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Osteosynthesis of femoral neck fracture

The sliding-screw-plate with or without compression

In a prospective study of 220 displaced femoral neck fractures treated with a sliding-screw-plate, the cases were allocated to osteosynthesis with or without compression. In surviving patients followed for at least 1 year, union occurred in 57/85 with compression and 58/71 without compression. At 2 years, necrosis was radiographically evident in 9/37 and 7/36 united fractures. Thus, compression cannot be recommended when displaced femoral neck fractures are treated with a sliding-screw-plate.

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During the last decade the sliding-screw-plate has been widely accepted in the treatment of trochanteric hip fractures. Several authors (Clawson 1964, Sahlstrand 1974, Jacobs et al. 1976, Jensen 1981) have reported good results, and Jensen (1981) showed that the sliding-screw-plate was superior to both the McLaughlin nail-plate and Jewett nail-plate in the treatment of unstable fractures.

The sliding-screw-plate may also be used in the treatment of femoral neck fractures, but only a few series have been published so far (Cassebaum & Parkes 1973, Rau et al. 1982). Furthermore, the compression hip screw supplies the surgeon with the possibility of applying compression across the fracture, which has been recommended by several authors (Charnley 1960, Kaessmann et al. 1972, Schwarz 1979, Schwarz & Newald 1981). However, in femoral neck fractures the value of compression has not been demonstrated (Hargadon & Pearson 1962, Schwarz 1979).

This study presents the results of a prospectively planned, follow-up examination of displaced femoral neck fractures allocated to sliding-screw-plate osteosynthesis with or without compression across the fracture.

Patients and methods

The two orthopaedic departments at The University Hospital in Odense receive emergency admissions on alternate days, and the patients were accordingly allocated to two treatment groups.

The study included all patients of 40 years and above with displaced fractures of the femoral neck, admitted to the Orthopaedic Departments between October 1979 and October 1981. Only displaced fractures, i.e. Garden's stage 3 and 4 fractures were included in this series.

During the study, 234 cases of displaced fractures of the femoral neck were admitted to the hospital. Fourteen patients were excluded: one had a pathological fracture; two died before operation was performed; one, in whom the fracture could not be reduced, was treated with a Moore prosthesis; one was treated with a Thornton nail as only local anaesthesia could be offered; three were Danish tourists living in other parts of the country; and six patients refused to participate in the follow-up.

In the remaining 220 patients, sliding-screw-plate osteosynthesis was performed with compression in 112 cases and without compression in 108 cases. Thirty-nine patients were males. In the group treated with compression the median age was 79 (40–94) years compared to 77 (40–92) years in the group treated without compression. Sixty-four patients died with insufficient follow-up, but without signs of osteosynthesis failure. Thus, 156 patients with a follow-up period of at least 1 year were available for analysis. For the united fractures the median follow-up was 24 (12–41) months in the group with compression and 28 (12–43) months in the group without compression.

On admission to hospital, traction through the tibial tubercle was applied. Final adjustment of the fracture was made on the fracture table using fluoroscopy with an image intensifier. Operation was performed at the earliest opportunity, but not as an emergency.

In the group with compression, a stainless steel compression hip screw (Richards) was inserted and

compression was applied by the compressing screw. Lag screws with threads 19.1 mm or 28.6 mm long were used. During the last 15 months of the study a supplementary 6.5 mm cancellous bone screw was applied in order to prevent rotation of the capital fragment. In the group treated without compression, a vitallium compression hip screw (Howmedica) was inserted but no compression was applied; however, before closing the wound the fracture was heavily impacted. The operations were performed largely by the same surgeons in both departments, because all surgeons except the consultants rotate between the two departments for periods of 1 year.

Postoperatively, early mobilization was encouraged. If not otherwise contraindicated, the patients were out of bed, sitting in a chair, the day after the operation. On the second or third day, the patients were allowed to walk with elbow crutches. The patients were allowed to walk with elbow crutches. The patients were allowed to bear weight on the operated leg – generally up to the threshold of pain. As this study primarily aimed to elucidate the rate of union, a follow-up period of at least 1 year was demanded unless failure was evident earlier.

