Revision Rates After Surgical Treatment for Femoral Neck Fractures: Results of 2-Year Follow-up

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Summary. *Background and Objective. Intracapsular fractures of the femoral neck account for a major share of fractures in the elderly. Open reduction and internal fixation has been shown to have a higher rate of revision surgery than arthroplasty. The aim of this study was to assess and compare the rates of revision surgery performed after internal fixation and primary total hip arthroplasty.*

Material and Methods. Between 2004 and 2006, 681 intracapsular femoral neck fractures in 679 consecutive patients were treated with internal fixation or total hip arthroplasty at our institution. Revision surgery rates were evaluated at 1-, 3-, 6-, 12-, and 24-month follow-up.

Results. There was no significant difference in the ratio of internal fixation to total hip arthroplasty during 2004–2006 (P=0.31). The mean rate of total hip arthroplasty was 19.1% with a lower rate being among patients younger than 60 years. Revision surgery rates at the 2-year follow-up were higher in the internal fixation group compared with total hip arthroplasty group (28.9% vs. 7.0%, P<0.001). Patients who underwent internal fixation were at a 4-fold greater risk of having revision surgery at the 2-year follow-up than those who underwent total hip arthroplasty (odds ratio, 4.11; 95% CI, 1.95–8.65; P<0.001). Age was a significant risk factor for revision surgery after total hip arthroplasty (hazard ratio, 0.93; 95% CI, 0.87–0.98; P=0.02), but not significant after the internal fixation (P=0.86).

Conclusions. Higher revision surgery rates after internal fixation favors arthroplasty as a primary choice of treatment for the femoral neck fractures.

Introduction

Hip fractures are one of the most common fractures in the elderly population and the main cause of morbidity and mortality. Every year about 1.6 million people worldwide sustain hip fractures (1). About 50% of proximal femoral fractures are extracapsular for which internal fixation (IF) is a reliable method of treatment; however, the optimal treatment of displaced intracapsular fractures remains in debate (2). Some authors recommend internal fixation if the fracture can be adequately repositioned, bone is of good quality, and there is no evidence of osteoarthritis. Fractures that are more than 24 hours old should be treated with total hip arthroplasty (THA). Hemiprosthetic replacement is appropriate for very old patients (3). Other studies have shown that hip arthroplasty compared with internal fixation for the treatment of displaced femoral neck fractures significantly reduces the risk of reoperation at the cost of higher superficial infection, blood loss, time in surgery, and length of hospitalization (4). Although significantly more complications are observed after IF, there is no clear choice for a treatment method that offers superior functional results (5). With the development of hip arthroplasty techniques, a discussion still remains in the literature regarding the treatment of these fractures and the choice of an operative technique. The surgical choice associated with a higher revision surgery rate and prolonged recovery after hip fractures imposes a growing financial burden of healthcare, creating a need for additional research to advance the treatment of these patients (6). The total costs per patient was higher for patients in the internal fixation group than in the hemiarthroplasty group internal fixation. In the randomized trial study, reoperation rates of 42% for internal fixation and 10% for hemiarthroplasty were reported (7). Some authors reported a 1.9% revision rate in patients who underwent total hip arthroplasty for subcapital femoral neck fractures and 0.7% in the those who underwent total hip arthroplasty for other reasons (8). The 1-year implant survival was 89% after screw fixation for undisplaced fractures, 79% after screw fixation for displaced fractures, and 97% after hemiarthroplasty for displaced fractures (9).

Some studies have shown that patients who underwent arthroplasty had fewer surgical complications at 2 and 5 years postoperatively and reduced reoperation rates at 1, 2, and 5 years postoperatively than those who underwent IF (10). However, the

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optimal treatment of displaced intracapsular hip fractures in elderly patients remains unknown. Therefore, we performed a retrospective study to assess and compare revision surgery rates after IF and primary THA.

