Costs of internal fixation and arthroplasty for displaced femoral neck fractures

A randomized study of 68 patients

Cecilia Rogmark, Åke Carlsson, Olof Johnell and Ingemar Sernbo

Department of Orthopaedics, Malmö University Hospital, SE-205 02 Malmö, Sweden.
Correspondence: cecilia@rogmark.com
Submitted 01-07-03. Accepted 02-10-24

ABSTRACT We included in a prospective, randomized study 68 patients aged 70 years or older, with displaced cervical hip fractures. The patients were randomized to internal fixation with hook-pins (36) or primary arthroplasty (32) (total or hemiarthroplasty due to their prefracture status) and followed for 2 years. Patients with rheumatoid arthritis, mental confusion and/or residence in an institution were excluded. The postoperative stay in hospital, rehabilitation wards or nursing homes were recorded as well as complications and the costs of surgery. The aim of this study was to compare the accumulated costs of each method, during the first 2 years after the fracture.

In the internal fixation group, 15/36 were considered failures, as compared to 1/32 in the arthroplasty group. As regards primary treatment of the fracture, the durations of surgery and hospital stay were shorter after internal fixation, but the total need for hospitalization/institutionalizaion was somewhat longer in these patients. The mean 2-year cost for a patient with internal fixation was USD 21,000 and of one with primary arthroplasty USD 15,000.

We conclude that primary arthroplasty is a cost-efficient treatment. Considering the very much higher failure rate after internal fixation—leading to increased suffering for these patients—primary arthroplasty stands out as the best method for displaced fractures of the femoral neck.

Displaced fractures of the femoral neck can be treated with primary arthroplasty or closed reduction and internal fixation with hook-pins or screws. In a previous report (Rogmark et al. 2002), we found that the functional results after 2 years indicated that primary arthroplasty is better. In this report, we compare the accumulated costs for the public sector of each method, during the first 2 years after fracture.

Patients and methods

During 1995–1997 in Malmö, Sweden, 68 patients aged 70 or older, having dislocated femoral neck fractures (Garden 3–4) were included in a 2-year prospective, consecutive randomized study. This was a part of a multicenter investigation involving 12 hospitals in southern Sweden (Rogmark et al. 2002). The Malmö subgroup was chosen for this analysis of costs for practical reasons (1 emergency hospital, 1 municipality). In Malmö, the in-hospital care is provided by the County Council in the Department of Orthopedics, and the care after discharge by the Municipal Council on rehabilitation wards and in nursing homes. In Malmö, there is no geriatric ward in hospitals available for orthopedic patients. Since the organization of care after discharge varies, it was too difficult to compare all the centers in this multicenter study.

We excluded patients with mental confusion, those who were bedridden or residing in institutions on admission, or had sustained a fracture more than 2 days before admission.

The patients were randomized to internal fixation or arthroplasty by choosing a sealed envelope, when the patient was transferred from the emer-

gency room to the orthopedic ward. The Ethics Committee at Lund University approved the study and the patients gave their informed consent.

36 patients received internal fixation and 32 arthroplasty. The decision to perform a total hip arthroplasty (THA) or hemiarthroplasty was based on a score including the patient's age, habitat, ability to walk and mental status. A younger, active and independent patient received a THA. The arthroplasty group comprised 21 THAs and 11 hemiarthroplasties. Hansson hook-pins were used for internal fixation and Charnley or Charnley-Hastings prostheses for arthroplasty.

In the internal fixation group, failure was defined as non-union (including early redisplacement of the fracture), segmental collapse of the femoral head or deep infection. Neither local irritation from the pin ends nor extraction of pins when the fracture had healed was classified as failure. In the arthroplasty group, 2 or more dislocations, loosening, deep infection or femoral fracture adjacent to the prosthesis were considered failures.

All patients were followed with clinical and radiographic examinations at 4, 12 and 24 months after surgery. A standardized questionnaire was used, that also included the preoperative status (social and medical factors), which was similar in the treatment groups.

As regards the costs of material, the cost of an arthroplasty, USD 1,085, reflects our proportion of total and hemiarthroplasties. The cost of a THA is estimated at USD 1,274 with additional material, such as bone cement, etc., while that of a hemiarthroplasty is USD 725. The costs of reoperation are the actual cost of each reoperation performed divided by the number of patients in the group. The stay in an institution was calculated in the same way, as all 'institution days' were summarized and then divided by the number of patients in the group. The 'additional out-patient visits' excluded the planned 4-, 12- and 24-month visits.

Information concerning hospital and rehabilitation ward stays and postoperative residence was obtained from the questionnaire and validated by reviews of medical charts. The average costs of care in rehabilitation wards, nursing homes, etc., were obtained from Malmö Municipal Council; for treatment and care in the orthopedic department from the National Board of Health and Welfare and for time in the operating room from the County Council. The costs of hospital care include overhead costs. Current costs of the implants and additional equipment for the operation were used (October 2000).

