Arch Orthop Trauma Surg (1996) 115:90–93

ORIGINAL ARTICLE

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Undisplaced femoral neck fracture in the elderly

Received: 8 May 1995

Abstract The results and the related conditions of 250 undisplaced femoral neck fractures managed by percutaneous Knowles pinning were evaluated. All of the patients were over 59 years old, and the protocol of management and follow-up was determined prospectively. The duration from injury to management was 3.0 (range 1–12) days, the operation time was 20 (range 10–44) min, and most of the patients were discharged without hospitalization. The follow-up period was 74 (range 24–138) months. The final results showed 226 (90.4%) fractures with smooth course of union (mean union time: 24 weeks), 15 (6.0%) fractures with nonunion, and 9 (3.6%) fractures with implant problems. Eighteen (7.2%) hips developed avascular necrosis of femoral head after union. The analysis showed that the rate of complications was higher in elderly persons with undisplaced femoral neck fractures.

Introduction

Percutaneous internal fixation has been well discussed in displaced femoral neck fractures [6], but its role in undisplaced femoral neck fractures has not been described specifically. Operations in the elderly have an increased risk of morbidity and mortality [1, 11, 12], but their values in operations for undisplaced femoral neck fractures in the elderly have not been reported clearly. This study attempts to elucidate (1) the effects of percutaneous Knowles pinning and (2) the morbidity and related conditions in treatment of undisplaced femoral neck fractures in patients over 59 years old.

Patients and methods

From June 1983 to November 1992, 389 consecutive undisplaced femoral neck fractures in 381 cases were managed with percutaneous Knowles pinning in our hospital. Patients enrolled in this study should fulfill two criteria: (1) over 59 years old (i.e., at least 60 years old); (82) with sufficient records for evaluation at final follow-up. Three hundred and ten patients (81.4%) with 318 (81.7%) fractures could fulfill the first criteria, and during follow-up, 54 of them (17.4%) with 60 fractures (20.8%) died because of various medical diseases or traffic accidents (Table 1). Seven deaths (2.3%) occurred within the first 2 months after the fracture treatments. In addition, we were unable to contact another 8 cases (2.6%) with 8 fractures (2.5%) at the final follow-up. Overall, 62 cases (20%) with 68 fractures (21.4%) did not have sufficient records. Thus, 250 fractures (78.6%), in 248 patients (80%), were collected for the final evaluation. The mechanisms of injury were falling down for various reasons in 225 fractures (90%), traffic accident in 15 (6%), and others in 10 (4%). There were 153 men and 95 women, average age of 73 (range 60–92) years (Table 2), involving 132 right and 118 left limbs, with 14 (5.6%) combined injuries, including 5 fractures of the distal radius, 4 fractures of the proximal humerus, 2 head injuries, 1 fracture of the clavicle, 1 fracture of the olecranon, and 1 fracture of the ribs. All the associated injuries were managed surgically or conservatively as indicated. The duration from injury to pinning of the fractures was 3 (1–12) days. In addition, no noticeable arthritic change was noted in all the injured hips preoperatively. The protocol of management and follow-up, including a special chart for evaluation, were arranged prospectively.

All the patients were treated by junior staff members, under the supervision of senior staff members. Anesthesia used was local in 10 fractures (4%), spinal in 90 (36%), and epidural in 150 (60%). During the operation, the patients were put in supine position on a fracture table without traction, and a C-arm fluoroscope was used for intra- and postoperative check-up. The procedures were: put one guide pin in the center of femoral neck through one 0.3-cm skin incision and then, percutaneously, put four Knowles pins parallel to the guide pin in the 4 positions which formed a diamond or

Table 1 Causes of mortality

Cause	*n*
Cardiovascular disease	12
Cerebrovascular disease	10
Respiratory disease	8
Neoplasm	8
Complications of diabetes mellitus	5
Other medical diseases	9
Traffic accident	2
Overall	54

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box shape in cross-section view of the femoral neck via four 0.5-cm skin incisions. All the pin tips were positoned about 0.5 cm below the subchrondral bone of the femoral head. After the locations of the pins were checked, the skin incisions were closed with 5 stitches, and no drain tube was inserted. Except for some patients with associated injuries or special medical conditions that made hospitalization necessary, all other patients were discharged from the emergency unit after recovery from the anesthesia, with oral antibiotics prescribed for 3 days. Stitches were removed at the first postoperative visit in the outpatient clinic. Weight-bearing with the injured limb was not allowed for 8 weeks after the operation, after which partial weight-bearing was permitted till union of the fracture. Exercises for strengthening muscle and increasing range of motion ROM were started immediately after the operation.

