

# Displaced femoral neck fracture: comparison of primary total hip replacement with secondary replacement after failed internal fixation

## A 2-year follow-up of 84 patients

Richard Blomfeldt, Hans Törnkvist, Sari Ponzer, Anita Söderqvist and Jan Tidermark

Karolinska Institutet, Department of Orthopaedics at Stockholm Söder Hospital, SE-118 83 Stockholm, Sweden  
Correspondence RB: richard.blomfeldt@sodersjukhuset.se  
Submitted 05-02-10. Accepted 05-12-11

**Introduction** Recent randomized controlled trials have shown that for the active and lucid elderly patient with a displaced femoral neck fracture, a primary total hip replacement (THR) is superior to internal fixation (IF) regarding the need for secondary surgery, hip function and health-related quality of life (HRQoL). Despite the high failure rate for IF, the method is still recommended for this patient cohort by some authors. One argument is that if IF fails, there is always the possibility of performing a secondary salvage THR. The main aim of our study was to determine whether a primary THR, as compared to a secondary THR after failed IF, gives a better outcome after 2 years.

**Methods** We compared outcome for 43 patients with a primary THR to the outcome for 41 patients who were treated with a secondary THR after failed IF. All patients (mean age 80 years) were lucid and had a displaced femoral neck fracture. Hip function (Charnley score) and health-related quality of life (HRQoL, EQ-5D) were assessed 2 years after the THR procedure.

**Results** Hip function was better in the primary THR group: the mean Charnley score was 15/18 as compared to 13/18 in the secondary THR group ( $p < 0.001$ ). The patients with failed IF who later underwent a secondary THR experienced a more pronounced decrease in HRQoL (EQ-5D index score) during the first year of treatment compared to patients in the primary THR group, with a difference of 0.25 in the EQ-5D index score at the 4-month follow-up ( $p = 0.02$ ).

**Interpretation** We found that a secondary THR after failed IF results in inferior hip function compared to a primary THR for a displaced femoral neck frac-

ture in the active and lucid elderly patient. Moreover, the patients with failed IF had to undergo at least one re-operation and experienced a significant reduction in HRQoL before the salvage THR

Recent randomized controlled trials (RCTs) have shown that for the relatively healthy, active and lucid elderly patient with a displaced femoral neck fracture, a primary THR is superior to IF regarding the need for secondary surgery, hip function (Jonsson et al. 1996, Johansson et al. 2000, Neander 2000, Ravikumar and Marsh 2000, Rogmark et al. 2002, Tidermark et al. 2003) and health-related quality of life (HRQoL) (Tidermark et al. 2003, Blomfeldt et al. 2005b). Despite the high failure rate of IF—in the range 35–50% (Lu-Yao et al. 1994, Tidermark 2003)—the method has been recommended in this group of patients by some authors (Franzen et al. 1990, Lykke et al. 2003). Firstly, it is often claimed that retaining the patient's own femoral head will give better hip function than that achieved with a primary THR. However, a recent RCT comparing THR and IF has shown that even after 4 years, hip function and HRQoL are at least as good in the primary THR group, even when only patients with uneventfully healed fractures are used for comparison (Blomfeldt et al. 2005b). Secondly, if IF fails, there is always the possibility of performing a salvage THR. There have been some studies suggesting that a secondary THR after failed internal

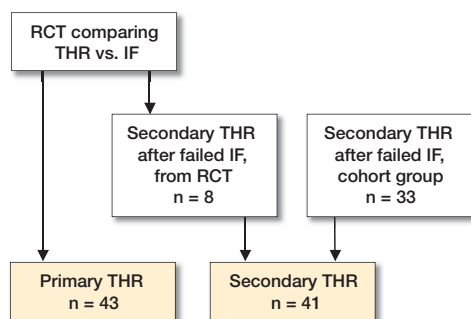


Figure 1. Flow chart describing the recruitment of the study population.

fixation will yield results comparable to those of a primary THR (Franzen et al. 1990, Tabsh et al. 1997). However, both of the latter two studies compared the results of a secondary THR after failed IF with the results of a primary THR in patients with degenerative joint disease, mainly osteoarthritis. To the best of our knowledge, there has only been 1 study comparing primary THR with a secondary THR after failed IF. It showed a higher complication rate and an inferior functional outcome in the secondary THR group (McKinley and Robinson 2002). The study did not include an assessment of HRQoL, nor any prospective data regarding patient outcome during the treatment period before the secondary THR.

