Comparison of Internal Fixation with Total Hip Replacement for Displaced Femoral Neck Fractures

Randomized, Controlled Trial Performed at Four Years

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Background: Recent randomized, controlled trials performed at two years postoperatively have shown that a primary total hip replacement is superior to internal fixation for the treatment of a displaced femoral neck fracture in a relatively healthy, mentally competent, elderly patient. The primary aim of the present study was to evaluate the outcomes at four years.

Methods: One hundred and two patients (mean age, eighty years) who had an acute displaced femoral neck fracture were randomly allocated to be treated with total hip replacement or internal fixation. The inclusion criteria were an age of at least seventy years, absence of severe cognitive dysfunction, an independent living status, and the ability to walk independently. The main outcome measurements were hip complications, reoperations, hip function, and health-related quality of life.

Results: The mortality rate was 25% in both groups. At the forty-eight-month follow-up evaluation, the rate of hip complications was 4% in the patients treated with total hip replacement and 42% in those treated with internal fixation (p < 0.001) and the reoperation rates were 4% and 47%, respectively (p < 0.001). The arthroplasty group had no additional hip complications or reoperations between the twenty-four and forty-eight-month follow-up visits. In the fixation group, the percentage of hip complications increased from 36% to 42% and the percentage of reoperations increased from 42% to 47% during the same period. The hip function was significantly better and the decline in health-related quality of life was less pronounced in the arthroplasty group than it was in the fixation group at the four, twelve, and twenty-four-month follow-up evaluations. Ninety-seven percent of the patients in the arthroplasty group and 57% of the patients in the fixation group who were available for follow-up at forty-eight months had no hip complications (p < 0.001).

Conclusions: Compared with internal fixation, primary total hip replacement provides a better outcome for mentally competent elderly patients with a displaced femoral neck fracture. The complication and reoperation rates were significantly lower and hip function and health-related quality of life were at least as good at four years after the surgery.

Level of Evidence: Therapeutic Level I. See Instructions to Authors for a complete description of levels of evidence.

The optimal treatment for an acute displaced femoral neck fracture in an elderly patient is still under debate. There is a growing opinion that the outcome would be improved by a more patient-related, rather than a strictly diagnosis-related, approach—that is, the treatment should be based on the patient’s age, functional demands, and individual risk profile. The goal of future research should be to identify selection criteria by which we can identify subgroups of patients that would be optimally treated by any of the surgical methods available—i.e., internal fixation, hemiarthroplasty, or total hip replacement. The population of elderly patients with femoral neck fracture comprises several subpopulations, ranging from the mentally competent, relatively healthy, active patient who is capable of living independently and has a long life expectancy to the institutionalized, cognitively impaired, bedridden patient. It is not likely that one method would be optimal for all of the subpopulations.

A number of recent randomized, controlled trials have shown that, for a relatively healthy, active, and lucid patient, a primary total hip replacement is superior to internal fixation regarding the need for secondary surgery, hip function, and the health-related quality of life. The follow-up period in these trials has been limited to two years except in the study by Neander (which was partly randomized) and that by Raviku-
Comparison of Internal Fixation with Total Hip Replacement for Displaced Femoral Neck Fractures

The previously published randomized, controlled trial included 102 patients with an acute displaced femoral neck fracture (Garden stage III or IV). Eighty-two (80%) of the patients were female, and the mean age was eighty years (range, seventy to ninety-six years). The inclusion criteria were an age of at least seventy years, the absence of severe cognitive dysfunction (at least three correct answers on a ten-item mental test [the Short Portable Mental Status Questionnaire]), independent living status, and the ability to walk independently with or without walking aids. Patients with a pathological fracture, a displaced fracture that had been sustained more than twenty-four hours before presentation, or rheumatoid arthritis or osteoarthritis were not included. After clearance by an anesthetist, the patients were randomized, with a sealed-opaque-envelope technique, to be treated with internal fixation with two cannulated screws or to be treated with a primary total hip replacement (Fig. 1).