The patients were followed up once every 2 weeks in the first 2 postoperative months and then once every month till union. After union, the patients were followed up at least once every year. Additional visits were made as necessary. Evaluations of the final results were done via a visit to the outpatient clinic including plain radiography, questionnaire, and bone scan in cases of questionable hip pain. Special charts for the 250 fractures were prepared in two parts: one concerned clinical performance according to a modified evaluation guide from that set by Arnold et al. [2], and the other recorded radiographic findings. The results of the clinical performance were graded as good for no pain, full ROM, return to preinjury walking ability and daily activity; acceptable for occasional pain, mildly impaired ROM and walking ability, and mildly limited daily activity, with no indication for surgical intervention; poor for significant pain, restrictive ROM, walking ability, and daily activity, which made surgical intervention necessary. The radiographic findings included the position of pins, the condition of bony union, and other pathologies, such as ANFH or arthritis. The final evaluations were done by the same physician (F. Y. C.). The final follow-up period averaged 74 (24–138) months. Student's *t*-test was used to evaluate the significance of the results.

Results

No mortality or complication in the fracture management occurred during or immediately after any operation.

The operation time was 20 (range 10–44) min, and the blood loss was less than 30 cc in all cases. The time of intraoperative exposure to radiation was 20 (range 10–35) s. The hospital stay lasted 0.7 (range 0–10) days; for 223 fractures (89%), discharge took place immediately after recovery from the anesthesia. The others were hospitalized mainly for medical diseases or combined injuries that needed further management. In 224 cases, 226 fractures (90.4%) achieved bony union without pin problems in 24 (range 18–30) weeks. There were 2 superficial wound infections among the 226 fractures (0.8% of the 250 fractures) which disappeared after antibiotic treatment without any sequelae. The union time was 22.4 (range 18–25) weeks for patients between 60 and 69 years of age, 26 (range 22–28) weeks for patients between 70 and 79 years, and 27 (range 24–30) weeks for patients over 79 years. The difference is statistically significant between the union times of the age group 60–69 years and the other two ($P < 0.005$), but not between the two older age groups ($P > 0.05$).

Nine (3.6%) fractures developed implant problems, of which six (2.4%) involved migration of the pin tips to the joint and were managed with prolonged non-weight-bearing of the injured limb. The causes might be technical imperfection, with multiple trials of pinning during the operation, and/or severe osteoporosis of the bone. Three of the six patients (aged 65, 67, and 76 years) obtained union at weeks 22, 26, and 28, respectively, after the operation. Pins were removed with no sequelae by the final follow-up. The other three patients (aged 72, 79, and 85 years) developed nonunions, and removal of the pins with total hip replacements was conducted. The other 3 (1.2%) pin problems all involved breakage with displacement of the fractures due to too early weight-bearing (3–5 weeks after operation), and all were managed with removal of the broken pins and total hip replacements.

Fifteen patients (6.0%) developed nonunions without pin problems, though the nonunions were all united by 1 year. Ten were men and five were women, and their age distribution is shown in Table 2 (mean 77 years). Thirteen patients, 86.7% of the non-unions, were over 69 years old (11.1% of the 117 fractures over 69 years old). Two patients, 13.3% of the nonunions, were between 60 and 69 years old (1.5% of the 133 fractures in patients aged 60–69 years). Thus, it was clear that the nonunion rate rose significantly in patients over 70 years of age ($P < 0.005$). Total hip replacements were performed in all these cases of nonunions. In this series, the overall union rate was 91.6% (229/250), and the overall nonunion rate was 7.2% (18/250).

