Quality of life after hip revision with impaction bone grafting on a par with that 4 years after primary cemented arthroplasty

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Background **There have been few studies evaluating patient-reported quality of life outcomes after hip revision with impaction bone grafting.**

Patients and methods **The inclusion criteria were aseptic loosening after primary arthroplasty performed for osteoarthrosis, and first-time revision with impacted morselized allograft bone and cemented Exeter stem. During a 4-year period, 35 patients were eligible and all were included. The Nottingham Health Profile (NHP) was completed by the patients and the Charnley hip scores recorded by the examining surgeon preoperatively, after 6 months and yearly up to 4 years (28 patients) postoperatively. For comparison, 35 osteoarthrotic patients completed the NHP 4 years after cemented Exeter primary arthroplasty.**

Results **At 4 years, the NHP scores for the revision patients did not differ significantly from those recorded in the primary arthroplasty group. Among the revision patients, mixed model analysis showed improvement in NHP pain ($p < 0.001$) and physical mobility scores ($p = 0.002$). The effect size at 4 years was large for pain (1.2) and moderate for physical mobility (0.6). The major improvement was recorded at 6 months, with no further substantial change observed. The correlations between the NHP and Charnley scores were weak or moderate (r, –0.15 to –0.67).**

Interpretation **Hip revision with impaction bone grafting leads to substantially improved quality of life, similar to that 4 years after primary arthroplasty.**

Although an increasing number of patients are undergoing hip revision arthroplasty, few studies have addressed quality of life outcomes using validated measures. Two previous studies have reported favorable short-term results of hip revision, measured with validated quality of life questionnaires (Hozack et al. 1997, Dawson et al. 2001). To our knowledge, no study has prospectively evaluated the medium-term outcomes of hip revision arthroplasty performed with impacted morselized allograft bone and cement, or compared them with those of primary arthroplasty using validated quality of life questionnaires. This revision method (Gie et al. 1993, Slooff et al. 1996) has been studied with regard to radiographic outcomes (Kärrholm et al. 1999). In some studies, the clinical results have been evaluated with the Charnley scores (Gie et al. 1993) and early complications have been reported (Ornstein et al. 2002).

The main objective of this study was to prospectively assess the medium-term quality of life outcomes of first-time hip revision with impacted morselized allograft bone and cemented Exeter stem in osteoarthrotic patients with aseptic loosening. The secondary objectives were (1) to assess any correlations between the scores obtained from a self-reported generic health status measure and the corresponding examiner-recorded hip-specific scores, and (2) to compare the quality of life outcomes of revision with those of cemented primary hip arthroplasty in patients with primary osteoarthrosis.

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Patients and methods

From 1994 through 1997, 103 hip revision arthroplasties involving the stem and/or the socket were performed at our department. Impacted morselized allograft bone and cement was used in all the revisions except 4, in which conventional cemented revision was performed because impaction allografting was judged to be technically inappropriate or because of short expected patient survival (Ornstein 2002). The inclusion criteria for this study were a previous primary arthroplasty because of primary osteoarthrosis, aseptic loosening of the stem with or without socket loosening, and a first-time revision using impacted morselized allograft bone and cement. Of the 97 patients (99 hips) who had hip revision performed with impacted morselized allograft bone and cement during the 4-year period, 35 patients (35 hips) met the inclusion criteria for the present study and were all included. The mean age of these patients was 73 (60–87) years and 19 were men. The mean time since the primary arthroplasty was 11 (3–17) years. Bone stock deficiency (Gustilo and Pasternak 1988) in the femur was type I in 12 patients, type II in 18 patients, and type III in 5 patients. Bone stock deficiency in the acetabulum was type I in 10 patients, type II in 11 patients, and type III in 10 patients; 4 sockets were not loose. Of the 4 non-loose sockets, 2 were found to be damaged and were revised, and 2 were not revised. Revision of all loose components was done using impacted morselized allograft bone and cement and the standard Exeter stem and socket. Revision of the 2 non-loose but damaged sockets was done without use of allograft bone (Ornstein et al. 1999, 2001).