The main aim of our study was to determine whether a primary THR—as compared to a secondary THR after failed IF—yields a better outcome after 2 years for an active, lucid elderly patient with a displaced femoral neck fracture. The secondary aim was to determine HRQoL within the group of patients with failed IF who later underwent a secondary THR during the treatment period.

### Patients and methods

We recruited 43 patients with a primary THR and 8 patients with a secondary THR from a randomized controlled trial (RCT) comparing primary THR and IF (Tidermark et al. 2003). All THR operations in both groups were performed by one of two surgeons (JT or HT). In order to increase the power of the study, we recruited 33 other patients with a secondary THR owing to failed IF after an acute displaced femoral neck fracture (from a cohort

Table 1. Baseline data before fracture (n = 84). Primary THR (n = 43) or secondary THR (n = 41) after failed IF

|   | Primary THR | Secondary THR |
|---|-------------|---------------|
| Mean age (SD)                                     | 79 (5.0)    | 80 (5.3)      |
| Female sex, n (%)                                 | 37 (86)     | 38 (93)       |
| Mobility: no walking aid or just one stick, n (%) | 39 (91)     | 38 (93)       |
| ADL A&B <sup>a</sup> , n (%)                      | 42 (98)     | 39 (95)       |

<sup>a</sup> ADL A&B indicates independence in at least 5 of all 6 functions

of patients also treated by the same two surgeons during the same period of time). The patients in the primary THR group were operated between 1996 and 2000, and the patients in the secondary THR group were operated between 1997 and 2001. Thus, 84 patients (75 women) with mean age 80 (70–90) were included: 43 patients in the primary THR group and 41 in the secondary THR group (Figure 1). All patients satisfied the same inclusion criteria before the primary operation, i.e. a displaced femoral neck fracture (Garden III and IV), age  $\geq 70$ , absence of severe cognitive dysfunction,  $\geq 3$  correct answers on a 10-item mental test (the Short Portable Mental Status Questionnaire (SPMSQ) (Pfeiffer 1975)), independent living status (i.e. not institutionalized), and independent walking ability with or without walking aids.

Total hip replacement was carried out using an anterolateral modified Hardinge (1982) approach, with the patient in the lateral decubitus position. We used the Exeter stem (modular) with a 28-mm head and the OGEE acetabular component. Patients in both groups were mobilized immediately with full weight bearing as tolerated.

The groups were similar before the fracture regarding age, sex, ADL functions (Katz et al. 1963), and walking ability (Table 1). Follow-up was performed 2 years after the THR and included an assessment of the indication for the secondary THR, general complications, hip complications, ADL status, hip function and health-related quality of life (HRQoL). All clinical variables except hip motion were assessed by an unbiased observer (a research nurse not involved in the surgery or in clinical decisions). The research nurse was not blinded to the type of surgical intervention.

Table 2. Hip function (Charnley hip score) and HRQoL (EQ-5D<sub>index</sub> score) at the 24-month follow-up after a primary THR (n = 43) or secondary THR (n = 41) after failed IF

|                          | Primary THR<br>Mean (SD) | Secondary THR<br>Mean (SD) | P-value <sup>a</sup> |
|--------------------------|--------------------------|----------------------------|----------------------|
| Hip total score          | 15 (2.3)                 | 13 (2.6)                   | < 0.001              |
| Hip score pain           | 5.6 (1.1)                | 4.7 (1.6)                  | 0.005                |
| Hip score movement       | 4.9 (0.7)                | 4.5 (0.9)                  | 0.01                 |
| Hip score walking        | 4.5 (1.5)                | 3.7 (1.3)                  | 0.04                 |
| HRQoL: EQ-5D index score | 0.70 (0.28)              | 0.68 (0.20)                | 0.3                  |

Charnley hip total score: 3 = worst possible, 18 = best possible.  
 Charnley hip dimension score: 1 = total disability, 6 = normal state.  
 EQ-5D index score: 0 = worst possible health state, 1 = full health.  
<sup>a</sup> P-values are given for differences between the primary and secondary THR groups.

The Katz ADL index (Katz et al. 1963) status is based on an evaluation of the functional independence or dependence of patients in bathing, dressing, using the toilet, transferring, continence and feeding. ADL index A indicates independence in all 6 functions, whereas index B indicates independence in all but 1 of the 6 functions. Indices C–G indicate dependency on others when bathing and at least 1 more function.