Avascular necrosis of the femoral head developed in 18 patients (7.2%) after union, between 10 and 24 months after the initial trauma. All presented with pain, and the diagnosis was confirmed by plain X-rays or bone scan examination. Removal of the pins and core decompression

Table 2 Results according to different age groups

Events age (years):	Number of limbs (percentage in the same age group)				
	60–69	70–79	80–89	≥ 90	Total
Union without pin problem					
Without ANFH	119 (89.5%)	80 (79.2%)	6 (50.0%)	3 (75.0%)	208 (83.2%)
With ANFH	9 (6.8%)	8 (7.9%)	1 (8.3%)	–	18 (7.2%)
Pin migration	2 (1.5%)	3 (3.0%)	1 (8.3%)	–	6 (2.4%)
Pin breakage	1 (0.7%)	2 (2.0%)	–	–	3 (1.2%)
Nonunion	2 (1.5%)	8 (7.9%)	4 (33.3%)	1 (25.0%)	15 (6.0%)
Overall	133 (53.2%)	101 (40.4%)	12 (4.7%)	4 (1.6%)	250 (100%)

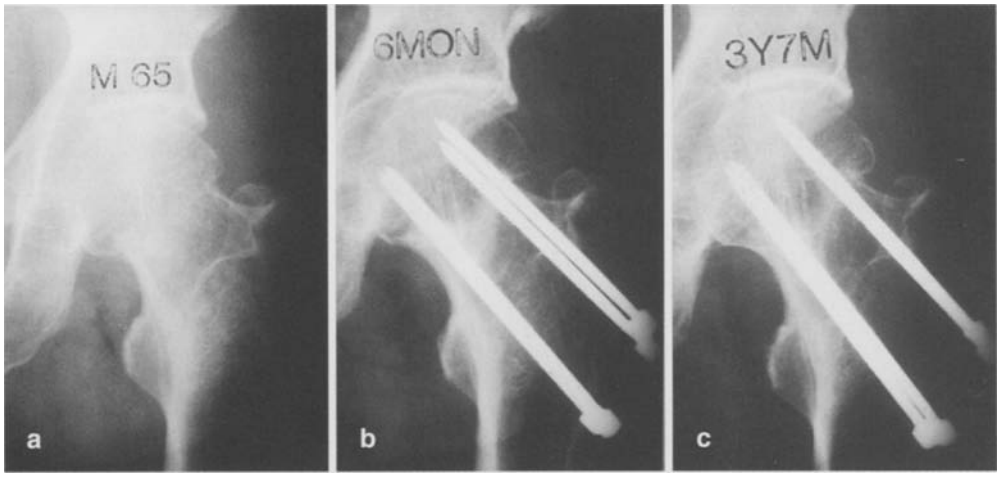

Fig. 1 A 65-year-old man with undisplaced femoral neck fracture: **a** preoperative X-ray; **b** X-ray taken 6 months after operation and showing union; **c** X-ray taken 3 years and 7 months after operation; no complication is visible

were done in 4 cases without collapse of the head, and the pain subsided with no further change in the head by the final follow-up. The other 14 patients were given a total hip replacement for collapse of the head with moderate or marked arthritis of the joint. The age distribution in case of ANFH is shown in Table 2; there were no statistically significant differences between the age groups ($P > 0.5$). In our series, the overall complication rate was 10.4% (26/250), excluding the cases of ANFH, and 17.6% (44/250) when including them.

At final follow-up, in the 209 patients (211 fractures) with union and without ANFH, 189 (90.4%) had good functional results, 16 (7.7%) had acceptable results, and 4 (1.9%) had poor results. Six of the 16 acceptable cases and all of the 4 poor cases were noted to have moderate to severe arthritic change of the injured hips at 5 to 10 years after the initial trauma. The two patients with bilateral femoral neck fractures had acceptable results, and no arthritis could be noted in their hips. No other factors, besides injury of the hip, could be related to the arthritis. Four poor and 14 acceptable cases were over 69 years old (20.4% of the 88 cases over 69 years old) at the time of the initial injury. The other 2 patients graded as acceptable were 67 and 69 years old (1.7% of the 121 patients between 60 and 69 years of age). None suffered complications during the course of treatment and healing. In all the cases of good functional results, no apparent arthritis of the injured hip could be noted. It was shown that age over 69 years and arthritis were correlated to the functional results ($P < 0.01$) (Fig. 1).

The timing of surgery was not related to the functional result nor any complication ($P > 0.05$).