Nottingham Health Profile

Evaluation of quality of life was done with the Nottingham Health Profile (NHP), a measure that has been validated and used in the assessment of patients with hip osteoarthrosis before and after arthroplasty (Hunt et al. 1980, Wiklund et al. 1988, Wiklund and Romanus 1991, Rissanen et al. 1996, Garellick et al. 1998, Söderman and Malchau 2000). The patients completed the NHP questionnaire before, and also 6 months and 1, 2, 3, and 4 years after revision. Preoperatively, the questionnaire was completed by the patients, without assistance, on admission to hospital. Postoperatively, the questionnaire was mailed to the patients up to one week before their scheduled follow-up evaluation at the hospital, and the patients returned the completed questionnaires during their visit. The NHP consists of 6 scales (pain, physical mobility, energy, sleep, emotional reaction, and social isolation). Each scale has multiple items with yes/no response choices. The responses to the items in each scale are weighted and summed to give a final scale score ranging from 0 (best) to 100 (worst). The pain scale has 8 items inquiring about the presence of constant pain, unbearable pain, pain at night, and pain on walking, changing position, sitting, standing, and going up and down stairs. The physical mobility scale has 8 items inquiring about the ability to walk at all and difficulty or need for assistance to walk about outdoors, to walk about indoors, to get up and down stairs, to stand for a long time, to dress, bend, and reach for things.

Charnley score

The Charnley pain, walking ability, and range of motion scores (Charnley 1979) for each patient were recorded by the examining surgeon preoperatively, and at each follow-up evaluation.

Dropouts

5 patients died of causes unrelated to the hip surgery (2 patients during the second postoperative year, 1 during the third and 2 during the fourth). 2 patients did not complete the NHP questionnaire preoperatively, but completed it at the follow-up evaluations. 2 patients (men aged 76 and 73 years at surgery) declined participation in the 4-year follow-up evaluation. Because of death or non-attendance, a number of patients had missing values at 6 months (n = 6), 1 year (n = 2), 2 years (n = 5), 3 years (n = 4), and 4 years (n = 7).

Primary arthroplasty

For comparison, the NHP was used to measure quality of life outcomes among a control group of patients who had undergone primary cemented hip arthroplasty. At our department in 1998, 45 patients above 60 years of age were operated on with primary arthroplasty using a cemented Exeter prosthesis because of primary osteoarthrosis. At 4 years postoperatively, 3 patients had died, 1

Table 1. The Nottingham Health Profile (NHP) scale scores

	Revision arthroplasty						Primary arthroplasty
		postoperative					postoperative
NHP scale [a]	preoperative (n = 33)	6 months (n = 29)	1 year (n = 33)	2 years (n = 30)	3 years (n = 30)	4 years[b] (n = 28)	4 years [b] (n = 35)
Pain	51 (29)	16 (26)	12 (15)	15 (19)	12 (16)	16 (21)	22 (27)
Physical mobility	39 (19)	26 (28)	24 (25)	28 (27)	26 (26)	24 (26)	23 (20)
Energy	33 (38)	23 (36)	19 (34)	24 (39)	27 (36)	28 (40)	28 (32)
Sleep	25 (25)	12 (17)	13 (19)	15 (20)	16 (23)	14 (14)	21 (28)
Emotional reaction	13 (20)	10 (21)	6 (12)	6 (13)	11 (19)	9 (14)	10 (19)
Social isolation	7 (10)	5 (20)	7 (12)	6 (13)	6 (15)	9 (13)	6 (14)

[a] NHP mean (SD) score ranges from 0 (best) to 100 (worst).
[b] No significant differences in the 4-year scores between the primary and revision groups in any scale.

patient had developed cognitive impairment, and 2 patients had had their hip arthroplasty revised. The NHP questionnaire was mailed to the 39 eligible patients, and this was followed when necessary by two telephone reminders. 1 patient (a man aged 76 years at surgery) could not be located and 3 patients (women aged 81, 72 and 63 years) did not respond. Thus, 35 patients returned completed questionnaires. No preoperative NHP data were available for these patients.

