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Long-term outcome of patients with avascular necrosis, after internal fixation of femoral neck fractures

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Abstract

We retrospectively reviewed 84 patients who underwent internal fixation of an intracapsular femoral neck fracture. The mean age was 58 years and the time from injury to operative treatment was 5.3 days. The mean follow-up was 4.7 years (range, 2–8 years). At the latest follow-up, in the 46 patients with undisplaced (Garden I, II) fractures, nonunion occurred in two patients and avascular necrosis of the femoral head in nine. Six of these nine patients had a good or excellent result, one had a fair result, and two had a poor result. Of 35 patients with no sign of avascular necrosis, 32 patients had a good or excellent result, two a fair and one had a poor result. In the group of 38 patients with displaced (Garden III, IV) fractures, nonunion occurred in six patients and avascular necrosis of the femoral head in 15. Of these 15 patients, 10 had a good or excellent result, two had a fair result, and three had a poor result. Of 17 patients with no sign of avascular necrosis, 14 had an excellent result and three patients a poor result. Overall only five of the 24 patients who developed avascular necrosis of the femoral head had undergone total hip arthroplasty. Internal fixation remains a simple and safe, method of treatment for both undisplaced and displaced femoral neck fractures in middle-age patients. Despite the relatively high rate of avascular necrosis after internal fixation of femoral neck fractures, only a few of these patients (20%) required further surgical treatment in the follow-up period of this study.
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1. Introduction

In postindustrial countries, as the population become proportionally more elderly there is an increased incidence of femoral neck fractures which constitutes a major socioeconomic problem [3]. The treatment of these fractures remains a major challenge in modern orthopaedics.

Treatment options for femoral neck fractures include internal fixation and hip replacement. The decision as to which is best for any patient may be influenced by many factors [4].

Most authors agree that patients under 65 years of age with an undisplaced femoral neck fracture should be treated with internal fixation. On the other hand, prosthetic replacement is more common in patients with displaced fractures, older than 65 years of age, associated with poor health, neurological disease and osteopenic bone [4,24].

Femoral neck fractures in the elderly have a high mortality and morbidity with mortality rates of 20% to 36% 1 year after the injury [1,2,8,11,14,19]. Nonunion and avascular necrosis are the main complications after internal fixation. Nonunion rates range from 17 to 33% [2,8,21]. The overall incidence of avascular necrosis after fixation of femoral neck fractures is 25% [1,17,21,22,26]. It has been noted, however, that despite poor radiographic results due to late collapse of the femoral head, patients with avascular necrosis may have relatively mild symptoms and less than half of these patients may require prosthetic hip replacement [2,3]. On the other hand, a significant number of elderly individuals will die before avascular necrosis becomes symptomatic [1,2,8,11,14,19].

To facilitate decision making for patients in the “gray zone of age”, we prospectively evaluated the clinical and radiographic outcome in patients who underwent internal fixation for a femoral neck fractures, with special attention to postoperative avascular necrosis and disability requiring reoperation.

2. Materials and methods

From January 1990 to December 1996, 325 patients were admitted to the authors’ Orthopaedic Department with an intracapsular femoral neck fracture.

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Twenty-three patients were treated conservatively due to poor medical condition or patient's refusal. Three of these patients died within a month. Twelve patients were treated with hip compression screw and side plate, and five with a valgus osteotomy and screw fixation. A primary hemiarthroplasty was performed in 126 patients and total hip arthroplasty in 51 patients.

Of 108 patients who underwent internal screw fixation, 84 patients were available for follow-up evaluation. Preoperative, immediate postoperative and, latest follow-up plain radiographs were available in all 84 patients. To evaluate avascular necrosis, the radiographic criteria of Ficat and Arlet [12] were used. Nonunion was defined by the absence of any fracture healing after a period of 6 months. All patients were evaluated clinically according to Harris Hip Score (HHS) [16]. A score of 90–100 points was considered an excellent result, 80–90 points as good, 70–80 points as fair, and below 70 points as poor [12].

