

SUBCAPITAL FRACTURES OF THE FEMUR

Re-operations with Internal Fixation

CARL ZETTERBERG¹, LARS IRSTAM² & GUNNAR B. J. ANDERSSON¹

Departments of Orthopaedic Surgery¹ and Diagnostic Radiology², Sahlgren Hospital, Göteborg, Sweden

Over a period of 5 years, 55 re-operations with internal fixation were performed on 51 patients. The re-operations constituted 9.2 per cent of all operations employing internal fixation for subcapital fractures of the femur during that period. The indications for re-nailing were penetration of the nail through the femoral head, or slipping of the nail, with or without dislocation of the fracture.

Only 26 per cent of the re-nailed fractures healed. Seventy-three per cent showed avascular necrosis and 61 per cent non-union.

Key words: femoral fractures; femoral neck fractures; femur head necrosis; femur neck; fracture fixation

Accepted 4.i.79

The treatment of subcapital fractures of the femur is a matter of considerable controversy. Various methods of internal fixation, as well as primary prosthetic replacement, all have their proponents (Boyd & Salvatore 1964, Fredriksen et al. 1967, Flynn 1974, Hunter 1974, Steen-Jensen & Holstein 1975, D'Arcy & Devas 1976). The obvious reason for this uncertainty is the high incidence of complications in these fractures, complications which at present cannot be fully predicted (Garden 1961, 1971, 1974, Ellison & Mull 1974, Flynn 1974, McCown & Miller 1976).

When reduction and internal fixation is preferred, three main complications occur: non-union, avascular necrosis with late segmental collapse of the femoral head, and problems related to the internal fixation device. These frequently occur simultaneously. While non-union and avascular necrosis have been thoroughly discussed in

the literature, less interest has been devoted to the problems arising from the fixation device. This is understandable since non-union and late segmental collapse are clearly the dominating complications. Also, there are many methods of fixation each having different problems (Albright & Weinstein 1975, Burkhardt et al. 1975, Weinstein 1975, Barnes et al. 1976).

The problems related to the fixation device are mainly penetration into the hip joint and lateral slipping of the fixation device with or without fracture displacement. Fracture of the appliance itself and local irritation at the lateral tip of the device also occur. When these complications are clinically significant the surgeon can either remove the fixation device without further treatment, insert a new device or insert a prosthesis.

The purpose of the present investigation was to study the results in patients in whom a second fixation device was inserted.

PATIENTS AND METHODS

During the 5-year period, 1965 through 1969, 595 operations were performed in which internal fixation was used in the treatment of subcapital fractures of the femur. Fifty-five of these (9.2 per cent) were re-operations.

The re-operations were performed on 51 patients; four were re-operated twice. The mean age of the patients at the time of the second operation was 68 years (ranging from 36 to 91 years); 70 years in 40 women, and 61 years in 11 men.

Thirty-six patients were followed for more than 1 year, 13 for less than a year, and two were lost to follow-up.

In the 36 patients surviving the first year with the femoral head intact, the follow-up was continued until femoral head necrosis was obvious, a prosthetic replacement or Girdlestone type operation was performed, or the patient died. The Garden system of classification was adopted to determine the type of fracture, the degree of displacement, the accuracy of reduction and the position of the fixation device (Garden 1961, 1964, 1971, 1974, Nieminen & Satokari 1975, Barnes et al. 1976).

The fracture was considered united when uninterrupted bone extended over the fracture line, which was partly or completely filled by calcified tissue. Pseudarthrosis was defined as a situation in which the fracture line was open and the bone sclerotic on both sides. Necrosis of the femoral head was characterized by localized sclerosis and segmental collapse causing deformity.

The results were evaluated with respect to the following factors: the age and sex of the patient, the delay before the first operation and the time interval between the first operation and re-operation, the indication for re-operation, the type of fracture, the accuracy of reduction, and the position of the fixation device.

Statistical analysis was performed at the 5 per cent level of significance using the χ^2 -test.

The primary operation

A Stage IV fracture, according to Garden, was present in 44 patients (86 per cent), a Stage III in 5 (10 per cent), and a Stage II in 2 (4 per cent). The operation was performed within 3 days in 16 patients, between 4 and 7 days in 26 and with a delay of 8 to 14 days in 9.