Statistics

The mean NHP scale scores were calculated for the revision and primary arthroplasty groups. In the revision group, a mixed model analysis (Brown and Prescott 1999, Ranstam 2002) was done to estimate the change in NHP scores from baseline at each 1-year postoperative interval for the 28 patients who had completed the 4-year follow-up. The effect size at 4 years (mean difference between the preoperative and 4-year postoperative scores divided by the standard deviation of the preoperative scores) was calculated (Kazis et al. 1989). The effect size is an estimate of the magnitude of health change measured by each scale; a value of 0.2 is considered to indicate a small degree of improvement in health, 0.5 moderate, and 0.8 or greater a large health improvement. For the Charnley scores, the changes from preoperatively to 4 years after revision were analyzed using the Wilcoxon signed ranks test. The correlation between the NHP scores for pain and physical mobility and the Charnley scores for pain and walking ability, respectively, were analyzed with the Spearman correlation coefficient (r).

We used the Mann-Whitney test to compare the primary arthroplasty group with the revision group regarding age, and the chi-square test was used to compare the 2 groups regarding sex and Charnley category. The Mann-Whitney test was used to compare the 4-year postoperative NHP scores for the primary and revision groups. For the main outcome variables (NHP pain and physical mobility scores), we calculated the 95% confidence interval (CI) for the mean difference in scores between the primary and revision group to aid in the interpretation of the results with regard to the adequacy of the sample size (Guyatt et al. 1995). No previous studies have established the magnitude of NHP scale score that would be considered as an important difference. In a recent study, the minimally important difference in scores for health-related quality of life questionnaires has been estimated to one half a standard deviation (Norman et al. 2003).

Results

Nottingham Health Profile

The mean preoperative NHP scores for pain had improved after hip revision by approximately 35 points, and for physical mobility and sleep by approximately 10 points (Table 1). The major improvement was recorded 6 months after revision, with no further substantial change observed for these scales. The mixed model analysis showed a significant improvement in the pain and physical mobility scores, and this was persistent (Table 2). An early significant improvement in the

Table 2. The change in NHP scores from baseline, estimated at 1-year postoperative intervals (mixed model analysis) for 28 patients who completed 4 years of follow-up after hip revision

NHP scale	Estimate (95% CI), p-value 1 year	2 years	3 years	4 years
Pain	–39 (–48 to –30), <0.001	–37 (–46 to –28), <0.001	–40 (–49 to –31), <0.001	–35 (–44 to –27), <0.001
Physical mobility	–15 (–24 to –7), <0.001	–13 (–22 to –5), 0.002	–14 (–22 to –6), 0.001	–13 (–22 to –5), 0.002
Energy	–15 (–27 to –3), 0.01	–13 (–25 to –1), 0.03	–7 (–19 to 5), 0.24	–4 (–16 to 8), 0.47
Sleep	–9 (–17 to –1), 0.02	–6 (–14 to 2), 0.16	–5 (–13 to 2), 0.17	–6 (–14 to 2), 0.14
Emotional reaction	–7 (–13 to –1), 0.02	–7 (–14 to –1), 0.02	–4 (–11 to 2), 0.17	–4 (–10 to 2), 0.14
Social isolation	–1 (–6 to 4), 0.67	–2 (–6 to 3), 0.52	–2 (–7 to 3), 0.36	3 (–2 to 8), 0.23

Table 3. The number of patients showing improvement or worsening in NHP scores from preoperatively to 4 years after hip revision, using 10 points as a minimally important change

NHP scale	Improvement (points) >15 (n)	10–15 (n)	<10 (n)	Worsening (points) 10–15 (n)	>15 (n)
Pain	19	2	4	0	2
Physical mobility	11	6	2	3	5
Energy	4	2	16	0	5
Sleep	8	3	9	2	5
Emotional reaction	5	0	19	1	2
Social isolation	2	0	20	0	5

scores for energy, emotional reaction and sleep was observed, but the effect was not persistent. The effect size at 4 years after revision was large for pain (1.2), moderate for physical mobility (0.6), and small to moderate for sleep (0.3). Among the 27 patients who had preoperative and 4-year follow-up scores, pain and physical mobility scores had improved by at least 10 points in 21 and 17 patients, respectively (Table 3). For the revision patient who had 4-year follow-up but no preoperative scores, the pain score was 30 and the physical mobility score was 10.