Material and Methods

Between 2004 and 2006, 681 intracapsular femoral neck fractures in 679 consecutive patients were treated with IF or THA at our institution. Two patients had bilateral femoral neck fractures.

The method of operative treatment was chosen according to the fracture type, duration after accident, and patient's age. Undisplaced (Garden type I and II) fractures were treated with internal fixation only; displaced (Garden type III and IV) and acute (<72 hours) fractures were treated with internal fixation, except Garden type IV fractures in patients older than 70 years.

There were 219 men (32.3%) and 460 women (67.5%). The mean patients' age was 74 years (95% CI, 73–75), and that of men and women, 69 years (95% CI, 67–71) and 76 years (95% CI, 75–77), respectively. On the day of surgery, 71% of the patients were aged 70 years and more.

Of the 551 IF operations, 533 (96.7%) were carried out using 2 noncannulated partially threaded Ullevaal screws, while 18 operations (3.3%) were done using 130° sliding hip screw plates. Primary hip arthroplasty was carried out using the total hip prosthesis of cemented type in 130 cases (Table 1).

Analysis of Revision Operations. A revision operation was defined as a total hip replacement operation carried out after failed IF or revision arthroplasty after failed primary THA. No reosteosynthesis operations after IF were carried out. Follow-up end points were the date of December 31, 2008, the date of patient's death, or the revision surgery date. The mean follow-up time after surgery was 25 months (95% CI, 23–26). Revision surgery rates were compared between the THA and IF groups.

Statistical Analysis. Statistical analysis was carried out using the statistical analysis program STATA version 9. Mean values and their confidence intervals were calculated. The Nelson-Aalen method was used to calculate the total frequency of revision surgeries, and comparisons between curves were estimated using the log-rank test. Cox proportional hazards regression analysis was used to estimate risk factors associated with revision surgery. Univariate statistical analysis was performed using the χ^2 test, and multivariate analysis was performed using simple logistic regression. A *P*-value of less than 0.05 was statistically significant.

Table 1. The Distribution of the Operations by Year of Operation

Year	Internal Fixation n (%)	Total Hip Arthroplasty n (%)
2004	184 (84.0)	35 (16.0)
2005	161 (78.6)	44 (21.4)
2006	206 (80.2)	51 (19.8)
Total	551 (80.9)	130 (19.1)

Results

There was no significant difference in the ratio of IF to THA during 2004–2006 (P=0.31). The mean THA rate was 19.1%. THA operations in the group of patients younger than 60 years and those older than 60 years accounted for 13.9% and 19.9%, respectively. Comparison of the THA and IF groups by different age groups showed no significant differences in the revision surgery rates (χ^2 test, P=0.94) (Table 2).

Analysis of Revision Surgery

IF Group. There were 117 revision surgeries performed following initial IF during the 2-year period: 21.6% (115/533) of revision surgeries after IF were performed with Ullevaal screws, and 11.1% (2/18) were performed with sliding hip screw plates with no significant difference between the groups (χ^2 test, P=0.60). The revision surgery rates at 1-, 3-, 6-, 12-, and 24-month follow-up were 1.8%, 7.2%, 15.0%, 22.0%, and 28.5%, respectively (Fig. and Table 3).

THA Group. In this group, 8 revision surgeries were performed after the primary hip replacement operations. Dislocation was the most common cause of revision surgery (n=6, 75.0%). In one case, débridement for deep wound infection was carried out and 1 operation for aseptic femoral component loosening. The revision surgery rates at 1-, 3-, 6-, 12-,

Table 2. Patient Age Distributions in Primary and Revision Operations for IF and THA Groups

Age group, years	Internal Fixation		Total Hip Arthroplasty	
	Total, n	Revision operations, n (%)	Total, n	Revision operations, n (%)
<50	26	6 (23.1)	5	2 (40.0)
50–59	42	8 (19.0)	6	0 (0.0)
60–69	90	24 (26.7)	29	4 (13.8)
70–79	185	43 (23.2)	51	1 (2.0)
80+	208	36 (17.3)	39	1 (2.6)
Total	551	117 (21.2)	130	8 (6.1)