Charnley's hip score (Charnley 1972) defines the clinical state of the affected hip joint in 3 dimensions: pain, movement and walking ability. Each dimension is graded from 1 to 6 with 1 = total disability and 6 = normal state. The total score as well as the scores for the dimensions pain, movement and walking ability are presented.

HRQoL was rated using the EQ-5D score (Brooks 1996). An EQ-5D index score of 0 indicates the worst possible health state and a value of 1 indicates full health. The study was conducted according to the Helsinki Declaration: all patients gave their informed consent to participate and the protocol was approved by the local Ethics Committee at Huddinge Hospital.

### Statistics

Ordinal and scale variables were tested with the Mann-Whitney U-test. Nominal variables were tested by the Chi-square test or Fisher's exact test. All tests were two-sided. The results were considered significant at  $p < 0.05$ . We used the statistical software SPSS version 12.0.1 for Windows.

## Results

### Surgical data

4 patients in the primary THR group developed general medical complications before the 4-month follow-up: 2 superficial wound infections and 2 deep venous thromboses. After a new fall 6 weeks postoperatively, 1 patient sustained a periprosthetic fracture that was successfully treated with internal fixation, and the final outcome was good. There were no dislocations or deep infections in the study group during the 2-year follow-up.

The indication for the secondary THR was nonunion in 29/41 patients and avascular necrosis (AVN) in the remaining 12 patients. 5 of the patients had had their screws removed previously. The mean time elapsed between IF and the secondary THR was 11 (0–41) months. Among the patients for whom the indication for re-operation was nonunion, the mean time elapsed was 8 (0–26) months, and in patients with AVN the time elapsed was 16 (3–41) months. Before the 4-month follow-up, 5 patients developed general medical complications: 2 pneumonias, 1 decubital ulcer, and 2 peroneal nerve palsies (transient in 1 case). There were no hip complications in the secondary THR group.

### Functional outcome and HRQoL at the 2-year follow-up

There were no significant differences in ADL between the groups at follow-up. At 24 months 38/43 patients (88%) in the primary THR group and 33/41 patients (80%) in the secondary THR group were categorized as indices A and B. Hip function was significantly better in the primary THR group and HRQoL was assessed to be slightly higher in this group, although the difference was not statistically significant (Table 2).

### HRQoL during the first 2 years after the primary operation

As the 43 patients with a primary THR and 8 of the patients with a secondary THR were recruited from the same randomized controlled trial compar-

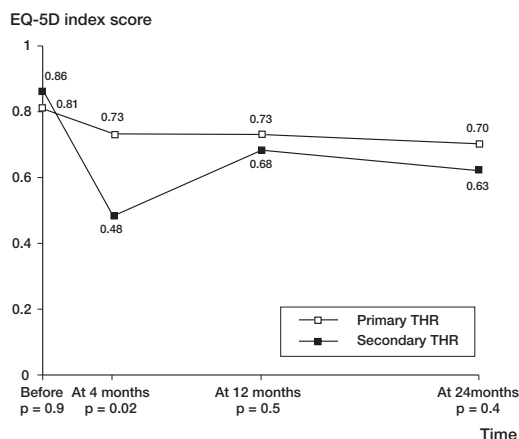


Figure 2. HRQoL (EQ-5D index score) for patients with a primary THR (n = 43) or IF who later underwent a secondary THR (n = 8) during the first two years after the primary operation. EQ-5D index score: 0 = worst possible health state, 1 = full health. P-values are given for differences between groups.

ing primary THR and IF (Tidermark et al. 2003), prospective data were available on HRQoL during the first 2 years after the primary operation in this selected group, including follow-ups at 4, 12 and 24 months. The patients with failed IF experienced a significant decrease in HRQoL (EQ-5D index score) during the first year as compared to patients in the primary THR group (Figure 2). The secondary THR in this subpopulation was carried out at a mean of 13 (2–28) months after the IF procedure.

## Discussion

Our finding of better hip function in the primary THR group is not surprising, and is in agreement with the results of a previous study on comparable groups (McKinley and Robinson 2002). In contrast to our study, McKinley and Robinson (2002) found an increased frequency of superficial wound infections and postoperative dislocations in the secondary THR group. Moreover, in their long-term follow-up, they found an increased risk of prosthetic revision, with 10% of revisions in the primary THR group and more than 30% in the secondary THR group over 10 years. The main indication for revision arthroplasty was mechanical loosening, perhaps due to difficulties in positioning

the stem optimally and the reduced possibility of pressurizing the cement owing to the screw holes remaining after IF.