Charnley score

The median score for pain had improved from 3 points preoperatively to 6 points at 4 years after the operation ($p < 0.001$), and the median score for walking ability had improved from 3 points to 4 points ($p = 0.03$). The median score for range of motion was 5 points, both preoperatively and at 4 years. The correlation between the NHP and Charnley pain scores was moderate preoperatively ($r = –0.44$) and weak at 4 years ($r = –0.15$). The correlations between the NHP scores for physical mobility and the Charnley scores for walking ability were moderate both preoperatively ($r = –0.34$) and 4 years after the operation ($r = –0.67$).

Primary arthroplasty

The patients in the primary arthroplasty group did not differ significantly from those in the revision group regarding age, sex or Charnley category (Table 4). At the 4-year follow-up, none of the NHP scale scores differed between the primary

Table 4. Comparison of the revision and primary arthroplasty groups 4 years after surgery

	Revision	Primary	P-value
Number of patients	28	35	–
No. of women : men	15 : 13	18 : 17	0.7
Age (at surgery), mean (range) years	73 (60–84)	72 (61–85)	0.3
Charnley category, A or B : C (n)	17 : 11	16 : 19	0.6

and the revision arthroplasty group (Table 1). The mean difference (95% CI) between the primary and the revision group in the NHP pain score was 6.4 (-6.4–19), while in the NHP physical mobility score it was -1.3 (-13–11).

Postoperative complications

6 patients sustained femoral shaft fractures during the first 4 months after revision, necessitating open reduction and internal fixation in 5 and revision of the stem in 1. Using 10 points as a cutoff for improvement or worsening, the preoperative NHP physical mobility score worsened in 4 of these 6 patients at 4 years and in 1 patient whose final follow-up before death was at 2 years, and improved in 1 patient. The corresponding NHP pain scores improved in 4 patients, were unchanged in 1 patient, and worsened in 1 patient.

Femoral head dislocation occurred during the first 6 postoperative weeks in 4 patients. They were treated with orthosis for 3 months, with no further dislocations in 3 of the patients. 1 patient continued to have recurrent dislocations.

Discussion

We found that patient-reported quality of life outcomes after hip revision with impaction allografting were equal to those after primary cemented arthroplasty 4 years postoperatively. Although the sample size was small, the 2 groups were comparable. In addition, the lower limit of the 95% confidence interval for the difference in pain score (–6.4 points) suggests that the sample size was adequate, assuming that a minimally important difference in favor of primary arthroplasty would correspond to –10 points. However, for the physical mobility score, a possibly important difference of up to –13 points in favor of primary arthroplasty might be shown with a larger sample size, but a larger difference appears to be unlikely. In a study of 1056 patients who completed the NHP 2–10 years after primary hip arthroplasty, the standard deviation for the NHP pain and physical mobility scores was 27 and 25 points, respectively (Söderman et al. 2001). Based on the recent suggestion of using one half a standard deviation as a criterion for minimally important difference (Norman et al. 2003), the threshold of 10 points used in the present study seems reasonable.

We found that hip revision with impacted morselized allograft bone and cement led to a significant improvement in quality of life in several respects. Substantial improvement in pain and moderate improvement in physical mobility was the principal outcome. A small to moderate improvement in the scores for sleep, as interpreted with the effect size, was also shown. The scores for the NHP energy scale improved after surgery, but gradually deteriorated and returned to preoperative levels at 4 years. Because the mean scores for the emotional reaction and social isolation scales were relatively low before revision, no clinically important improvement in score would be expected. Our prerevision emotional reaction scores were slightly worse and the social isolation scores were similar to the corresponding scores for a reference population used for comparison with hip arthritis patients (Garellick et al. 1998).

Similarly, a previous study using the NHP in primary hip arthroplasty showed the greatest improvement to occur in the pain and physical mobility scales (Rissanen et al. 1996). However, the NHP social isolation scores before primary arthroplasty in previous studies (Wiklund and Romanus 1991, Garellick et al. 1998) were worse than the corresponding scores before revision arthroplasty in our study. One explanation might be that patients modify their social activities after primary hip arthroplasty. Another explanation might be a difference in the severity of preoperative pain; previous studies of primary arthroplasty, which included patients with hip arthritis of various causes, reported preoperative NHP pain scores of approximately 60 points (Rissanen et al. 1996) and 75 points (Wiklund and Romanus 1991, Garellick et al. 1998).