3. Results

The mean follow-up of the 84 patients who were available for follow-up evaluation was 4.7 years (range, 2–8 years). There were 53 women and 31 men with a mean age of 58 years (range, 17–84 years). Fifty fractures were on the left hip and 34 on the right. The fractures were classified according to Garden classification [13]. Forty-six patients had a nondisplaced Garden type I or II fracture (Group A) and 38 had a displaced Garden type III or IV (Group B).

The mean time elapsed between injury and surgical treatment was 5.3 days (range, 0–10 days). Internal fixation was performed under spinal anaesthesia and fluoroscopic control using three or four cancellous 6.5 mm screws. All patients received prophylactic antibiotic coverage beginning 1 h before the operation and continuing for 48 h postoperatively. Prophylactic anticoagulation with low molecular heparin was begun in all patients on admission and was continued for 8–30 days postoperatively until the discharge of the patient.

3.1. Group A

Forty-six patients had an undisplaced femoral neck fracture (Garden I, II). At the latest follow-up, two of these patients developed nonunion. Nine of the 46 patients had radiographic signs of avascular necrosis of the femoral head. Seven of these nine patients had an avascular necrosis of Ficat–Arlet stage 2 with normal femoral head contour and mixed lysis and sclerosis and two patients of Ficat–Arlet stage 3 with subchondral collapse. The remaining 35 patients had no signs of avascular necrosis or any other complication. Six of the nine patients with avascular necrosis of the femoral head had a good or excellent result. One patient had fair result and the other two patients had a poor result. Thirty-two of the 35 patients with no signs of avascular necrosis had good or excellent results, two fair and one patient poor (Table 1).

Table 1
Clinical and radiographic results in 46 patients with undisplaced (Garden I, II) femoral neck fractures

Radiographic outcome	HHS > 80, good or excellent	HHS 70–80, fair	HHS < 70, poor
No AVN 35 (76.2%)	32	2	1
AVN 9 (19.5%)	6	1	2
Nonunion 2 (4.3%)			2
Total: 46	38 (82.6%)	3 (6.5%)	5 (11%)

AVN = avascular necrosis; HHS = Harris Hip Score [16].

3.2. Group B

Thirty-eight patients had a displaced femoral neck fracture (Garden III, IV). Six of these patients developed nonunion. Fifteen of the 38 patients had radiographic signs of avascular necrosis of the femoral head. Twelve of these 15 patients had an avascular necrosis of Ficat–Arlet stage 2, and three patients of Ficat–Arlet stage 3. The remaining 17 patients had no signs of avascular necrosis or any other complication. Ten of the 15 patients with avascular necrosis of the femoral head had a good or excellent result. Two patients had a fair result, and the other three patients had a poor result. Fourteen of the 17 patients with no signs of avascular necrosis had a good or excellent result, and the remaining three patients had a poor result (Table 2).

3.3. Complications

There were seven minor early complications: urinary tract infection occurred in four patients, symptomatic venous thrombosis in two patients and pressure sores in one. Late complications included avascular necrosis of the femoral head in 24 patients and fracture nonunion in eight patients.

3.4. Reoperations

Overall 17 of the 84 patients (20%) required further surgical treatment. A total hip arthroplasty was performed in

Table 2
Clinical and radiographic outcome in 38 patients with displaced (Garden III, IV) femoral neck fractures

Radiographic outcome	HHS > 80, good or excellent	HHS 70–80, fair	HHS < 70, poor
No AVN 17 (44.7%)	14		3
AVN 15 (39.5%)	10	2	3
Nonunion 6 (15.8%)			6
Total: 38	24 (63.2%)	2 (5.2%)	12 (31.6%)

AVN = avascular necrosis; HHS = Harris Hip Score [16].

eight patients for nonunion, in five for symptomatic avascular necrosis of the femoral head and in four with a poor functional result without any radiographic sign of avascular necrosis.

4. Discussion

In the elderly, morbidity and mortality is high after femoral neck fracture due both to injury and surgical intervention. Kenzora et al. [19] report 19% death rate 12 months after fracture, Asnis and Wane-Sgaglione [1] 20% in 5 years, while Evans et al. [11] reported a 6-month corrected mortality rate as high as 36%. Similar data with more than 20% mortality 1 year later after the injury have been reported [2,8,14].