Closed reduction was used in 48 patients, open in 3. The accuracy of reduction, according to Garden, was acceptable or good in 35 fractures (70 per cent) and poor in 14 (27 per cent). Two



Figure 1. Johansson three-flanged nail. Inserted with a cross-nail.

sets of radiographs could not be properly evaluated. The method of fixation was a Johansson nail in 48 femurs, an Aronsson nail in two and a Thornton nail in one; i.e. flanged nails were used in all patients. Twenty-eight of the Johansson nails were secured laterally with a cross-nail to prevent slipping (Figure 1). The location of the nail was central on both X-ray projections in 19 patients, in one of the projections in 22, and in none in 8. Again, it was not possible to evaluate two of the sets of radiographs (Table 1).

The re-operation

The indications for re-operation were penetration through the femoral head in 19 hips (37 per cent), lateral slipping of the nail without fracture dislocation in 13 hips (26 per cent), and lateral slipping with simultaneous dislocation in 19 hips (37 per cent). Clinical symptoms were present in all subjects, mainly as pain and decrease in range of motion. The time interval between the primary operation and the re-operation was less than 3 months in 20 patients (40 per cent), from 3 to 6 months in 14 (27 per cent), and more than 6 months in 17 (33 per cent). Those patients in whom lateral slipping of the nail

Table 1. Location of the nail. (Central means that the nail is positioned within the central 30° of the head in each projection.)

Antero-posterior projection	Anterior	Lateral projection Central	Posterior
High	0	4	1
Central	4	19	5
Low	4	9	3

with dislocation of the fracture occurred were, as a rule, re-operated on earlier than the others (Figure 2).

At re-operation a Johansson nail was used in 41 patients, an Aronsson nail with a cross-screw in 10 (Figure 3). Closed reductions were made in 14 of the 19 fractures in which dislocation occurred.

RESULTS

In the 51 patients a third operative procedure was necessary in 26 patients, a fourth in nine, and a fifth in one. Thus, a total of 139 operations were performed on the 51 patients, an average of 2.7 operations each. Fourteen endoprostheses, 15 nail-removals, one Girdlestone operation and 7 nail or screw fixations were performed at these later operations.

Thirteen fractures united (26 per cent), while pseudarthrosis occurred in 31 (61 per cent) (Table 2). Neither union nor pseudarthrosis was established in the seven fractures followed for less than 6 months.

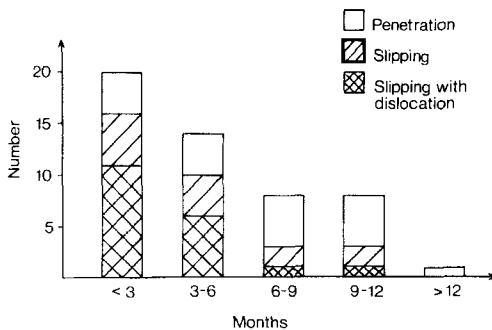


Figure 2. The time interval between the first and the second nailing for the different indications.

Necrosis, with late segmental collapse, occurred in 37 hips (73 per cent) (Table 2). In 30 of these there was a simultaneous occurrence of pseudarthrosis and necrosis.