Our comparison between the revision and the primary arthroplasty group has been limited by the absence of preoperative NHP scores for the latter group. Our postoperative NHP scores were similar to those reported for 94 primary hip arthroplasty patients (mean age 75 years, 46% men) randomly selected from the Swedish national register (Söderman et al. 2000). In a study that compared primary and revision hip arthroplasty (151 and 49 patients, respectively) 2 years postoperatively using the

SF-36 quality-of-life questionnaire, the primary arthroplasty group had a significantly better mean score for the physical functioning scale but no significant score differences were found for the remaining scales, including the bodily pain scale (Hozack et al. 1997). Another study that compared cemented primary and revision arthroplasty 4 years postoperatively (53 and 25 patients, respectively) using a modified Harris hip score showed no significant difference in pain and function (Robinson et al. 1999), but the study did not use a validated quality-of-life questionnaire.

The correlations between the NHP scores and the Charnley scores were weak to moderate. Although this can partly be explained by the difference between a general health status measure (based on patients' self-report) and a hip-specific score recorded by the examining surgeon, other factors may be involved. Previous research has suggested that patients report better health with interview-administered rather than self-administered health status measures (McHorney et al. 1994, Hoher et al. 1997, Lyons et al. 1999). This observation supports the importance of including measures of patient-reported outcomes in the assessment of hip arthroplasty.

In a previous study of all revisions performed for a variety of reasons using impacted morselized allograft bone and cement, we reported a relatively high rate of early complications—mainly femoral fractures (Ornstein et al. 2002). The present analysis showed that 5 of 6 patients who sustained early postoperative femoral shaft fracture had postoperative physical mobility scores that were worse than than preoperatively, but pain scores had improved. With longer follow-up, the possible effect of prosthetic loosening on the NHP scales can also be assessed.

A possible limitation of our study is the small number of patients included. The aim was to study medium-term quality of life outcomes of a specific hip revision arthroplasty in a well-defined patient population. We therefore chose to have strict criteria, including only osteoarthrotic patients with aseptic loosening who underwent first-time revision. In patients fulfilling these criteria, revision arthroplasty with impacted morselized allograft bone and cemented Exeter stem appears to result in significant medium-term improvement in quality of life which is comparable to that experienced after primary cemented hip arthroplasty.

Authors' contributions

IA participated in the design of the study and data collection, performed the analysis and drafted the manuscript, and EO and RJ participated in the design and conduction of the study and editing of the manuscript. HF, AS and MS participated in conduction of the study.

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Brown H, Prescott R. Applied mixed models in medicine. Wiley, Chichester, England 1999.

Charnley J. Low friction arthroplasty of the hip. Springer-Verlag, Berlin, Germany 1979.

Dawson J, Fitzpatrick R, Frost S, Gundle R, McLardy-Smith P, Murray D. Evidence for the validity of a patient-based instrument for assessment of outcome after revision hip replacement. J Bone Joint Surg (Br) 2001; 83: 1125-9.

Garellick G, Malchau H, Herberts P. Specific or general health outcome measures in the evaluation of total hip replacement. A comparison between the Harris hip score and the Nottingham Health Profile. J Bone Joint Surg (Br) 1998; 80: 600-6.

Gie G A, Linder L, Ling R S, Simon J P, Slooff T J, Timperley A J. Impacted cancellous allografts and cement for revision total hip arthroplasty. J Bone Joint Surg (Br) 1993; 75: 14-21.

Gustilo R B, Pasternak H S. Revision total hip arthroplasty with titanium ingrowth prosthesis and bone grafting for failed cemented femoral component loosening. Clin Orthop 1988; (235): 111-9.

Guyatt G, Jaeschke R, Heddle N, Cook D, Shannon H, Walter S. Basic statistics for clinicians: 2. Interpreting study results: confidence intervals. CMAJ 1995; 152: 169-73.

Hoher J, Bach T, Munster A, Bouillon B, Tiling T. Does the mode of data collection change results in a subjective knee score? Self-administration versus interview. Am J Sports Med 1997; 25: 642-7.