Internal fixation was carried out with the patient on a fracture table. The fractures were reduced with closed methods, with the aid of an image intensifier, and were fixed internally with two cannulated screws (Olmed; DePuy/Johnson and Johnson, Sollentuna, Sweden). The goals for screw posi-

Materials and Methods

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tional were modified from the recommendations by Lindqvist and Törnkvist. The reduction was categorized as good (displacement of <2 mm, a Garden angle of 160° to 175°, and posterior angulation of <10°), fair (displacement of <5 mm, a Garden angle of 160° to 175°, and posterior angulation of <20°), or poor (displacement of >5 mm, a Garden angle of <160° or >175°, and posterior angulation of >20°). The position of the screw was categorized as good if its tip was <5 mm from the subchondral bone. As viewed in the anteroposterior projection, the distal screw was aimed to be introduced at the level of the lesser trochanter and to lie on the calcar femorale. The proximal screw was introduced at least 2 cm from, and parallel to, the distal screw, with an angle of <10° between the two screws. As viewed in the lateral projection, the screws were supposed to be parallel and positioned in the central or posterior third of the femoral head and neck.

Total hip replacement was carried out with use of the modified Hardinge approach, with the patient in the lateral decubitus position. An Exeter modular stem (Howmedica, Malmö, Sweden) with a 28-mm head and an Ogee acetabular component (DePuy/Johnson and Johnson, Sollentuna, Sweden) were implanted. The patients in both groups were allowed to sit on a high chair immediately after the surgery and to stop using crutches at their own convenience. After six weeks, there were no restrictions. All operations were performed by one of two surgeons (J.T. or H.T.) who were experienced with both procedures.

The perioperative details and the results at the four, twelve, and twenty-four-month follow-up evaluations have been reported previously. There were no significant preoperative differences between the groups regarding age, gender, cognitive function, ability to carry out activities of daily living, walking ability, or comorbidities (Table I).

The present study included clinical and radiographic examination at approximately forty-eight months (mean [and standard deviation], 48.8 ± 1.6 months). Fracture-healing, hip complications, ability to carry out activities of daily living, ability to live independently, new fractures of the lower extremity, hip function, and health-related quality of life were assessed. All clinical variables except hip motion were assessed by an unbiased observer (a research nurse who was not involved in the surgery or clinical decisions). That observer was not blinded with regard to the type of surgical intervention.

Comorbidity was graded as A (healthy), B (another illness not affecting rehabilitation), or C (another illness that affected rehabilitation).

The ADL (activities of daily living) index described by Katz et al. was used to evaluate the functional independence or dependence of patients with regard to bathing, dressing, using the toilet, transferring, continence, and feeding. An ADL index of A indicates independence in all six functions; an index of B indicates independence in all but one of the six functions; and indices of C through G indicate dependence on another for bathing and at least one more function.

Landing conditions were categorized as independent (living in one's own home or in housing for the elderly) or as institutionalized (living in a care group for demented patients or in a nursing home).

Hip complications in the fixation group were defined as nonunion, osteonecrosis, or peri-implant fracture. Local pain from protruding screws was not defined as a hip complication. The fracture was defined as healed if there were visible trabeculations across the fracture line and no signs of osteonecrosis. Nonunion was defined as an absence of radiographically visible trabeculations across the fracture line and included early redisplacement or progressive displacement. Hip complications in the arthroplasty group were recorded as dislocation, periprosthetic fracture, or radiographic signs of loosening of the femoral or acetabular component.

Charnley’s numerical classification defines the clinical state of the affected hip joint in terms of pain, movement, and walking ability. Each dimension is graded on a scale of 0 to 6, with 0 indicating total disability and 6 indicating a normal state. The mean value and the percentage of patients with the best scores (5 and 6) for each dimension were determined.

### Table I Baseline Data for the One Hundred and Two Patients

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total Hip Replacement (N = 49)</th>
<th>Internal Fixation (N = 53)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>79.2 ± 5.0</td>
<td>81.4 ± 6.6</td>
</tr>
<tr>
<td>Cognitive function (SPMSQ)</td>
<td>9.0 ± 1.1</td>
<td>8.7 ± 1.6</td>
</tr>
<tr>
<td>EQ-5D index score before fracture</td>
<td>0.80 ± 0.22</td>
<td>0.84 ± 0.13</td>
</tr>
<tr>
<td>Female</td>
<td>40 (82)</td>
<td>42 (79)</td>
</tr>
<tr>
<td>No walking aid or just one cane</td>
<td>45 (92)</td>
<td>46 (87)</td>
</tr>
<tr>
<td>ADL index of A or B</td>
<td>48 (98)</td>
<td>51 (96)</td>
</tr>
<tr>
<td>Comorbidity grade of A or B</td>
<td>40 (82)</td>
<td>44 (83)</td>
</tr>
</tbody>
</table>

*There were no significant differences between the treatment groups. †SPMSQ = Short Portable Mental Status Questionnaire, and ADL = activities of daily living. ‡The values are given as the mean and standard deviation. §The values are given as the number of patients with the percentage in parentheses.
The health-related quality of life was rated with use of the EuroQol-5D (EQ-5D) index. An EQ-5D index score of 0 indicates the worst possible health state, and a value of 1 indicates full health.