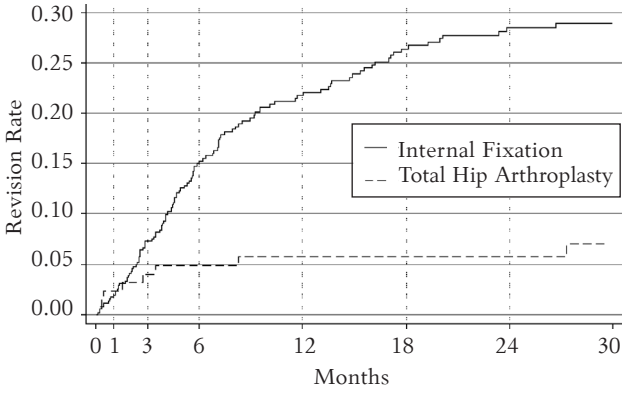


Fig 1. Cumulative revision surgery rates in the internal fixation and total hip arthroplasty groups

Table 3. Cumulative Incidence of Revision Surgeries (Log-Rank Test, $P<0.001$)

Time, months	Internal Fixation		Total Hip Arthroplasty	
	Revisions, % (95% CI)		Revisions, % (95% CI)	
1	1.8	1.0–3.5	2.3	0.7–7.2
3	7.2	5.2–10.1	4.0	1.6–9.6
6	15.0	12.0–19.3	4.8	2.1–10.8
12	22.0	18.0–27.0	5.7	2.7–12.1
18	26.4	21.8–31.9	5.7	2.7–12.1
24	28.5	23.6–34.3	5.7	2.7–12.1
30	28.9	24.0–34.7	7.0	3.4–14.1

and 24-month follow-up were 2.3%, 4.0%, 4.8%, 5.7%, and 5.7%, respectively (Fig. and Table 3).

Significantly more revision operations were performed in the IF than THA group ($P<0.001$). Patients who underwent IF were at a 4-fold greater risk of having revision surgery at 2-year follow-up than those who underwent THA (OR, 4.11; 95% CI, 1.95–8.65; $P<0.001$). Univariate Cox regression analysis showed that age was a statistically significant risk factor for revision surgery in the THA group (HR, 0.93; 95% CI, 0.87–0.98; $P=0.02$), but not statistically significant in the IF group ($P=0.86$).

Discussion

Ullevaal screws and sliding hip screw plates are accepted as one of the most widely used constructions for IF of femoral neck fractures. No significant differences were observed comparing different implants used for IF in the earlier meta-analysis conducted by Parker and Stockton (11). Our study also showed no significant difference in the revision surgery rate comparing 2 different types of implants ($P=0.60$). Nevertheless, an advantage of sliding hip screws versus parallel cancellous screws has been recently reported for more vertical fractures (Pauwels type 3) (12).

The ratio of IF to THA did not change significantly in our clinic during the study period, and THA accounted for 16.0%, 21.4%, and 19.8% in 2004, 2005, and 2006, respectively. No subtotal hip replacement operations were performed at our clinic in 2004–2006. The data of the Swedish National Hip Fracture Register (RIKSHÖFT) showed substantial changes in the preference of treatment method over the last decade. The rate of IF as the method of choice for the treatment of displaced femoral neck fractures declined steadily. Primary IF was carried out in 88% of cases in 1998, but only in 24% of cases in 2007. Primary replacement surgery comprised 12% of operations in 1998 and 76% in 2007 (13). According to the study by Jain et al. carried out in the United Sates during the period 1991–2001 (n=162 152), only about 20% of patients underwent IF. The predominant treatment method was hemiarthroplasty, the rate of which increased from 67.8% to 75.3%, while the proportion of patients who underwent THA decreased from 11.6% in 1991 to 6.6% in 2001 (14). Gjertsen et al. reported that internal fixation was carried out in 95% of cases of undisplaced fractures, and 52% of displaced fractures were treated with hemiarthroplasty (15).

