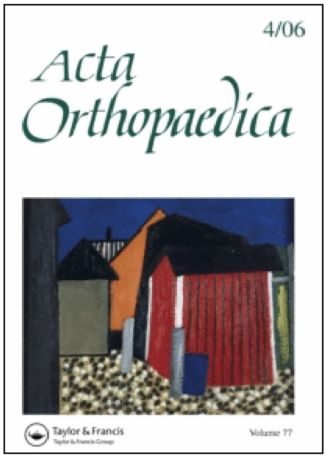

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Total hip replacement after femoral neck fractures in elderly patients : Results of 8,577 fractures reported to the Norwegian Arthroplasty Register

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Total hip replacement after femoral neck fractures in elderly patients

Results of 8,577 fractures reported to the Norwegian Arthroplasty Register

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Background A total hip arthroplasty (THA) is often used as treatment for failed osteosynthesis of femoral neck fractures and is now also used for acute femoral neck fractures. To investigate the results of THA after femoral neck fractures, we used data from the Norwegian Arthroplasty Register (NAR).

Patients and methods The results of primary total hip replacements in patients with acute femoral neck fractures (n = 487) and sequelae after femoral neck fractures (n = 8,090) were compared to those of total hip replacements in patients with osteoarthrosis (OA) (n = 55,109). The hips were followed for 0–18 years. The Cox multiple regression model was used to construct adjusted survival curves and to adjust for differences in sex, age, and type of cement among the diagnostic groups. Separate analyses were done on the subgroups of patients who were operated with Charnley prostheses.

Results The survival rate of the implants after 5 years was 95% for the patients with acute fractures, 96% for the patients with sequelae after fracture, and 97% for the OA patients. With adjustment for age, sex, and type of cement, the patients with acute fractures had an increased risk of revision compared to the OA patients (RR 1.6, 95% CI: 1.0–2.6; p = 0.05) and the sequelae patients had an increased risk of revision (RR 1.3, 95% CI: 1.2–1.5; p < 0.001). Sequelae hips had higher risk of revision due to dislocation (RR 2.0, 95% CI: 1.6–2.4; p < 0.001) and periprosthetic fracture (RR 2.2, 95% CI: 1.5–3.3; p < 0.001), and lower risk of revision due to loosening of the acetabular component (RR 0.72, 95% CI; 0.57–0.93; p = 0.01) compared to the OA patients. The increased risk of revision was most apparent for the first 6 months after primary operation.

Interpretation THA in fracture patients showed good results, but there was an increased risk of early dislocations and periprosthetic fractures compared to OA patients.

Background

Every year, approximately 7,000 patients receive a total hip arthroplasty (THA) in Norway (4.7 million inhabitants). Primary osteoarthrosis was the reason for the THAs in 71% of cases, and 11% were performed due to sequelae after proximal femur fractures (The Norwegian Arthroplasty Register 2005). An increasing number of patients are being operated with THA as primary treatment for acute fractures of the femoral neck (Malchau et al. 2002, The Norwegian Arthroplasty Register 2005). This may reflect a shift of indication from primary osteosynthesis to THA in patients with displaced femoral neck fractures.

Previous studies from the Norwegian Arthroplasty Register (NAR) have found that patients with sequelae after femoral neck fracture had a higher risk of revision compared to primary osteoarthrosis

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patients (Skeide et al. 1996, Furnes et al. 2001). These studies did not, however, include patients with acute femoral neck fractures. Randomized studies have shown that THA is a good treatment for acute fractures (Tidermark et al. 2002, 2003, Abboud et al. 2004, Blomfeldt et al. 2005). To investigate whether these results could be demonstrated on a national basis, we assessed the results of THA after acute femoral neck fractures, and sequelae after these fractures, by using data from the ongoing prospective study of THA in Norway.