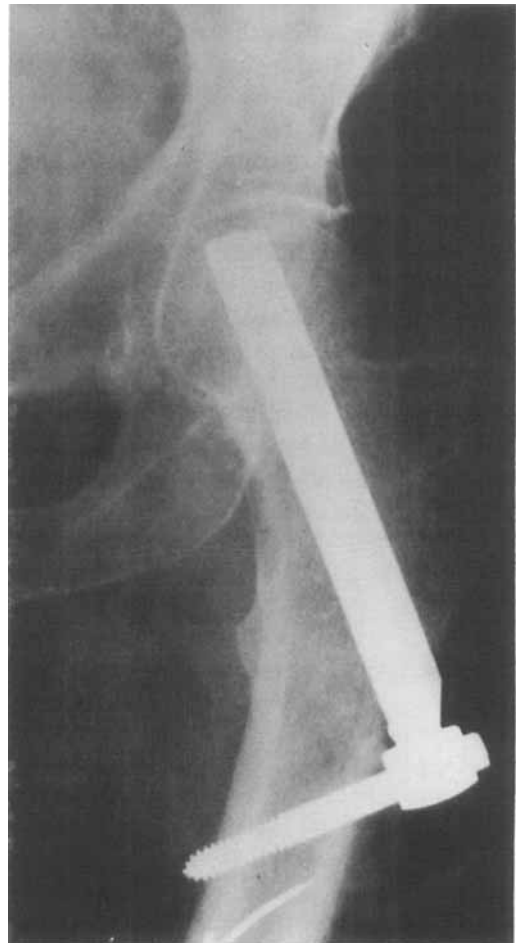


Figure 3. Aronsson flanged-nail. Inserted with a cross-screw.

Table 2. Results

Indication for re-operation	Number of patients	United Number	Pseud-arthrosis Number	Follow-up < 6 months	Necrosis Number
Penetration into hip joint	19	3	13	(3)	15
Lateral sliding/ no dislocation	13	6	5	(2)	8
Lateral sliding/ dislocation	19	4	13	(2)	19
Total	51	13	31	(7)	37

Seven cases of necrosis developed in hips where the fracture had healed, and in hips with a follow-up of less than 6 months.

Of the 13 patients with a follow-up less than a year, five had died, four had had a prosthetic replacement, and two had developed a femoral head necrosis during that time.

Age and sex did not statistically significantly influence the result. The results were significantly better in patients in whom lateral slipping without simultaneous dislocation of the fracture occurred, than for the two other indications ($P < 0.05$, Table 2). The delay before the first operation, the time interval before re-operation, the type of fracture, the accuracy of reduction and the position of the fixation device were all without statistically significant influence on the end-result.

DISCUSSION

The poor results in the present study confirm those reported earlier by Carlquist (1947), Johansson (1964) and Öhman et al. (1969). Carlquist found 16 cases of necrosis among 24 re-operated patients, Johansson noted 30 among 48, and Öhman et al. observed 9 among 12. The incidence of necrosis is considerably higher than that reported in the literature for primary internal fixation of fractures of the neck of femur (Öhman et al.

1969). It is probable that some of the patients in the present study could have benefited from the use of a different salvage procedure, such as a prosthetic replacement. Albright & Weinstein (1975) have described a number of alternative salvage procedures, and Maquet (1976) and others advocate the use of a femoral osteotomy.

Other methods of internal fixation than those used in the present study, permitting better compression in the fracture, are now widely used and seem to improve the primary result (Pugh 1955, Fielding et al. 1974, Wehner 1974, Ziegler 1974, Burkhardt et al. 1975, Fielding 1975, Forgon 1975, Forgon et al. 1975). The result of the present study indicates that re-operation with internal fixation is a method in which frequent complications can be expected. The risk of complications seems particularly high in patients in whom a re-dislocation of the fracture occurs. Prosthetic replacements should thus be considered as the secondary operation.

REFERENCES

- Albright, J. P. & Weinstein, S. L. (1975) Treatment for fixation complications. *Arch. Surg.* **110**, 30-36.
- Barnes, R., Brown, J. T., Garden, R. S. & Nicoll, E. A. (1976) Subcapital fractures of the femur. A prospective review. *J. Bone Jt Surg.* **58-B**, 2-24.