Hozack W J, Rothman R H, Albert T J, Balderston R A, Eng K. Relationship of total hip arthroplasty outcomes to other orthopaedic procedures. Clin Orthop 1997; (344): 88-93.

Hunt S M, McKenna S P, McEwen J, Backett E M, Williams J, Papp E. A quantitative approach to perceived health status: a validation study. J Epidemiol Community Health 1980; 34: 281-6.

Kärrholm J, Hultmark P, Carlsson L, Malchau H. Subsidence of a non-polished stem in revisions of the hip using impaction allograft. Evaluation with radiostereometry and dual-energy X-ray absorptiometry. J Bone Joint Surg (Br) 1999; 81: 135-42.

Kazis L E, Anderson J J, Meenan R F. Effect sizes for interpreting changes in health status. Med Care 1989; 27: S178-S189.

Lyons R A, Wareham K, Lucas M, Price D, Williams J, Hutchings H A. SF-36 scores vary by method of administration: implications for study design. J Public Health Med 1999; 21: 41-5.

McHorney C A, Kosinski M, Ware J E, Jr. Comparisons of the costs and quality of norms for the SF-36 health survey collected by mail versus telephone interview: results from a national survey. Med Care 1994; 32: 551-67.

Norman G R, Sloan J A, Wyrwich K W. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. Med Care 2003; 41: 582-92.

Ornstein E. Hip revisions with impacted morselized allograft bone and cement. Patient outcome, prosthetic fixation and risks. Acta Orthop Scand (Suppl 306) 2002; 73: 1-66.

Ornstein E, Franzén H, Johnsson R, Sandquist P, Stefansdottir A, Sundberg M. Migration of the acetabular component after revision with impacted morselized allografts: a radiostereometric 2-year follow-up analysis of 21 cases. Acta Orthop Scand 1999; 70: 338-42.

Ornstein E, Atroshi I, Franzén H, Johnsson R, Sandquist P, Sundberg M. Results of hip revision using the Exeter stem, impacted allograft bone, and cement. Clin Orthop 2001; (389): 126-33.

Ornstein E, Atroshi I, Franzén H, Johnsson R, Sandquist P, Sundberg M. Early complications after one hundred and forty-four consecutive hip revisions with impacted morselized allograft bone and cement. J Bone Joint Surg (Am) 2002; 84-A: 1323-8.

Ranstam J. Problems in orthopedic research: dependent observations. Acta Orthop Scand 2002; 73: 447-50.

Rissanen P, Aro S, Sintonen H, Slätis P, Paavolainen P. Quality of life and functional ability in hip and knee replacements: a prospective study. Qual Life Res 1996; 5: 56-64.

Robinson A H, Palmer C R, Villar R N. Is revision as good as primary hip replacement? A comparison of quality of life. J Bone Joint Surg (Br) 1999; 81: 42-5.

Slooff T J, Buma P, Schreurs B W, Schimmel J W, Huiskes R, Gardeniers J. Acetabular and femoral reconstruction with impacted graft and cement. Clin Orthop 1996; (324): 108-15.

Söderman P, Malchau H. Validity and reliability of Swedish WOMAC osteoarthrosis index: a self-administered disease-specific questionnaire (WOMAC) versus generic instruments (SF-36 and NHP). Acta Orthop Scand 2000; 71: 39-46.

Söderman P, Malchau H, Herberts P. Outcome after total hip arthroplasty: Part I. General health evaluation in relation to definition of failure in the Swedish National Total Hip Arthoplasty register. Acta Orthop Scand 2000; 71: 354-9.

Söderman P, Malchau H, Herberts P. Outcome of total hip replacement: a comparison of different measurement methods. Clin Orthop 2001; (390): 163-72.

Wiklund I, Romanus B. A comparison of quality of life before and after arthroplasty in patients who had arthrosis of the hip joint. J Bone Joint Surg (Am) 1991; 73: 765-9.

Wiklund I, Romanus B, Hunt S M. Self-assessed disability in patients with arthrosis of the hip joint. Reliability of the Swedish version of the Nottingham Health Profile. Int Disabil Stud 1988; 10: 159-63.