Patients and methods

Patients

Approximately 98% of all primary hip prostheses and revisions in Norway have been registered in the NAR since 1987 (Engesaeter et al. 1992, Havelin et al. 1993, Arthursson et al. 2005, Espehaug et al. 2006). The register contains prospective data on more than 97,000 primary total hip arthroplasties (from September 1987 to the end of December 2005) and thus provides excellent data for the study of factors affecting outcome after THA. Information is collected using a questionnaire that is filled in by the surgeon (Havelin 1999).

In this study we included patients operated with a primary THA due to acute femoral neck fracture, or sequelae after this fracture, and compared the results with those from patients with OA. Of the 97,773 primary THAs registered in the NAR from September 1987 to December 2005, 81,221 patients were operated because of acute femoral neck fracture, sequelae after femoral neck fractures, or OA. In order to obtain more comparable age groups, patients younger than 60 years of age were excluded. Patients reported as sequelae after femoral neck fractures, without an earlier operation for the fracture, were also excluded. With these criteria for inclusion, only 8.8% of the prostheses turned out to be uncemented, and thus there were too few for meaningful analyses in the different diagnostic groups. Consequently, we only included patients operated with cemented prostheses (both femoral and acetabular component). After exclusion, there were 63,686 THAs registered with the diagnoses acute femoral neck fracture (n = 487), sequelae after femoral neck fracture (n = 8,090), or OA (n = 55,109). To investigate whether the brand of prosthesis affected the results, separate analyses of the patients operated with Charnley prostheses were performed.

Due to an increase in the number of THAs resulting from acute femoral neck fractures during the last years of the study period, we performed separate analyses on patients operated in the period 1987–1995 and on patients operated after 1995. All patients were followed until time of revision, until their death, or up to December 31, 2005. A revision was defined as an operation involving removal or change of one or more prosthesis components. Time of death was obtained from Statistics Norway.

Statistics

We used the Cox model to calculate the percentage survival. Cox regression models were used to adjust for differences in sex, age, and cement type in the different diagnostic groups with follow-up from 0 to 17 years. Furthermore, the Cox model was used to construct adjusted survival curves at mean values of the covariates. The percentage survival was given at 5 years due to short follow-up for the hips of patients with acute fracture.We used the Cox regression model to calculate differences in revision risk with different reasons for revision as endpoint in the different diagnosis groups. Non-parametric (time-dependent) relative risks were calculated using scaled Schoenfeld residuals (Therneau and Grambsch 2000). Two-sided p-values less than 0.05 were considered significant. Relative risks are presented with 95% CI.

Results

The fracture and sequelae patients were generally older than the OA patients, and there was a higher proportion of women in the fracture and sequelae groups (Table 1).

The Cox adjusted prosthesis survival after 5 years using all causes of revision as endpoint was 95.1% (95% CI: 92.3–97.6) for the patients with acute fracture of the femoral neck, 95.9% (95% CI: 95.4–96.4) for the patients with sequelae after femoral neck fracture, and 97.1% (95% CI: 97.0–97.3) for the OA patients (Figure 1). After adjustments

Table 1. Descriptive statistics for the different patient groups

	n	Mean age (range) [SD]	Women	Earlier operation
Acute fracture	487	76 (60–97) [7.7]	82%	0%
Sequelae after fracture	8,090	77 (60–100) [7.3]	81%	100%
OA	55,109	74 (60–97) [6.5]	71%	1.7%

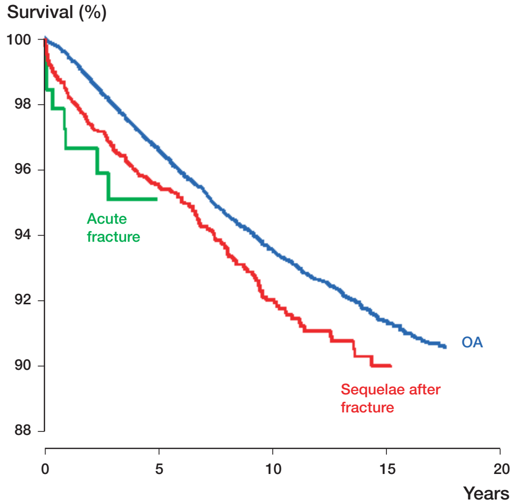

Figure 1. Adjusted prosthesis survival curves for the different diagnoses.