In the outcome analysis, all patients who had been included in the study remained in their primary randomization group according to the intention-to-treat principle, regardless of secondary procedures. The patients who were lost to follow-up had been followed for as long as possible, and their results are presented separately.

The study was performed according to the Helsinki Declaration. All patients gave informed consent to participate, and the protocol was approved by the local ethics committee.

Statistical Methods
The analyses were performed with SPSS 12.0.1 for Windows (SPSS, Chicago, Illinois) statistical software. All scale variables were tested for normality with the Kolmogorov-Smirnov test. The Student t test was used for parametric scale variables in independent groups. The Mann-Whitney U test was used for nonparametric scale variables and ordinal variables in independent groups. Nominal variables were tested with the chi-square test or the Fisher exact test. All tests were two-sided. The results were considered significant at $p < 0.05$. Trend values ($0.05 \leq p < 0.1$) are displayed in this paper, and all other values are reported as not significant. In order to maximize the power of the statistical tests, we did not apply any correction factor (such as Bonferroni correction) to the p values, which may increase the possibility of a Type-I error.

Results
In our previously published two-year-follow-up study, the fracture reduction was considered to be good in forty-six (87%) of the fifty-three patients in the fixation group and fair in the remaining seven. The screw position was thought to be good in fifty-one (96%) of the fifty-three patients. The stem position was considered to be good in forty-eight (98%) of the forty-nine patients in the arthroplasty group, and the stem was in 8° of varus in one patient. The acetabular component was in a good position in forty-four (90%) of the forty-nine patients. The lateral opening was increased by 5° to 8° in the five remaining patients, one of whom also demonstrated 6° of retroversion. The operatively treated limb was lengthened by a mean of 6 mm (range, –10 to +24 mm). There were two superficial infections in the arthroplasty group but no deep infections. The failure rate, with regard to hip complications and the number of patients undergoing a reoperation, was higher in the fixation group than in the arthroplasty group.

Surgical Outcome for All Patients
The surgical outcomes after forty-eight months are shown in Figure 1. In the entire study population, including the patients who later died (25% of the population) or were lost to follow-up (5%), the rate of hip complications was 4% (two of forty-nine) in the arthroplasty group and 42% (twenty-two of fifty-three) in the fixation group ($p < 0.001$); nonunion occurred in 23% of the patients in the fixation group and osteonecrosis, in 19%. The rate of reoperations was significantly higher in the fixation group (47% [twenty-five of fifty-three]), with 34% having a subsequent arthroplasty and 13%, screw removal) than it was in the arthroplasty group (4% [two of forty-nine]) ($p < 0.001$). Three of the patients in the fixation group who underwent a total hip replacement had had a previous operation for screw removal, which was not included among the reoperations for the analysis. The differences between the groups regarding reoperations were still significant if only the major reoperations (the arthroplasties) were counted in the fixation group ($p < 0.001$).

The mortality rate was 24% (twelve of forty-nine) in the arthroplasty group and 25% (thirteen of fifty-three) in the fixation group (difference not significant). A life-table analysis of the percentage of surviving patients who had not had a reoperation is displayed in Figure 2.

Eight patients (16%) in the arthroplasty group and ten (19%) in the fixation group had a new fracture involving the lower extremities during the four-year follow-up period (difference not significant). There were four femoral neck fractures, three trochanteric fractures, and one periprosthetic fracture in the arthroplasty group and eight femoral neck fractures, one pubic ramus fracture, and one tibial condylar fracture in the fixation group. There were no ipsilateral periimplant fractures in the fixation group.