Discussion

Most of the patients with femoral neck fracture were elderly, so the main considerations in deciding on the management are risk, results, and economic and social costs. For undisplaced femoral neck fractures, both conservative and surgical treatments have been recommended [3–5, 7, 8]. In conservative treatment, the surgical risk can be avoided, but good results demand prolonged immobilization, great cooperation and endurance of the patient, and more postoperative nursing care, which would increase the perioperative medical complications, delay functional recovery, and raise the economic and social costs. Besides, the fractures might displace during the course of immobilization. In surgical treatment, the surgical risk cannot be avoided, but if the fixation is rigid enough, there are more good results, and function recovers earlier without the necessity for prolonged immobilization and nursing care, which can reduce the perioperative medical complications and the economic and social costs. If the surgical method is simple and safe, this could represent a more promising option, which was shown in our series. Our results revealed that percutaneous Knowles pinning for undisplaced femoral neck fractures carries a very low surgical risk, high rate of good result, and low economic and social costs. We think this kind of treatment is undoubtedly better than conservative treatment, compared with the results in other series [7, 8].

In comparison with other surgical series [2–4, 10], our results are slightly worse, which shows that the rate of morbidity associated with bony union in the elderly (over 69 years old) is higher, despite the simplicity of the fracture and our treatment. The results also indicate that the elderly (especially over 69 years old) have a higher incidence of worse functional results. This arises mainly due to more widespread osteoporosis, relatively poorer general condition and ability to cooperate, lack of necessary social care, less interest in achieving a better functional result, and greater dependence on external or social support. However, if we can avoid some technical errors, pay more attention to postoperative care, and follow up more closely in the first postoperative 2 months, some complications still could be avoided, and the results could improve. Although our results also showed that the timing of surgery did not affect the functional results or the complication rate, we still recommend operating as soon as possible to prevent perioperative complications due to prolonged immobilization.

It was shown in our series that the incidence of ANFH in the elderly with an undisplaced femoral neck fracture is

similar to that reported in other series [2–4, 8–10], and all the ANFHs developed within 2 years after the injury, so we think all these patients should be closely followed for at least 2 years in order to detect early ANFH and save the hip joints. The real cause of arthritic change in our cases cannot be ascertained with certainty, because the arthritis developed late after the injury. We do not know the incidence of osteoarthritis in normal hips, but it does not seem high in our series. No definite method can be used to prevent progression of the arthritis, so close follow-up for this purpose is unjustified in patients after 2 or 3 years.

In conclusion, in the treatment of undisplaced femoral neck fractures in the elderly, percutaneous Knowles pinning is a simple, safe, and effective method. In the postoperative period, elderly patients should be treated with more care and support by the medical system, their family, and society in order to obtain the best results.

References

1. Anderson B, Ostberg J (1972) Long-term prognosis in geriatric surgery: 2 to 17 year follow up of 7922 patients. J Am Geriatr Soc 20:255–258
2. Arnold WD, Lynden JP, Mynkoff J (1974) Treatment of intracapsular fracture of the femoral neck. J Bone Joint Surg [Am] 56:254–262
3. Bentley G (1968) Impacted fractures of the neck of the femur. J Bone Joint Surg [Br] 50:551–561
4. Bentley G (1980) Treatment of nondisplaced fractures of the femoral neck. Clin Orthop 152:93–101
5. Holmberg S, Kalen R, Thorngren KG (1987) Treatment and outcome of femoral neck fractures. Clin Orthop 218:42–51
6. Husby T, Alho A, Nordsletten L, Bugge W (1989) Early loss of fixation in femoral neck fractures: comparison of three devices in 244 cases. Acta Orthop Scand 60:69–72
7. Parker MJ, Anand JK (1992) Cost-benefit analysis of hip fractures. J Bone Joint Surg [Br] 74:261–264
8. Raaymakers ELBF, Marti RK (1991) Nonoperative treatment of impacted femoral neck fractures: a prospective study of 170 cases. J Bone Joint Surg [Br] 73:950–954
9. Robinson CM, Saran D, Annan IH (1994) Intracapsular hip fractures. Clin Orthop 302:83–91
10. Shih CH, Wang KC (1991) Femoral neck fracture. Clin Orthop 272:195–200
11. Skinner P, Riley D, Ellery J, Beaumont A, Coumine R, Shafighian B (1989) displaced subcapital fractures of femur: a prospective randomized comparison of internal fixation, hemiarthroplasty and total hip replacement. Injury 20:291–293
12. Soreide O, Molster A, Raugstad TS (1979) Internal fixation versus primary prosthesis replacement in acute femoral neck fractures: a prospective, randomized clinical study. Br J Surg 66:56–60