for differences in sex, age, and cement in the Cox regression model, the patients with an acute fracture had 1.6-times higher risk of revision (p = 0.05) compared to OA patients. The sequelae patients had 1.3 times higher risk of revision (p < 0.001) (Table 2). The sequelae patients had a lower risk of revision due to loosening of the acetabular component when compared to OA patients (RR 0.71, p = 0.01), and they had an increased risk of revision due to loosening of the femoral component (RR 1.2, p = 0.005), dislocation of the prosthesis (RR 2.0, p < 0.001), and revision due to periprosthetic fractures (RR 2.2, p < 0001) (Table 2). We found nearly the same risk estimates in the patients with acute fracture, but these results were not statistically significant due to lower numbers of patients (Table 2). In a separate analysis of the patients operated with Charnley prostheses, we found an increased risk of revision due to dislocation in patients operated due to acute fracture as compared to OA patients (RR 4.5, 95% CI: 1.9–11; p = 0.001). In the Charnley group, there were more revisions in the sequelae group than in OA patients due to all causes of revision (RR 1.3, 95% CI: 1.1–1.5; p = 0.001), dislocation (RR 2.2, 95% CI: 1.6–2.9; p < 0.001), and periprosthetic fracture (RR 1.9, 95% CI: 1.0–3.3; p = 0.04) (Table 3). The time-dependent relative

Table 2. Number of revisions after diagnosis. Several reasons may exist for each revision. The table also shows relative risk (RR) of revision for the different diagnoses. RR was adjusted for differences in sex, age, and type of cement in a Cox model

Reason for revision	OA (n 55,109)		Acute fracture (n 487)			Sequelae after fracture (n 8,090)		
	n	Reference	n	RR (95%CI)	P-value	n	RR (95%CI)	P-value
All revisions	2,904	1	16	1.6 (1.0–2.6)	0.05	375	1.3 (1.2–1.5)	< 0.001
Loose acetabular component	993	1	0			68	0.72 (0.57–0.93)	0.01
Loose femoral component	1,765	1	7	1.6 (0.76–3.4)	0.2	187	1.2 (1.1–1.5)	0.005
Dislocation	412	1	5	2.0 (0.81–4.7)	0.1	112	2.0 (1.6–2.4)	< 0.001
Deep infection	315	1	4	2.5 (0.93–6.7)	0.07	46	1.3 (0.97–1.8)	0.08
Periprosthetic fracture	127	1	1	2.4 (0.33–17)	0.4	32	2.2 (1.5–3.3)	< 0.001
Pain	162	1	2	4.0 (0.99–10)	0.05	14	0.93 (0.53–1.6)	0.8

Table 3. Subanalyses of Charnley prostheses. Number of revisions after diagnosis. Several reasons may exist for each revision. The table also shows relative risk (RR) of revision for the different diagnoses. RR was adjusted for differences in sex, age and type of cement in a COX model

Reason for revision	OA (n 26,790)		Acute fracture (n 221)			Sequelae after fracture (n 4,414)		
	n	Reference	n	RR (95%CI)	P-value	n	RR (95%CI)	P-value
All revisions	1,916	1	9	1.6 (0.82–3.0)	0.2	242	1.3 (1.1–1.5)	0.001
Loose acetabular component	203	1	0			36	0.76 (0.53–1.1)	0.1
Loose femoral component	1,395	1	4	1.2 (0.45–3.2)	0.7	142	1.2 (0.98–1.4)	0.08
Dislocation	203	1	5	4.5 (1.9–11)	0.001	69	2.2 (1.6–2.9)	< 0.001
Deep infection	199	1	1	1.1 (0.15–7.7)	1.0	30	1.3 (0.87–1.9)	0.2
Periprosthetic fracture	72	1	1	5.3 (0.73–39)	0.1	15	1.9 (1.0–3.3)	0.04
Pain	92	1	0			7	0.82 (0.38–1.8)	0.6