The patients with a failed IF in our study had to wait a considerable time before their secondary THR. The mean duration between IF and secondary THR was more than 8 months in patients with nonunion, and almost 16 months in patients with AVN. This reflects the time it takes to properly diagnose the fracture healing complication in these patients, but it may also partly reflect the waiting time for revision surgery. The significant deterioration in HRQoL in patients with fracture healing complications before revision surgery has been published previously with EQ-5D index scores down to 0.30 in a comparable patient group (Tidermark et al. 2002). This prolonged period of impaired hip function and reduced quality of life is especially unfortunate in these elderly patients who easily adapt to an unnecessarily low function and quality of life.

The low dislocation rate in this study compares favorably with previous studies on THR in patients with femoral neck fractures using the posterolateral approach (Skinner et al. 1989, Johansson et al. 2000, Neander 2000, Ravikumar and Marsh 2000, McKinley and Robinson 2002). In the study by McKinley and Robinson (2002), the dislocation rate was a considerable problem, especially in the secondary THR group with a rate of almost 20%. The reasons for this difference are probably patient selection and surgical technique. The use of the anterolateral approach in our study is probably the most important factor (Woo and Morrey 1982, Taine and Armour 1985), along with the use of a validated instrument to exclude patients with severe cognitive dysfunction (Pfeiffer 1975)—a major risk factor for dislocations after THR in patients with femoral neck fractures. In the study by Johansson et al. (2000), the dislocation rate was 32% in patients with mental dysfunction as compared to 12% in lucid patients. Since patients with severe cognitive dysfunction also have difficulties in assimilating rehabilitation regimens, as well as impaired functional outcomes after hip surgery, and an even more limited life expectancy as compared to lucid patients (Blomfeldt et al. 2005a), severe cognitive dysfunction should be regarded as a relative contraindication for THR.

We recruited a minor proportion of the patients in the secondary THR group from an RCT comparing IF and primary THR, and the remaining patients from a cohort treated during the same period of time by the same two surgeons as in the RCT. These patients with secondary THR may have been a selection that was not perfectly comparable to the primary THR group. As far as we can see from the baseline data, however, the groups were indeed similar. Furthermore, the indications for a revision arthroplasty are nearly always relative, and are aimed at improving the patient's functioning. All of the patients in the secondary THR group had to undergo a second orthopedic and anesthesiological assessment in which the indication for the salvage THR was balanced against the surgical risks. If there was a selection bias, this would most probably have led to a selection of healthier patients in the secondary THR group.

As the main aim of the study was to compare the outcome 2 years after the THR procedure, only patients who completed the 2-year follow-up were included. Consequently, general complications and hip complications may have been under-reported. Also, the limited number of patients is another weakness of the study, but the power appears to have been appropriate for detection of the differences in hip function between the groups.

In conclusion, our findings confirm the opinion that a primary THR is the preferred treatment for a relatively healthy, active and lucid elderly patient with a displaced femoral neck fracture. Previous studies have shown that the complication and re-operation rates are significantly lower (Skinner et al. 1989, Jonsson et al. 1996, Johansson et al. 2000, Neander 2000, Ravikumar and Marsh 2000, Rogmark et al. 2002, Tidermark et al. 2003, Blomfeldt et al. 2005b) and that the outcome regarding hip function and HRQoL is at least as good as with IF (Tidermark et al. 2003, Blomfeldt et al. 2005b). In addition, our study has shown that patients with a fracture healing complication after IF will have a significant deterioration in HRQoL during the treatment and that the secondary THR would, in all probability, give an inferior outcome compared to a primary THR. On the other hand, for the patient with a fracture healing complication, a secondary THR seems to be a safe salvage procedure with a good outcome, although not giving a

hip function that is fully comparable to that after a primary THR.

#### *Contributions of authors*

RB and JT were involved in the study design, data analysis and drafting of the manuscript. AS was mainly involved in the data collection. HT and SP were mainly involved in the drafting of the manuscript.

This study was supported in part by grants from the Trygg-Hansa Insurance Company, the Swedish Orthopaedic Association, and Stockholm County Council.