- Boyd, H. B. & Salvatore, J. E. (1964) Acute fracture of the femoral neck; internal fixation or prosthesis? *J. Bone Jt Surg.* **46-A**, 1066-1068.
- Burkhardt, G., Markwardt, D. & Weygandt, A. (1975) Die Kirschner-Drahtbündelung proximaler Oberschenkelfraktur. *Beitr. Orthop. Traum.* **22**, 267-272.
- Carlquist, N. (1947) Comparison of the results from non-operative treatment and from osteosynthesis by multiple nailing of medial fractures of the collum femoris. *Acta chir. scand.* **45**, Suppl. 127.
- D'Arcy, J. & Devas, M. (1976) Treatment of fractures of the femoral neck by replacement with the Thompson prosthesis. *J. Bone Jt Surg.* **58-B**, 279-286.
- Ellison, N. & Mull, T. D. (1974) Unique anesthetic problems in elderly patients coming to surgery for fracture of the hip. *Orthop. Clin. N. Amer.* **5**, 493-508.
- Fielding, J. W., Wilson, S. & Ratzan, S. (1974) A continuing end-result study of the intracapsular fracture of the neck of the femur treated with the telescoping Pugh-nail. *J. Bone Jt Surg.* **56-A**, 1464-1472.
- Fielding, J. W. (1975) Pugh-nail fixation of displaced femoral neck fractures. A long-term follow-up. *Clin. Orthop.* **106**, 107-116.
- Flynn, M. (1974) A new method of reduction of fractures of the neck of the femur based on anatomical studies of the hip joint. *Injury* **5**, 309-317.
- Forgon, M. (1975) Bessere Stabilisierung der Schenkelhalsfraktur mittels Zugschrauben-Osteosynthese nach der Principen der AO. *Arch. orthop. Unfall-chir.* **81**, 207-217.
- Forgon, M., Mamel, E. & Kuukli, F. (1975) Lassen sich mit Verbesserung der Stabilität einer Schenkelhalsosteosynthese die Komplikationen bei der Heilung vermindern. *Arch. orthop. Unfall-chir.* **81**, 219-224.
- Fredriksen, T., Grewald, I., Hansen, J. B., Jensenius, H., Langberg, K. & Nielsen, F. U. (1967) The prognosis for patients with medial femoral neck fracture. *Acta chir. scand.* **133**, 369-374.
- Garden, R. S. (1964) Stability and union in subcapital fractures of the femur. *J. Bone Jt Surg.* **46-B**, 630-647.
- Garden, R. S. (1961) Low-angle fixation in fractures of the femoral neck. *J. Bone Jt Surg.* **43-B**, 647-663.
- Garden, R. S. (1971) Malreduction and avascular necrosis in subcapital fractures of the femur. *J. Bone Jt Surg.* **53-B**, 183-197.
- Garden, R. S. (1974) Reduction and fixation of subcapital fractures of the femur. *Orthop. Clin. N. Amer.* **5**, 683-712.
- Hunter, G. A. (1974) A further comparison of the use of internal fixation and prosthetic replacement for fresh fractures of the neck of the femur. *Brit. J. Surg.* **61**, 382-384.
- Johansson, S. H. (1964) The prognosis of femoral neck fractures with special reference to complications and old age. *Acta Soc. Med. upsalien.* **69**, 125-160.
- Maquet, P. (1976) Guérison de la pseudarthrose du col fémoral par modification des contraintes. *Acta orthop. belg.* **42**, 5-11.
- McCown, P. L. & Miller, W. A. (1976) Long-term follow-up of hip fractures. *S. med. J. (Bgham, Ala.)* **69**, 1540-1542.
- Nieminen, S. & Satokari, K. (1975) Classification of medial fractures of the femoral neck. *Acta orthop. scand.* **46**, 775-781.
- Öhman, U., Björkegren, N-Å. & Fahlström, G. (1969) Fracture of the femoral neck; a five year follow-up. *Acta chir. scand.* **135**, 27-42.
- Pugh, W. L. (1955) A self adjusting nail-plate for fractures about the hip joint. *J. Bone Jt Surg.* **37-A**, 1085-1093.
- Steen-Jensen, J. & Holstein, P. (1975) A long term follow-up of Moore-arthroplasty in femoral neck fractures. *Acta orthop. scand.* **46**, 764-774.
- Wehner, W. (1974) Die Schenkelhalsfraktur. *Zbl. Chir.* **99**, 1029-1040.
- Weinstein, S. L. (1975) Femoral neck fractures: Complications of internal fixation. *J. Iowa St. med. Soc.* **65**, 17-20.
- Ziegler, R. (1974) Zur Technik der Schenkelhalsnagelung. *Beitr. Orthop. Traum.* **21**, 641-642.

Correspondence to: Dr. Carl Zetterberg, Department of Orthopaedic Surgery I, Sahlgren Hospital, S-413 45 Göteborg, Sweden.