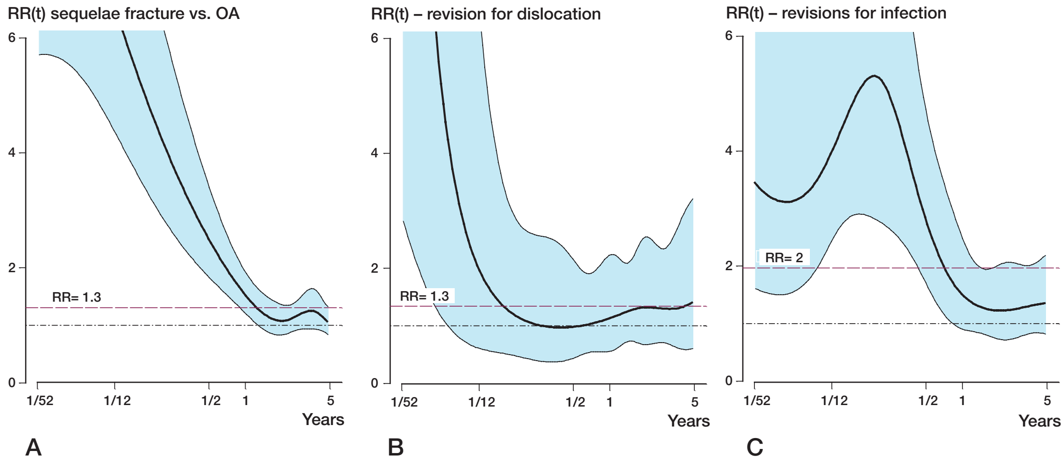

Figure 2. Time-dependent relative risks (RRs) of revision, with 95% confidence intervals, for prostheses in patients with sequelae after femoral neck fractures compared to prostheses in OA patients. The horizontal red dotted line indicates overall RR. The horizontal black line represents the risk of revision in OA patients. The x-axis is logarithmic. The curves show an increased overall RR of revision due to any cause during the first year (A), an increased RR of revision due to dislocation during the first 2 weeks (B), and an increased RR of revision due to infection during the first year (C)

risks of revision in the sequelae patients are presented in Figure 2. For the sequelae patients, the relative risk of revision was increased due to dislocations during the first 2 weeks, and due to infection during the first year postoperatively, as compared to OA patients.

For the subanalyses on patients operated before 1995, we found no difference in the results in comparison to patients operated after 1995. However, there were relatively few patients (n = 72) with acute fractures registered before 1995.

Discussion

Our study shows that THAs carried out because of primary OA had good outcome (with 2.9% revised after 5 years). Similarly, THAs after acute femoral neck fractures and sequelae after these fractures had good outcome. The outcomes were, however, inferior to those in the OA patients—mainly due to more dislocations in the first 2 weeks and more infections in the first year after surgery, and due to more periprosthetic fractures. This is in accordance with the findings of Pedersen et al. (2006) who found that patients with sequelae after trauma had an adjusted RR of implant failure of 2.8 between 31 days and 6 months after primary THA, when compared to OA patients. After 6 months, there was no statistically significant difference.