These data may argue against the use of expensive or intensive surgical procedures in some patients, thus altering the surgeon's decision regarding treatment [13]. Femoral neck fractures can be treated either with immediate prosthetic hip replacement (unipolar, bipolar, or total hip arthroplasty) or with internal fixation.

Prosthetic replacement after a femoral neck fracture has a relatively high rate of medical and postoperative complications. Total hip arthroplasty for femoral neck fractures has a high incidence of dislocation so should be mainly reserved for patients with pre-existing ostearthritis, metabolic bone disease, in unreducible fractures, in active patients with life expectancy greater that 5 years or in failure of internal fixation [7,10,15,16,19,20,28]. Nilsson et al. [25] reported that elective total hip arthroplasty for failed internal fixation of femoral neck fractures is a safe and successful procedure. According to Johansson et al. [18] total hip arthroplasty should be considered for a displaced femoral neck fracture in old patients with normal mental function and high functional demands and according to van Dortmont et al. [31], internal fixation should be considered the treatment of choice for displaced intracapsular femoral neck fractures in demented patients. Nilsson et al. [25] reported elective total hip arthroplasty for failed internal fixation of femoral neck fractures as a safe and successful procedure.

Internal fixation has been shown to be a safe and cost-effective treatment for femoral neck fractures and under image-intensifier fluoroscopy the operation time for fracture reduction and nailing is about 15 min [3]. The primary and main complications of internal fixation are nonunion and avascular necrosis. In the present study, six of the 38 patients (15.8%) with a displaced femoral neck fracture developed nonunion. Lowell [21] reported an overall nonunion rate of 17%, Barnes et al. [2] of 26%, while Lu-Yao et al. [22] in a meta-analysis of 106 series reported an average nonunion rate of 33%. Avascular necrosis occurs mainly in displaced fractures and is less common in undisplaced femoral neck fractures with a mean overall incidence of 25% [1,2,6,17,21,26,27]. Many authors have reported that despite the clear radiological evidence of avascular necrosis, the clinical consequences were not bad enough for further surgery [6,9,11,17,22,29,30].

Barnes et al. [2], in a study of 181 patients with late segmental collapse after fixation of subcapital fractures, reported that only 53 patients (27.2%) had disabling pain, but only 32 of the 53 patients (17.7%) had a salvage operation performed. Chiu and Lo [5] managed 250 undisplaced femoral neck fractures by internal fixation The final results showed 226 (90.4%) fractures with satisfactory union (mean union time: 24 weeks), 15 (6.0%) fractures with nonunion, and nine (3.6%) fractures with implant problems. Eighteen (7.2%) hips developed avascular necrosis of femoral head after union. Manukaran and Abdul Hamid [23] treated 62 patients with displaced femoral neck fractures by internal fixation. Union occurred in 41 patients (66.1%) by 8 months. Avascular necrosis was seen in 11 patients by 18 months (17.75%). Avascular necrosis and nonunion occurred together in six patients (9.68%). Secondary hemiarthroplasty was performed in only 10 patients (16.1%).

The results of the present study are consistent with those of the literature. Undisplaced femoral neck fractures were associated with a 19.5% rate of avascular necrosis. However, most of these patients had a segmental avascular necrosis without subchondral collapse and six out of nine patients with avascular necrosis had a satisfactory functional result. Overall only five out of 46 patients (10.8%) had a poor result after internal fixation of an undisplaced femoral neck fracture. Displaced fractures were associated with a 39.5% rate of avascular necrosis. However, 10 out of 15 patients with avascular necrosis had a satisfactory clinical result and level of daily activities. Overall poor results present in 12 out of 38 patients (31.6%) after internal fixation of a displaced fracture.

5. Conclusion

The authors currently favour internal fixation for treatment of undisplaced and a significant number of displaced femoral neck fractures; it is a simple and safe method of treatment. Despite the relatively high rate of avascular necrosis, only few of the patients who developed this complication had disabling symptoms at the latest follow-up and require further surgery. Patients with avascular necrosis and disabling symptoms after internal fixation can be treated with total hip arthroplasty.

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