The statistical analysis was done with the chi-square test, the Mann-Whitney U-test (Statistica v5.1, StatSoft Inc., USA).

An exchange rate of 10 SEK equal to 1 USD (March 2001) was used.

Results

48/68 women having a median age of 82 (70–94) years and 20/68 men having a median age of 81 (70–87) years were included. The median age of the two treatment groups was the same, 82 years, and there were 24 women in each group.

In the internal fixation group, 15/36 cases were considered to be failures. 8 had nonunion, 6 avascular necroses and 1 severe pain. 11 patients received a total hip arthroplasty as a secondary procedure and 3 patients a hemiarthroplasty. 1 was too weak for surgery. 1 patient later had a revision procedure with replacement of her THA, and still another had her pins exchanged (Figure 1).

In the arthroplasty group, 1/32 failures occurred ($p < 0.001$) due to a deep infection, which was treated without surgery. In our calculation, we included the costs of a reoperation, the usual procedure, although this patient was too weak for surgery. Another patient had a single dislocation immediately after surgery (not a failure, according to the study protocol).

In the internal fixation group, the average duration of anesthesia in the primary procedure was 119 (SD 53) min and in the arthroplasty group, 176 (SD 39) min ($p < 0.001$, Table 1).

The total duration of anesthesia—i.e., for the primary operation and for any secondary procedures during 2 years—was 233 (SD 220) min in the internal fixation group and 181 (SD 39) min in the arthroplasty group (Table 2).

We found no statistically significant difference between the groups as regards the mortality rate at 2 years—i.e., 10/36 in the internal fixation group and 5/32 in the arthroplasty group.

The need for postoperative rehabilitation and nursing varied. Many patients were discharged

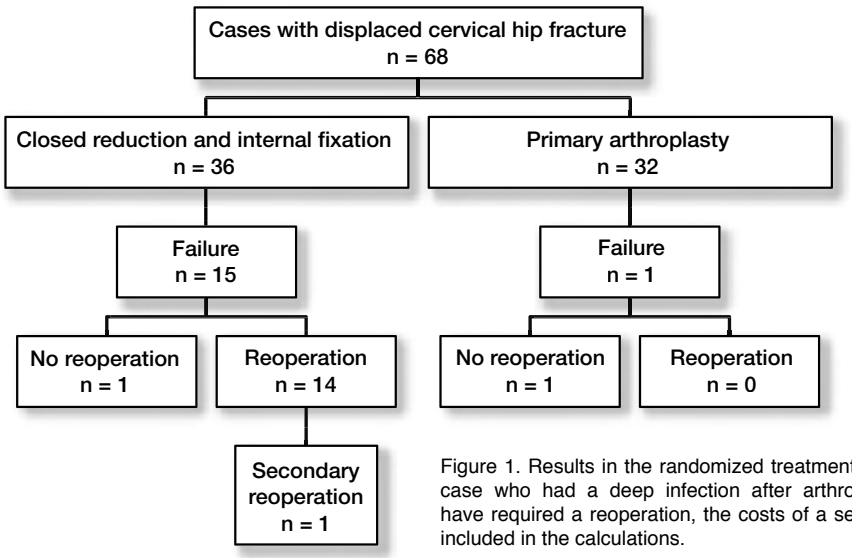

Figure 1. Results in the randomized treatment groups. Since a failed case who had a deep infection after arthroplasty would probably have required a reoperation, the costs of a secondary procedure are included in the calculations.

Table 1. Median values for treatment of the primary fracture

	From admission to surgery		Duration of surgery [a]		Hospital stay	
	hours	range	min	range	days	range
Internal fixation	22	4–37	24	10–38	8.5	3–32
Arthroplasty	25	11–53	64	20–118	12	7–21
P-value (Mann-Whitney U-test)	< 0.001		< 0.001		0.007	

[a] The duration of surgery in the internal fixation group does not include the reduction maneuver.

Table 2. Mean and median values of the total duration of treatment during 2 years after surgery

	Internal fixation		Arthroplasty	
	mean (SD)	median (range)	mean (SD)	median (range)
Total anesthesia (min)	233 (220)	142 (70–1285)	181 (39)	185 (100–300)
Total stay (days)				
Orthopedic ward	18 (16)	16 (3–96)	13 (4)	12 (7–21)
Rehabilitation ward	39 (79)	13 (0–400)	23 (36)	13 (0–180)
Nursing home	46 (139)	0 (0–605)	32 (122)	0 (0–656)
Additional out-patient visits (days)	1.2 (0.5)		0.2 (0.1)	

directly to their own homes, 18/36 in the internal fixation group and 13/32 in the arthroplasty group. The mean number of days spent on a rehabilitation ward and in a nursing home was somewhat higher in the internal fixation group than in the arthroplasty group (Table 2).