One of the most important risk factors for revision of prostheses in patients with acute femoral neck fractures and patients with sequelae was dislocation. Other studies have shown similar results (Lindberg et al. 1982, Skeide et al. 1996, Furnes et al. 2001, Bystrøm et al. 2003, Mishra et al. 2004, Berry et al. 2005). Bystrøm et al. found that femoral head size was an important risk factor for dislocations of THAs. It has been reported that increasing age and especially the presence of cerebral dysfunction is associated with a higher dislocation rate (Woolson and Rahimtoola 1999, Bystrøm et al. 2003). The patients with acute femoral neck fractures and sequelae after fractures in our study did, however, have a lower average age than normally presented in studies of femoral neck fracture patients (Tidermark et al. 2002, 2003, Blomfeldt et al. 2005, Gjertsen et al. 2006). The average age of patients with hip fractures in Norway is 80 years (Gjertsen et al. 2006), but those selected for THA are younger. The patients treated with a THA after femoral neck fractures in this study thus represent a selected group of femoral neck fracture patients. Other plausible explanations for the increased dislocation rate in these patients might be an increased tendency to fall, less muscular control, or abnormal local anatomy with limb shortening and scar tissue after the previous operation (Furnes et al. 2001). Only patients with recurrent dislocations undergo surgical revision. The rate of surgical treatment for recurrent dislocations has been reported to be about 40% (Daly and Morrey 1992). This means that our endpoint—including only revisions for dislocation—is very strict and our results would probably have been even more evident if we had included all dislocations as the endpoint.

In the time-dependence study, we found a statistically significantly increased risk of revision due to infection during the first year in the sequelae group relative to OA patients. Again, our study only included patients who underwent surgical revision with a new prosthesis, or with a change or removal of one or more of the components. Patients operated with soft tissue revision only are not registered; thus, we believe that the risk of deep infection is greater than what we found in this study. However, comparison of the relative risk estimates between OA patients and fracture patients should not be affected unless fracture patients are more often treated with soft tissue debridement and long-term suppression antibiotic treatment than OA patients. A previous study based on our register found no statistically significant difference in infection risk when sequelae patients and OA patients were compared (Skeide et al. 1996), but time-dependent analyses were not used. The risk of a deep infection is still low. More use of antibiotics, both systemically and in cement, may be one possible explanation for these good results (Espehaug et al. 1997, Engesaeter et al. 2003).

Patients with sequelae after femoral neck fractures have been reported to have an increased risk of periprosthetic fractures (Skeide et al. 1996, Furnes et al. 2001, Sarvilinna et al. 2004, The Swedish National Hip Arthroplasty Register 2005). Our study confirms these results. In a nationwide observational study, minor trauma—including a fall to the floor—and a spontaneous fracture are reported to be the main etiologies of periprosthetic femoral fractures (Lindahl et al. 2006). Patients with previous femoral neck fractures may have a greater tendency to fall. They are also osteoporotic, and thus more prone to fractures. Also, holes after the use of osteosynthesis material in the proximal femur may cause a weakness of the bone and may lead to periprosthetic fractures. Again, our study only included patients who had a surgical revision with a new prosthesis component. Patients treated with wire and/or plate fixation are not reported to the Arthroplasty Register, and were therefore not included in this study. The true number of periprosthetic fractures is therefore higher.

One important weakness of our study is the lack of information on minor complications and procedures. Also, this study has no results on the functional outcome and quality of life of patients in the different diagnostic groups. We plan to address these issues in further studies from the new Norwegian Hip Fracture Register, which was started in 2005 (Gjertsen et al. 2006).

An observational register-based study reflects the outcome for the average surgeon rather than for specialized centers, and it therefore reflects what one can expect with this procedure in a general setting. Results from observational register-based studies (cohort studies) may be less conclusive than those of randomized clinical trials. It has, however, been shown that if potential confounders are controlled, observational studies give results similar to those of controlled randomized trials (Benson and Hartz 2000). On the other hand, observational studies have several advantages over controlled randomized studies, such as lower cost, greater timeliness, and a broader range of patients.

Our study shows that THA is a good treatment not only for OA, but also for acute femoral neck fractures and for sequelae after femoral neck fractures. Even though we found an increase in relative risk of revision for the fracture patients, due to early dislocation and infection, and due to periprosthetic fractures compared to OA patients, the increased risk was small.

Contributions of authors

JEG: planning, conducting and first writer. SAL: planning (statistics) and reviewing the writing process. OF: idea, planning, and reviewing the writing process. JMF, LIH, LBE and TV: participated in the interpretation of the results, and reviewing the writing process.

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