Methods

At the end of each operation, the quality of fracture reduction was evaluated from radiographs in both frontal and lateral projections. In both projections the reduction was measured and classified as described by Frandsen & Andersen (1981). No difference was found between the two groups in the quality of reduction (Table 1). The position of the tip of the sliding-screw was determined in relation to the three segments of the femoral head in both the frontal and lateral radiographs (Frandsen & Andersen 1981) and divided into three groups. No difference was found between the two groups in the position of the screws.

At follow-up the cases were divided into three groups:

1. *Union* implied radiographically visible trabeculations across the fracture line.
2. *Failure* implied recurrence of the fracture deformity, including all cases in which the appliance failed. Osteonecrosis was not included in this group.
3. *Position holding, union doubtful* implied lack of radiographic evidence of union, although the fracture retained its position. No patient with more than 1 year follow-up was left in this group. The 64 patients who died before the 1-year follow-up were all placed in this group, although solid bone union had occurred in some.

Table 1. Results at follow-up of 156 femoral neck fractures related to quality of reduction and fixation

Sliding-screw-plate	Reduction	No. of fractures (failed)	Position of the sliding-screw	No. of fractures (failed)
With compression	Good	47 (12)	Good	52 (14)
	Fair	28 (10)	Fair	24 (10)
	Poor	10 (6)	Poor	9 (4)
Without compression	Good	41 (4)	Good	44 (7)
	Fair	22 (5)	Fair	20 (4)
	Poor	8 (4)	Poor	7 (2)

Results

In the group treated with compression, no difference was observed in the rate of union between those treated without (20/31) and those treated with (37/54) a supplementary 6.5 mm cancellous bone screw.

In the group treated with compression, 57/85 fractures united compared to 58/71 fractures treated without compression (Table 2); the difference was significant (Chi square: 4.27; $p < 0.05$).

There was no difference in the proportion of Garden (1961) Stage 4 fractures in the two treatment groups (Table 2). In the group treated without compression, Stage 3 fractures united better than Stage 4 fractures (Chi square: 7.94; $p < 0.005$). The same tendency was found in the group treated with compression, but the difference was not significant.

The incidence of radiographically evident necrosis of the femoral head was determined only for united fractures with at least 2 years of follow-up; it occurred in 9/37 of those treated with compression and in 7/36 of those treated without compression. The difference was insignificant.

Table 2. Union of 156 femoral neck fractures related to osteosynthesis method and primary displacement

Displacement (Garden)	Compression	No compression
3	29/37	34/36
4	28/48	24/35
3+4	57/85	58/71

Discussion

The two groups have been treated with two different compression hip screws with seemingly minor differences in design. Kyle et al. (1980) showed that such differences in the material and design of compression hip screws had relatively little effect on the sliding characteristics compared to the screw-plate angle and the engagement of the screw in the barrel.

In this study we found a higher rate of union in the group treated without compression compared to the group treated with compression. In two minor series of displaced femoral neck fractures treated with compression hip screws (Cassebaum & Parkes 1973, Rau et al. 1982), about 80 per cent of the fractures united. Cassebaum & Parkes (1973) applied compression to the same type of compression hip screw as used in this study in the group treated with compression. Rau et al. (1982), however, did not describe whether compression was applied or not, but reported a high rate of unsatisfactory results – mainly due to necrosis of the femoral head.

The application of compression to the lag screw implies the risk that the lag screw loses its grip by pulling out of the cancellous bone in the femoral head. The holding power of the lag screw (Richards; 19.1 mm length of thread) in the cancellous bone of the femoral head is lower in bones from women aged 80 years and above compared to women between 70 and 79 years (Frandsen & Madsen 1983). Whether the holding power is even lower in patients with femoral neck fractures is unknown, but in the group treated with compression no decline in union was seen as age advanced.

In order to ensure that the allocation of the patients did not result in incomparable groups, the patients were divided according to displacement, quality of reduction and position of the compression screw; no group differences were revealed. Previously, several authors (Garden 1961, Brown & Abrami 1964, Frandsen & Andersen 1981) have reported higher rates of union in Garden's Stage 3 fractures than in Stage 4 fractures, and this is supported by our results. However, Barnes et al. (1976) and Høgh et al. (1982) found no significant difference in the rate of union between Stage 3 and Stage 4 fractures.

The quality of reduction and the position of the appliance are known to influence the results substantially (Garden 1961, Barnes et al. 1976, Kofoed & Alberts 1980, Frandsen & Andersen 1981, Høgh et al. 1982). Within each group these observations were confirmed (Table 1).

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