The mean cost of a cervical hip fracture treated with internal fixation was USD 21,000 or a primary arthroplasty USD 15,000. This figure includeds care on the orthopedic ward, a rehabilitation ward and a nursing home for 2 years after the fracture, as well as the duration of the operation and costs of material (Table 3).

The failed cases with internal fixation had an average 2-year cost of USD 29,000, and the cost of the successful cases USD 12,000. The correspond-

Table 3. Average costs per patient (USD) of the primary and any secondary procedures due to the hip fracture 2 years after surgery

		Internal fixation			Arthroplasty		
	Cost/unit	Average patient	SD	Average cost per patient	Average patient	SD	Average cost per patient
Total anesthesia (min)	11	233	220	2540	181	39	1973
Cost of material (USD)							
Primary operation				113			1086
Secondary operation				524			40
Total stay (days)							
Orthopedic ward	401	18	16	7218	13	4	5213
Rehabilitation ward	140	39	79	5460	23	36	3220
Nursing home	110	46	139	5060	32	122	3520
Additional out-patient visits (days)	118	1.2	0.5	138	0.2	0.1	22
Sum				21052			15073

ing figures for primary arthroplasty were USD 16,600 for the failed case and USD 14,700 for the successful ones.

The direct cost for the patient is small in Sweden, because of the tax-financed health care system. Regardless of the amount of care a person was given, including medicines, he or she paid only a maximum of USD 200 per year in 1996. Since all patients in both groups have paid this fee, it is not mentioned in the comparisons.

The cost of municipal home help is not included in our figures, since there was no difference in the usage between the groups before the fracture or at any follow-up.

Discussion

Several studies have compared medical expenses before and after a hip fracture (Brainsky et al. 1997, Zethraeus et al. 1997, De Laet et al. 1999, Reginster et al. 1999) and have found increases in costs of USD 10,000–20,000 during the first year after the fracture.

It is difficult to compare the figures in the international literature concerning the total cost of hip fractures because the health and social welfare systems differ in various communities. There is no agreement as to which types of costs should be included. We compared the costs of internal fixation and primary arthroplasty after a fracture. Since internal fixation of displaced cervical hip fractures requires reoperation in 20%–36% of the patients, while the reoperation rate after primary arthroplasty is 6%–8% (Lu-Yao et al. 1994), there is reason to believe that internal fixation should be more expensive when the total costs are calculated. On the other hand, implants and additional equipment used in modern arthroplasty surgery are expensive, but can give better long-term results than less expensive uncemented unipolar prostheses (Eiskjaer and Ostgard 1993) and fewer reoperations.

In a patient treated with arthroplasty in our material, the mean cost was 70% of the mean cost in a patient with internal fixation. Iorio et al. (2001) found arthroplasty to be the most cost-effective treatment, especially total hip arthroplasty, as compared to internal fixation.

Our study shows that complications after an internally-fixated hip fracture generate considerable incremental costs. This is supported by the findings of Holmberg and Thorngren (1988) and Palmer et al. (2000) who noted up to a threefold increase in costs, as compared to an uncomplicated case.

Only if the failure rate after internal fixation could be reduced by about 15-20%, would the method cost as much as the arthroplasties in this material, with a failure rate of 3% and an average cost of USD 15,000 (Figure 2).

In our study, the frailest and most demented patients were excluded, which left a rather healthy and active cohort. Since the groups were randomized, and their age, social and medical prefracture

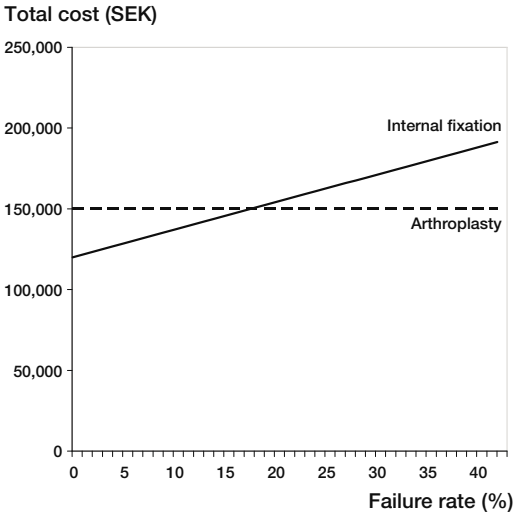

Figure 2. Total cost of treatment (per case) at different failure rates after internal fixation. The cost of an arthroplasty with a 3% failure rate is shown (dotted line).

data were similar, we could compare their care and place of residence 2 years after the fracture. We could not distinguish between various reasons for care in a nursing home, but assume that the hip fracture and its possible complications increased the patient's risk of becoming dependent. Autier et al. (2000) found a fivefold increase in institutionalization during the first year after a hip fracture, as compared to a control group without a fracture.

