures of femur and lower leg	17
Coxarthrosis (unilateral)	5
Congenital disease of the hip	2
Perthes' disease	1
Hip arthrodesis after TBC	1
Lower leg amputation	3
Gonarthrosis (unilateral)	1
Osteochondritis dissecans	1
Knee arthrodesis	1
Congenital deformity of the leg	1
Total	57

* Statistical analysis by Chi-square test with Yates' correction.

Table 4. Distal femoral fractures classified according to anatomical type, age and violence of the trauma

Type	*n*	Mean age	Moderate trauma	Severe trauma	Unknown trauma
Uni-C	33	65	21 (0.66)	11 (0.34)	1
Bi-C	65	61	29 (0.45)	35 (0.55)	1
Supra-C	39	69	33 (0.85)	6 (0.15)	–
Total	137	64.5	83	52	2

There was no conclusive difference in number, type and degree of trauma between lateral and medial unicondylar fractures. Three osteoporotic patients with unicondylar fractures caused by moderate trauma had a concomitant malleolar fracture of the same lateral or medial side.

Results of treatment. The results were acceptable (excellent or good) in about two-thirds of all fractures following both surgical and non-surgical treatment. The outcome of non-surgical treatment was satisfactory in 19 out of 22 unicondylar fractures, in 24 out of 35 bicondylar fractures and in 15 out of 22 supracondylar fractures. The mean time in traction was 7.3 weeks for bicondylar and 6.6 weeks for supracondylar fractures. Surgical treatment was satisfactory in 28 fractures and unsatisfactory in 15. The surgical methods used were condylar plates in four patients, Rush pins in four and screws in five patients in the unsatisfactory group. The unicondylar group showed only one unsatisfactory result, probably caused by soft tissue damage. Thus 12 out of 13 unsatisfactory cases were bicondylar or supracondylar fractures and all unsatisfactory cases were over 50 years of age.

The complications observed were one infection, three refractures and two non-unions in the non-surgical group, whereas in the surgical group there were three infections, of which one resulted in osteomyelitis, three non-unions and one broken plate.

The mobilization time following distal femoral fracture (Table 5) was longest for bicondylar and supracondylar fractures.

DISCUSSION

Conservative treatment using tibial traction for distal femoral fracture was reported by Mahorner & Bradburn (1933), with good final results in only a few cases. Modlin (1945) used tibial traction supplemented by vertical femoral traction, to balance the pull of the gastrocnemius muscle, and reported encouraging results. Retrospective reports during the 1960's by Stewart et al. (1966) and Neer et al. (1967) favoured simple non-operative methods of treatment. However, new surgical methods and materials (Müller et al. 1979, Zickel et al. 1977) have improved the results of surgery.

Because of the high percentage of elderly patients with previous diseases, the results in this material should not directly be compared with other reviews of young patients with healthy bones and fractures sustained by high energy trauma.

Table 5. Mobilization following distal femoral fractures. Time in weeks for 50 and 90 per cent of the patients

Type	50% of patients			90% of patients		
	Walking	Discharged from hospital	Full weight-bearing	Walking	Discharged from hospital	Full weight-bearing
Uni-C	1	2	8	6	10	14
Bi-C	7	8	12	11	17	22
Supra-C	5	9	12	12	19	22

The classification of fractures in the distal third of femur has been somewhat different in previous reports. Chiron et al. (1974) and Stewart et al. (1966) divided the fractures into unicondylar and supracondylar, and T-fractures (intercondylar), while Neer et al. (1967) omitted the first two groups and described four stages of T-fractures. Their classification is based on the direction and displacement of the femoral shaft and corresponding damage to the soft tissues.

In the present study, fractures were classified into supracondylar, unicondylar and bicondylar. The *supracondylar* fracture is *extra-articular* with regard to articular cartilage but might involve the suprapatellar pouch. The unicondylar and bicondylar fractures are *intra-articular* and involve the patellar joint and the congruence of the two condyles. Treatment of unicondylar fractures consists of apposition of the separated condyle to the other condyle, whereas in bicondylar fractures the two condyles have to be first apposed before the supracondylar fracture can be treated. This classification is preferred because it gives a simple verbally correct description of the fracture while at the same time suggesting treatment. The term "supracondylar fracture" should thus never be used synonymously with other types of distal femoral fracture. We have avoided further subdivisions of distal femoral fractures in this study of primary results, but have made a further classification into non-displaced, displaced and transcondylar, when examining late function and the development of gonarthrosis in these patients (Egund & Kolmert 1982). From the WHO registrations in Malmö the overall ratio of different levels of fractures of the femur during a 10-year period (1969–1978) showed that 4 per cent of 1007 fractures were in the distal third, 10 per cent in the shaft and 86 per cent in the proximal third. Thus the infrequency of the occurrence of distal femoral fractures gives most orthopaedic surgeons only limited experience of both classification and treatment.

Non-surgical treatment of 47 supracondylar and bicondylar fractures required a total of 333 weeks in traction (a mean of 6.6 and 7.3 weeks respectively). Fifty per cent of the patients left hospital after 8–9 weeks, which most probably corresponds with the average hospitalization time of 62 days described by Stewart et al. (1966). In our clinic, treatment in traction is not used for proximal and transverse shaft fractures of the femur. The alternative surgical stabilization, which is available for elderly patients and involves little risk owing to modern anaesthesiology, should probably be applied more frequently for fractures of the distal third of the femur. Some of the complications of refracture and non-union could thus be avoided, the costs of hospital treatment reduced and early mobilization made possible.

The surgical treatment of bicondylar and supracondylar fractures showed unsatisfactory results in patients over the age of 50: 4 out of 13 for A0 condylar plate, 4 out of 5 for Rush pin fixation and 3 out of 5 for screws. Failures with non-union, a broken plate and infection all occurred in the elderly. It is very important in patients in this age group for the osteosynthetic devices to be well applied and adjusted to the fragile skeleton. Application of the A0 condylar plate requires wide exposure (Müller et al. 1979). Because fractures are rarely operated on by orthopaedic surgeons anatomic reduction and the desired rigid internal fixation may be difficult to attain. There is also a risk that the plate may be stronger than the skeleton in elderly persons and cutting will result. The common Rush pin is easy to apply but may lose its distal insertion by cutting through the condyle, with malposition of the fracture as an unsatisfactory final result. Fixation by screws only was also unsuccessful. For patients below the age of 50 there was only one unsatisfactory result: improper fixation by screws in an oblique fracture of the lower femoral shaft, necessitating 6 weeks of traction postoperatively.

It was concluded from this material of elderly patients with previous diseases that early stabilization of the fracture would be of benefit, in order to avoid traction treatment in bed. The goal should be to mobilize patients with undisplaced fractures immediately and those with displaced fractures directly after operation, in suitable plasters or case braces. The operative treatment and osteosynthetic devices must be adjusted to the patient, the soft tissue and the bone quality to achieve an acceptable final outcome (Kolmert & Persson 1980). A new osteosynthetic device, de-

signed specially for the fragile skeleton, has therefore been developed in Lund. It consists of screws for the rigid fixation of the intra-articular part of the fracture. These are connected to intramedullary nails for elastic adjustment to the femoral shaft. The device has been in clinical use since October 1978.

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