Conversion from failed hemiarthroplasty to total hip arthroplasty

A Norwegian Arthroplasty Register analysis of 595 hips with previous femoral neck fractures

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Background and purpose Conversion total hip replacement (THR) is a common procedure after failed hemiarthroplasty, but there have been few reports describing the long-term outcome of this procedure.

Patients and methods Between 1987 and 2004, 595 THRs were reported to the Norwegian Arthroplasty Register as conversion THR for failed hemiarthroplasty after a femoral neck fracture in patients aged 60 years and older. 122 operations left the femoral stem intact, whereas 473 were converted with exchange of the femoral stem.

Results We found a lower risk of failure (revision surgery for any reason) for the conversion procedures with stem exchange (RR = 0.4; 95% CI: 0.25–0.81) than for the conversion procedures that retained the femoral stem. For the 473 conversion arthroplasties with exchange of the stem, we found no difference in risk of failure compared to all revision stems in the register, either for the complete prosthesis (RR = 0.8; CI: 0.50–1.20) or for the stem (RR = 0.9; CI: 0.53–1.59). However, for the 122 conversion procedures in which the femoral stem was retained, we found a significantly increased risk of failure for both the complete prosthesis (RR = 4.6; CI: 2.8–7.6) and for the acetabular cup (RR = 4.8; CI: 2.3–10) compared to primary hip arthroplasties.

Interpretation Our findings indicate that the seemingly easy operation of implanting an acetabular cup to convert a hemiarthroplasty to a total hip arthroplasty is an uncertain procedure and that the threshold for replacing the stem should be low.

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There is increasing evidence that primary hemiarthroplasty is a better treatment for displaced femoral neck fractures than osteosynthesis (Parker et al. 2002, Rogmark et al. 2002, Bhandari et al. 2005, Keating et al. 2006). Numerous different implants and designs are used, but no definite conclusions have been made regarding what type of hemiarthroplasty is most favorable (Parker and Gurusamy 2004, 2005). Acetabular cartilage degenerates more rapidly in response to articulation with a metallic hemiarthroplasty component (Dalldorf et al. 1995), but several studies have shown excellent long-term results of bipolar hemiarthroplasties (Wetherell and Hinves 1990, Eiskjaer and Ostgard 1993, Haidukewych et al. 2002). Conversion of a well-fixed hemiarthroplasty with failure on the acetabular side has been reported to be a simple procedure using a standard acetabular cup; the femoral stem may be left in situ (Sierra and Cabanela 2002). The need to replace the femoral stem depends on several factors: the indication for surgery, the type of failed hemiarthroplasty (including whether the failed implant has a remov-

Table 1. Descriptive statistics of the conversion procedures, all other primary operations in the register, and stem revisions in the register (only for patients aged 60 years and older)

	No. of operations	Age in years mean (range)	Men (%)
Primary operations	74,865	73 (60–100)	28
First revisions with stem revision [a]	3,081	74 (60–95)	42
Conversions from hemiarthroplasty			
all conversions	595	78 (61–98)	19
with stem exchange	473	77 (61–98)	20
with retention of the stem	122	80 (63–95)	13

[a] Includes only revisions where the index operation is included in the register.

Figure 1. Breakdown of conversion THA and all other primary operations in the arthroplasty register: the group of 473 conversions with stem exchange received a revision femoral stem and a primary acetabular cup. The group of 122 conversions with retention of the stem received only a primary acetabular cup.
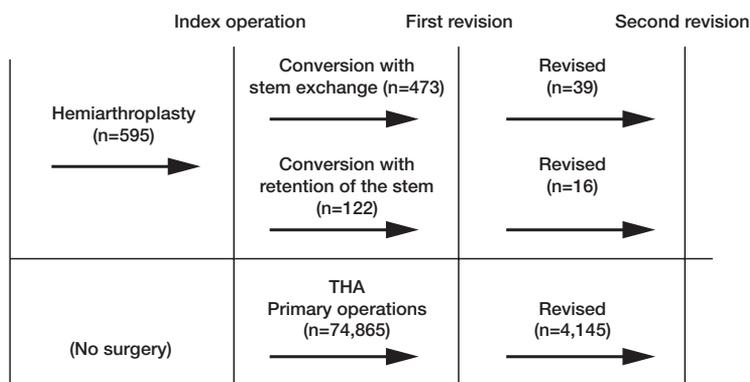
able unipolar or bipolar head), and compatibility with available components. There have been no previous reports documenting the success rate of this procedure, and few reports have explored the results of conversion from hemiarthroplasty to total hip arthroplasty. We describe the outcome of conversion total hip arthroplasty from previous hemiarthroplasty for femoral neck fractures, using data from the Norwegian Arthroplasty Register.