Transfer of a patient to a nursing home markedly affects the nursing costs. Once admitted to such an institution, patients seldom return to their own home (Fitzgerald et al. 1988, Bond et al. 1989). Borgquist and Thorngren (1994) found that patients who had a cervical hip fracture and were discharged to institutions cost almost five times more than those discharged to their own homes.

Effective and well-planned rehabilitation which aims at discharging the patient to an independent residence is crucial when trying to keep the costs of a hip fracture low (Holmberg and Thorngren 1988, Hollingworth et al. 1993). In a previous report, we found substantially better function after a primary arthroplasty than with internal fixation (Rogmark et al. 2002), therefore, choosing an arthroplasty may be the first step towards faster rehabilitation.

It would, of course, have been more satisfactory calculate the costs in the entire multicenter study. This proved to be impractical, because the various towns and rural districts had different organizations of their eldercare. Moreover, the data concerning patients who had received care was regarded as largely confidential. A follow-up time of more than 2 years would have included a few more failed cases after arthroplasty, but the costs of nursing homes, etc., would have been much more difficult to interpret, since normal ageing of the groups will lead to institutionalization in several cases. Many patients would have been lost because the high mortality after hip fractures. Unpublished data from this material show that there is still only 1 failed case after arthroplasty, even after 5 years.

Our study on selected patients with displaced femoral neck fractures shows that primary arthroplasty is a cost efficient treatment.

Financial support was obtained from Trygg-Hansa Research Foundation, Greta and Johan Kock Foundation and the Malmö University Hospital Research Funds.

The authors thank Dr Peder Rogmark for medico-economic advice.

No competing interests declared.

Autier P, Haentjens P, Bentin J, Baillon J M, Grivegnee A R, Closon M C, et al. Costs induced by hip fractures: a prospective controlled study in Belgium. Belgian Hip Fracture Study Group. Osteoporos Int 2000; 11 (5): 373-80.

Bond J, Gregson B A, Atkinson A. Measurement of outcomes within a multicentred randomized controlled trial in the evaluation of the experimental NHS nursing homes. Age Ageing 1989; 18 (5): 292-302.

Borgquist L, Thorngren K G. The financial cost of hip fractures. Acta Orthop Belg (Suppl 1) 1994; 60: 102-5.

Brainsky A, Glick H, Lydick E, Epstein R, Fox K M, Hawkes W, et al. The economic cost of hip fractures in community-dwelling older adults: a prospective study. J Am Geriatr Soc 1997; 45 (3): 281-7.

De Laet C E, van Hout B A, Burger H, Weel A E, Hofman A, Pols H A. Incremental cost of medical care after hip fracture and first vertebral fracture: the Rotterdam study. Osteoporos Int 1999; 10 (1): 66-72.

Eiskjaer S, Ostgard S E. Survivorship analysis of hemiarthroplasties. Clin Orthop 1993; 286: 206-11.

Fitzgerald J F, Moore P S, Dittus R S. The care of elderly patients with hip fracture. Changes since implementation of the prospective payment system. N Engl J Med 1988; 319 (21): 1392-7.

Hollingworth W, Todd C, Parker M, Roberts J A, Williams R. Cost analysis of early discharge after hip fracture. BMJ 1993; 307 (6909): 903-6.

Holmberg S, Thorngren K G. Consumption of hospital resources for femoral neck fracture. Acta Orthop Scand 1988; 59 (4): 377-81.

Iorio R, Healy W L, Lemos D W, Appleby D, Lucchesi C A, Saleh K J. Displaced femoral neck fractures in the elderly: outcomes and cost effectiveness. Clin Orthop 2001; 383: 229-42.

Lu-Yao G L, Keller R B, Littenberg B, Wennberg J E. Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. J Bone Joint Surg (Am) 1994; 76 (1): 15-25.

Palmer S J, Parker M J, Hollingworth W. The cost and implications of reoperation after surgery for fracture of the hip. J Bone Joint Surg (Br) 2000; 82 (6): 864-6.

Reginster J Y, Gillet P, Ben Sedrine W, Brands G, Ethgen O, de Froidmont C, et al. Direct costs of hip fractures in patients over 60 years of age in Belgium. Pharmacoeconomics 1999; 15 (5): 507-14.

Rogmark C, Carlsson A, Johnell O, Sernbo I. A prospective randomised trial of internal fixation versus arthroplasty for displaced fractures of the neck of the femur. Functional outcome for 450 patients at two years. J Bone Joint Surg (Br) 2002; 84 (2):183-8.

Zethraeus N, Stromberg L, Jonsson B, Svensson O, Ohlen G. The cost of a hip fracture. Estimates for 1,709 patients in Sweden. Acta Orthop Scand 1997; 68 (1): 13-7.