In our study, THA accounted for about 20% of operations; however, there was a trend toward fewer THA operations performed among patients aged more than 60 years: 24.4% in the 60- to 70-year-old group and 15.8% in patients aged more than 80 years. According to the literature data, IF is the preferred method of treatment for younger patients. Primary THA operations are chosen for senior patients because of poor bone quality, shorter rehabilitation, as well as the relatively lower risk for aseptic loosening of prosthesis components.

According to our study data, 22% of patients underwent THA operations within 1 year and 28.5% within 2 years after IF, whereas after primary THA within the 2-year period, only 5.7% of the cases were revised. The data from the Norwegian Hip Fracture Register showed that hemiarthroplasty was superior to IF in the treatment of displaced femoral neck fractures with the revision surgery rates being 22.6% and 2.9%, respectively, after 1 year (16). It should be noted that the definition of the term "complication" varies in the literature, as not every patient is considered as having a complication after construction migration, aseptic necrosis, or fracture nonunion. Furthermore, arthroplasty operations are not necessarily performed in all these cases (17). These data are not in line with the results from the cohort study by Iorio et al. In 186 patients aged 65 years and more, hip arthroplasty was carried out in only 7.5% of cases following IF and 13.9% of cases following hemiarthroplasty, and no revision surgeries were performed following total hip arthroplasty at the 6-year follow-up (18).

The data published in randomized studies are similar to those obtained in our study (Table 4). Revision surgery rates after IF in the treatment of

Table 4. Data From Randomized Studies

Study	Age Census	N	Follow-up, years	Revision surgery, %	
				Internal fixation	Arthroplasty
Rogmark et al. (19)	>70	450	2	43	6*
Blomfeldt et al. (20)	>70	102	4	47	4**
Frihagen at al. (1)	>60	222	2	40	10**
Roden et al. (21)	>60	100	5	64	6**
Our study	NA	681	2	29	6*

*Total hip arthroplasty, **hemiarthroplasty. NA, not applicable.

displaced femoral neck fractures vary from 40% to 64%, while revision surgery rates range 4%–10% for the patients after primary total hip replacement.

However, these results are hardly comparable, because many previous randomized studies are limited by an age census and patients' cognitive impairments, only include displaced femoral neck fractures, and compare IF with hemiartroplasty.

Our study revealed that during the 2-year period, young patients (<50 years) underwent 26 IF operations with 6 (23.1%) having revision hip arthroplasty operations. Haidukewich et al. in their study (n=73) reported that only 15% of patients in this age group underwent hip replacement surgery after 5 years. The main reason for hip replacement was aseptic femoral head necrosis, rather than fracture nonunion (22). Fracture displacement and the quality of reduction are claimed to be the 2 most important factors determining osteonecrosis in young patients with femoral neck fractures (12). As a possible limitation of the study was its nonrandomized retrospective design; therefore, it was difficult to compare our results with the data presented in literature. The surgical revision rate is the only criterion of femoral neck fracture treatment according to which the risk of localized complications can be determined accurately and objectively. Only one-third of patients achieve the same quality of life following their injury (17, 23). There is no standardized assessment of each of these criteria as a whole.

Significantly higher revision ratios after THA observed for younger patients should be interpreted with caution due to a small sample size and a small number of revision surgeries.

Randomized studies show that active patients without cognitive disorders, who are otherwise relatively healthy, might have better results with primary hip arthroplasty when compared with IF in terms of revision surgery, hip function, and quality of life (19, 24). There are no data in the literature regarding the benefit of an implant type (3), but some studies indicate that total hip replacement in comparison with hemiarthroplasty has advantages in active, independent patients (8, 19, 25).

Conclusions

Higher revision surgery rates after internal fixation favors arthroplasty as a primary choice of treatment for femoral neck fractures.

Statement of Conflict of Interest

The authors state no conflict of interest.

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