Of the 102 patients, five (5%) were lost to follow-up before forty-eight months postoperatively; three of these patients were in the fixation group, and two were in the arthroplasty group. Of the three patients in the fixation group, one had un-
dergoned a hemiarthroplasty to treat a nonunion at twenty-two months and was seen at the two-year follow-up evaluation, one patient was lost to follow-up after the two-year visit, and one was lost to follow-up after a four-month visit. In the arthroplasty group, one of the patients lost to follow-up had a dislocation and underwent a revision of the acetabular component and lengthening of the neck of the prosthesis at six months, after which the dislocation did not recur. The patient had good hip function at the twelve-month follow-up evaluation and then refused to return for additional examinations; however, he reported satisfactory hip function in a telephone interview at forty-eight months after the primary surgery. The other patient in the arthroplasty group who was lost to follow-up had a good outcome at the two-year follow-up visit.

*Surgical Outcome for Patients Available for Follow-up at Forty-Eight Months*

In the arthroplasty group, one (3%) of thirty-five patients available for follow-up at forty-eight months had had a hip complication and a reoperation. This patient sustained a periprosthetic fracture in a fall six weeks after the primary operation and was treated with internal fixation of the fracture, with an uneventful outcome. One additional patient in the arthroplasty group had a reoperation—a revision arthroplasty due to dislocations six months after the primary surgery. This patient was later lost to follow-up, as mentioned above. There were no hip complications in the arthroplasty group between twenty-four and forty-eight months, and there were no radiographic signs of loosening of the components in any of the patients at the four-year follow-up evaluation.

In the group treated with internal fixation, sixteen (43%) of the thirty-seven patients available for follow-up at forty-eight months had had a fracture-healing complication. Twelve (32%) of the thirty-seven had undergone an arthroplasty (a total hip replacement in eleven of them), and seven (19%) had had the fixation screws removed. All patients with a nonunion but only five of the nine patients with osteonecrosis underwent an arthroplasty. Two of the patients with osteonecrosis had screw removal only. Between the twenty-four and forty-eight-month follow-up evaluations, the percentage of fracture-healing complications increased from 36% to 42% and the percentage of reoperations increased from 42% to 47%.

**Functional Outcome and Health-Related Quality of Life**

There were no differences in the ADL index between the groups at the four, twelve, and twenty-four-month follow-up evaluations. At forty-eight months, 81% of the patients in the arthroplasty group and 70% in the fixation group had an A or B (normal) ADL index, which was not significant. This finding reflected a deterioration compared with the twenty-four-month ADL indices, which were A or B in 90% and 88%, respectively. The Charnley hip scores are presented in Table II. The hip function was generally better in the arthroplasty group at the four, twelve, and twenty-four-month follow-up evaluations. At forty-eight months, 81% of the patients in the arthroplasty group and 70% in the fixation group had a Charnley score of 5 or 6 points, which was not significant. This finding reflected a deterioration compared with the twenty-four-month Charnley scores, which were 5 or 6 points in 90% and 88%, respectively. The health-related quality of life according to the EQ-5D index score was better in the arthroplasty group at each additional follow-up evaluation.
follow-up point, but the differences were significant only at four months (p < 0.005) and twelve months (p < 0.05) (Fig. 3). The change in the EQ-5D index score between the time that the patient was included in the study and each follow-up evaluation (four, twelve, twenty-four, and forty-eight months) is shown in Table III. The decline in the score was more pronounced in the fixation group, but, with the numbers available, the difference between the groups at the forty-eight-month follow-up evaluation was not significant.

Among the patients available for follow-up at forty-eight months, thirty-four (97%) of the thirty-five in the arthroplasty group and twenty-one (57%) of the thirty-seven patients in the fixation group remained without a hip complication (p < 0.001). The hip function and health-related quality of life of these patients are shown in Table IV.

At forty-eight-months, there was a trend toward a higher percentage of patients living independently in the arthroplasty group (89%; thirty-one of thirty-five) than in the fixation group (70%; twenty-six of thirty-seven) (p = 0.082).

Discussion

The benefit of primary total hip replacement compared with internal fixation for the treatment of a displaced femoral neck fracture in a relatively healthy, cognitively intact, elderly patient is apparent even at four years postoperatively. The rate of hip complications and the need for secondary surgery are lower, and hip function and health-related quality of life are as good.