Blomfeldt R, Törnkvist H, Ponzer S, Söderqvist A, Tidermark J. Internal fixation versus hemiarthroplasty for displaced fractures of the femoral neck in elderly patients with severe cognitive impairment. *J Bone Joint Surg (Br)* 2005a; 87 (4): 523-9.

Blomfeldt R, Törnkvist H, Ponzer S, Söderqvist A, Tidermark J. Comparison of internal fixation with total hip replacement for displaced femoral neck fractures. Randomized, controlled trial performed at four years. *J Bone Joint Surg (Am)* 2005b; 87 (8): 1680-8.

Brooks R. EuroQol: the current state of play. *Health Policy* 1996; 37: 53-72.

Charnley J. The long-term results of low-friction arthroplasty of the hip performed as a primary intervention. *J Bone Joint Surg (Br)* 1972; 54 (1): 61-76.

Franzen H, Nilsson L T, Strömquist B, Johnsson R, Herrlin K. Secondary total hip replacement after fractures of the femoral neck. *J Bone Joint Surg (Br)* 1990; 72 (5): 784-7.

Hardinge K. The direct lateral approach to the hip. *J Bone Joint Surg (Br)* 1982; 64 (1): 17-9.

Johansson T, Jacobsson S A, Ivarsson I, Knutsson A, Wahlström O. Internal fixation versus total hip arthroplasty in the treatment of displaced femoral neck fractures: a prospective randomized study of 100 hips. *Acta Orthop Scand* 2000; 71 (6): 597-602.

Jonsson B, Sembo I, Carlsson A, Fredin H, Johnell O. Social function after cervical hip fracture. A comparison of hook-pins and total hip replacement in 47 patients. *Acta Orthop Scand* 1996; 67 (5): 431-4.

Katz S, Ford A, Moskowitz R, Jackson B, Jaffe M. Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychological function. *JAMA* 1963; 185: 94-9.

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.

Lykke N, Lerud P J, Stromsoe K, Thorngren K G. Fixation of fractures of the femoral neck. A prospective, randomised trial of three Ullevaal hip screws versus two Hansson hook-pins. *J Bone Joint Surg (Br)* 2003; 85 (3): 426-30.

- McKinley J C, Robinson C M. Treatment of displaced intracapsular hip fractures with total hip arthroplasty: comparison of primary arthroplasty with early salvage arthroplasty after failed internal fixation. *J Bone Joint Surg (Am)* 2002; 84 (11): 2010-5.
- Neander G. Displaced femoral neck fractures. Studies on osteosynthesis and total hip arthroplasty. Thesis 2000; Karolinska Institutet. <http://diss.kib.ki.se/2000/91-628-4167-X/>
- Pfeiffer E. A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *J Am Geriatr Soc* 1975; 23 (10): 433-41.
- Ravikumar K J, Marsh G. Internal fixation versus hemiarthroplasty versus total hip arthroplasty for displaced subcapital fractures of femur-13 year results of a prospective randomised study. *Injury* 2000; 31 (10): 793-7.
- 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.
- Skinner P, Riley D, Ellery J, Beaumont A, Coumine R, Shafiqian B. Displaced subcapital fractures of the femur: a prospective randomized comparison of internal fixation, hemiarthroplasty and total hip replacement. *Injury* 1989; 20 (5): 291-3.
- Tabsh I, Waddell J P, Morton J. Total hip arthroplasty for complications of proximal femoral fractures. *J Orthop Trauma* 1997; 11 (3): 166-9.
- Taine W H, Armour P C. Primary total hip replacement for displaced subcapital fractures of the femur. *J Bone Joint Surg (Br)* 1985; 67 (2): 214-7.
- Tidermark J. Quality of life and femoral neck fractures. *Acta Orthop Scand (Suppl 309)* 2003; 74: 1-42.
- Tidermark J, Zethraeus N, Svensson O, Törnkvist H, Ponzer S. Femoral neck fractures in the elderly: functional outcome and quality of life according to EuroQol. *Qual Life Res* 2002; 11 (5): 473-81.
- Tidermark J, Ponzer S, Svensson O, Söderqvist A, Törnkvist H. Internal fixation compared with total hip replacement for displaced femoral neck fractures in the elderly. A randomised, controlled trial. *J Bone Joint Surg (Br)* 2003; 85 (3): 380-8.
- Woo R Y, Morrey B F. Dislocations after total hip arthroplasty. *J Bone Joint Surg (Am)* 1982; 64 (9): 1295-306.