The rate of hip complications in the fixation group continued to increase, from 36% at twenty-four months to 42% at forty-eight months, and the reoperation rate increased from 42% to 47%. The increase in hip complications was due to detection of osteonecrosis in a number of patients after the twenty-four-month follow-up evaluation; the total rate of osteonecrosis was 19% at forty-eight months, and the rate of nonunions was 23%. This increase was in contrast to the outcome in the arthroplasty group, in which the rate of hip complications and the rate of reoperations each remained unchanged at 4%. According to the current state of the art, the fracture reduction and screw position were optimal in the vast majority of the patients in the fixation group, and the outcomes in that group at twenty-four months were equal to or better than those reported in most other studies. This is confirmed by the meta-analysis by Lu-Yao et al., in which the hip complication rate was 49%, with a 33% rate of nonunion and a 16% rate of osteonecrosis. In a large meta-analysis focusing on the choice of implant in almost 5000 patients, screws (as used in our study) appeared to be superior to pins, but there is no clinical evidence that the use of three or more screws is superior to the use of two screws.

There were no additional complications in our arthroplasty group between the twenty-four and forty-eight-month follow-up evaluations. The dislocation rate remained low at 2% and was on par with what can be expected after an elective total hip replacement in patients with osteoarthritis or rheumatoid arthritis. This low rate compares favorably with the dislocation rates (range, 9% to 22%) in other randomized, controlled trials of primary total hip replacement in patients with a femoral
The surgical approach was through a trochanteric osteotomy in the study by Jonsson et al. and was posterolateral in all of the others. The low rate of dislocation in our series is probably explained by our inclusion criteria, which were an ability to walk and live independently and, most importantly, no severe cognitive dysfunction. In the study by Johansson et al., the dislocation rate was 32% in patients with mental dysfunction compared with 12% in lucid patients. Assessment of cognitive function with a validated instrument, such as the Short Portable Mental Status Questionnaire (SPMSQ) used in our study, is advantageous, especially with regard to facilitating the implementation of the findings in future treatment protocols. Additionally, we believe that the anterolateral surgical approach has advantages over the posterolateral approach regarding stability of the hip joint, which is of crucial importance in patients with this particular diagnosis.

The four-year mortality rate of 25% in both groups in our study was lower than the two-year mortality rate in most series in which the patients were not selected on the basis of walking ability, living conditions, and cognitive function. The 25% rate is in sharp contrast to the finding of a study in which patients were selected if they were able to walk independently but had severe cognitive dysfunction (an SPMSQ score of <3). In that study, in which the patients were randomized to be treated with internal fixation or primary hemiarthroplasty, the two-year mortality rate was 42%. The expected longer survival of the patients selected for our study emphasizes the importance of a primary procedure with durable results. Total hip replacement seems to provide good long-lasting function. According to the Swedish National Hip Arthroplasty Register, 98% of patients in whom a hip fracture was treated with total hip replacement did not have a revision within eleven years. Given the expected mean duration of survival of a seventy-year-old Swedish woman and man (sixteen and thirteen years, respectively), it appears that most primary total hip replacements in patients older than seventy years of age will last throughout their remaining life span, provided that they do not have an early complication. This contention is also supported by the four-year follow-up study by Neander and the thirteen-year follow-up study by Ravikumar and Marsh. In the latter study, in which internal fixation, cementless hemiarthroplasty, and total hip replacement were compared, the thirteen-year revision rates were 33%, 24%, and 7%, respectively. Hip function was best in the total hip replacement group and worst in the hemiarthroplasty group. This unfavorable outcome of cementless hemiarthroplasty was confirmed by the 1986 study by Dorr et al.

In our study, hip function was significantly better and the decline in health-related quality of life was less pronounced in the arthroplasty group than in the fixation group at the four, twelve, and twenty-four-month follow-up evaluations, but the differences were no longer significant at the forty-eight-month evaluation. The scores for hip pain in the fixation group were markedly improved between the twenty-four and forty-eight-month follow-up evaluations, probably reflecting the fact that the majority of the patients with hip complications had undergone a reoperation. All patients with a nonunion and five of the nine with osteonecrosis had an arthroplasty, and eleven of the twelve patients who had an arthroplasty had a total hip replacement. Additionally, 19% of the patients had had the screws

### TABLE III Change in EQ-5D Score Between Baseline and Each Follow-up Evaluation

<table>
<thead>
<tr>
<th>Follow-up Time*</th>
<th>Change in EQ-5D Score Compared with Baseline (points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Hip Replacement†</td>
</tr>
<tr>
<td>4 mo</td>
<td>−0.09 ± 0.24</td>
</tr>
<tr>
<td>12 mo</td>
<td>−0.09 ± 0.27</td>
</tr>
<tr>
<td>24 mo</td>
<td>−0.11 ± 0.28</td>
</tr>
<tr>
<td>48 mo</td>
<td>−0.21 ± 0.36</td>
</tr>
</tbody>
</table>

* N = 94 at four months, n = 92 at twelve months, n = 84 at twenty-four months, and n = 72 at forty-eight months. † The values are given as the mean and standard deviation. ‡ The p values are given for the differences between the treatment groups. NS = not significant.

### TABLE IV Outcomes Regarding Hip Function (Charnley Score) and Health-Related Quality of Life (EQ-5D Index Score) for All Patients without a Hip Complication at Forty-eight Months Postoperatively*

<table>
<thead>
<tr>
<th></th>
<th>Total Hip Replacement (N = 34)</th>
<th>Internal Fixation (N = 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charnley pain score</td>
<td>5.5 ± 1.1</td>
<td>5.3 ± 1.1</td>
</tr>
<tr>
<td>Charnley movement score</td>
<td>4.7 ± 0.8</td>
<td>4.7 ± 1.2</td>
</tr>
<tr>
<td>Charnley walking score</td>
<td>3.9 ± 1.3</td>
<td>3.3 ± 1.7</td>
</tr>
<tr>
<td>EQ-5D index score</td>
<td>0.62 ± 0.31</td>
<td>0.52 ± 0.40</td>
</tr>
</tbody>
</table>

* The values are given as the mean number of points and the standard deviation. Charnley score: 1 = total disability, and 6 = normal state. EQ-5D index score: 0 = worst possible health state, and 1 = full health. There were no significant differences between the treatment groups.
removed. Of the patients in whom the fracture healed uneventfully, 24% underwent screw removal. There was an obvious deterioration in walking ability and health-related quality of life between the twenty-four and forty-eight-month follow-up evaluations in both groups, probably reflecting the natural course of aging, the increased frequency of comorbidities, and new fractures of the lower extremity. Eighteen percent of all patients sustained a new fracture of the lower extremity, and the fractures were predominately of the hip.

In a randomized, controlled trial comparing internal fixation with total hip replacement, it is inevitable that the difference in hip function and health-related quality of life between the two groups will decrease with time (in an intention-to-treat analysis) as a result of a substantial proportion of salvage arthroplasties being performed in the fixation group. Therefore, it is important to evaluate the overall outcome—i.e., revision surgery, hip function, and health-related quality of life—during this relatively long time period, rather than focusing exclusively on the outcome at the time of the final follow-up. Four years is a substantial period of the remaining lifetime of these elderly patients.

The opinion that the outcome following uneventful healing of a displaced femoral neck fracture treated with internal fixation is better than that of an arthroplasty seems not to be true when internal fixation is compared with primary total hip replacement in a group of relatively healthy, mentally competent patients. In the group of patients with an uneventful outcome, those treated with arthroplasty had better absolute values for hip function and health-related quality of life than those treated with internal fixation, although this difference was not significant at the forty-eight-month follow-up evaluation. Thus, the hip function and health-related quality of life at four years after the hip arthroplasties were at least as good as those following uneventful healing of internally fixed fractures.

The number of patients enrolled in this trial limited its statistical power for detecting differences in hip function and health-related quality of life, especially with the mortality rate reducing the number of patients available for long-term follow-up. However, the statistical power was adequate to confirm the difference in the rate of hip complications and reoperations and to support the conclusion that, at four years, the hip function and health-related quality of life provided by total hip replacement are similar to those provided by internal fixation. The fact that the nurse who performed the follow-up evaluations was not blinded to the type of surgical intervention is also a limitation. The questionnaires for most of the outcome variables were mailed to the patients a week before the scheduled follow-up visit. The questionnaires were filled out by the patients, and the nurse’s task at the follow-up evaluation was to ensure that all questions had been completed. A strength of the trial was that only 5% of the patients were lost to follow-up less than the forty-eight-months postoperatively.

In summary, the results of this study confirm that, at four years postoperatively, the outcomes of primary total hip replacement are better than those of internal fixation in mentally competent elderly patients with a displaced femoral neck fracture. The complication and reoperation rates were significantly lower following the hip arthroplasties, and the hip function and the health-related quality of life were similar to those following internal fixation. The criteria for selecting patients for treatment with total hip replacement are important, and we recommend use of a validated instrument for assessing cognitive function.

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