Patients and methods

This study is based on data from the Norwegian Arthroplasty Register, from September 1987 to December 2004. The register collects information on primary and revision total hip arthroplasties in Norway based on a standardized questionnaire completed by the surgeon after surgery (Havelin et al. 1993). The Register was recently validated and has a reporting rate close to 100%, both for primary and revision operations (Arthursson et al. 2005,

Espehaug et al. 2006). The total number of primary total hip arthroplasties in the register in December 2004 was 91,342 and the number reported as being a conversion from hemiarthroplasty due to a previous femoral neck fracture was 625. 3 cases were excluded because they were revisions to a new hemiarthroplasty, and thus should not have been reported. Only patients aged 60 years or older were selected for this study because of a significant age discrepancy between the conversion group and the register in general, leaving 74,865 primary total hip arthroplasties and 595 conversion procedures for further analysis (Table 1).

All subsequent procedures were linked to the primary operation, using the personal identification number for Norwegian citizens. Because conversion arthroplasty is recorded as a primary operation in the register, stratification was conducted to compare primary components with primary components, and revision components with revision components, as described in Figure 1. In addition to sex, age, and year of operation, we assessed the

following variables for the index operation and subsequent procedures: indication for revision surgery, prosthesis fixation technique, femoral head size, and type of implant used. Information regarding the removed hemiarthroplasty or hemiarthroplasties revised to any other kind of hemiarthroplasty was not reported to the register. The patients were followed until death or until December 31, 2004; data on patient deaths were obtained from Statistics Norway.

Statistics

We used Kaplan-Meier analysis to calculate survival probabilities with 95% confidence limits at 5 and 10 years. The reverse Kaplan-Meier method was used to calculate the median follow-up (Schemper and Smith 1996). Adjusted survival curves were calculated using Cox regression. Multiple Cox regression analyses were done to calculate relative risks (hazard ratios) for the different covariates (age, sex, cemented vs. uncemented implants, and indication for the index operation). For all analyses, we used the statistical packages S-Plus (S-Plus 2000 for Windows; MathSoft Inc., Seattle, Washington) and SPSS (SPSS 13.0 for Windows; SPSS Inc. Chicago, Illinois).

Results

The median annual incidence of conversion arthroplasty was 35 (18–62). 122 left the femoral stem intact, inserting an acetabular cup only or an acetabular cup and a modular head. 473 were converted with exchange of the femoral stem and insertion of an acetabular cup. There were 48 perioperative complications (10%) in the group with stem exchange, and 3 (3%) in the group with retention of the stem (p = 0.006). 35 of the complications in the group with stem exchange involved a fracture or perforation of the femur. 55 of the 595 hips (9%) were subsequently revised. The risk of a subsequent revision was higher than for other primary operations in the register, but lower than for other revisions (Figure 2a and Table 2). The mortality of the 595 patients was higher than for the 74,868 primary operations in the register (RR = 1.1; 95% CI: 1.0–1.3) when adjusting for age, sex, and diagnosis.

Conversions with stem exchange

In the group of 473 conversions with stem exchange and insertion of an acetabular cup, 231 received a modular stem and 242 stems were monoblock prostheses. 403 (85%) of the acetabular cups used were cemented and 67 (14%) were uncemented. In 3 cases, the fixation method was not reported. 407 patients (86%) received a cemented femoral stem and 60 patients (13%) received an uncemented femoral stem; in 6 cases the fixation method was not reported. The most frequently used femoral stems were Charnley (219), Exeter (54), Titan (32), Bio-Fit (22), Kar (20), and Corail (18). 30 different additional types of stems were used. The most frequently used acetabular cups were Charnley (223), Exeter (51), Titan (33), Spectron (22), and Tropic (21). 28 different additional types of cups were used. 219 of the monoblock stems (91%) had a 22-mm diameter head, while 198 of the modular stems (85%) had larger heads with diameters of 28 mm (138), 30 mm (16), or 32 mm (44). Median duration of surgery was 130 (20–360) min. The median follow-up time was 5.8 years. 39 patients (8%) underwent a subsequent revision after median 3.6 years (Table 3).

Conversions with retention of the stem

In the group of 122 conversions with retention of the femoral stem, 80 patients received an acetabular cup only and 42 received an acetabular cup and a modular head. 108 of the acetabular cups used were cemented and 13 were uncemented, and in 1 case the method of fixation was not reported. The most frequently used acetabular cups were Charnley (56), Titan (13), Exeter (6), Avantage (6), and Christiansen (6). 18 different additional types of cups were used. 62 cups (51%) had an inner diameter of 22 mm. Median duration of surgery was 80 (30–180) min. The median follow-up of all 122 patients was 3.6 years. 16 patients (13%) underwent a subsequent revision after median 0.5 years (Table 4).

In both groups, aseptic loosening and dislocations were the most common indication for revision surgery. The number of dislocations was high, especially in the group with retention of the stem (Table 4).
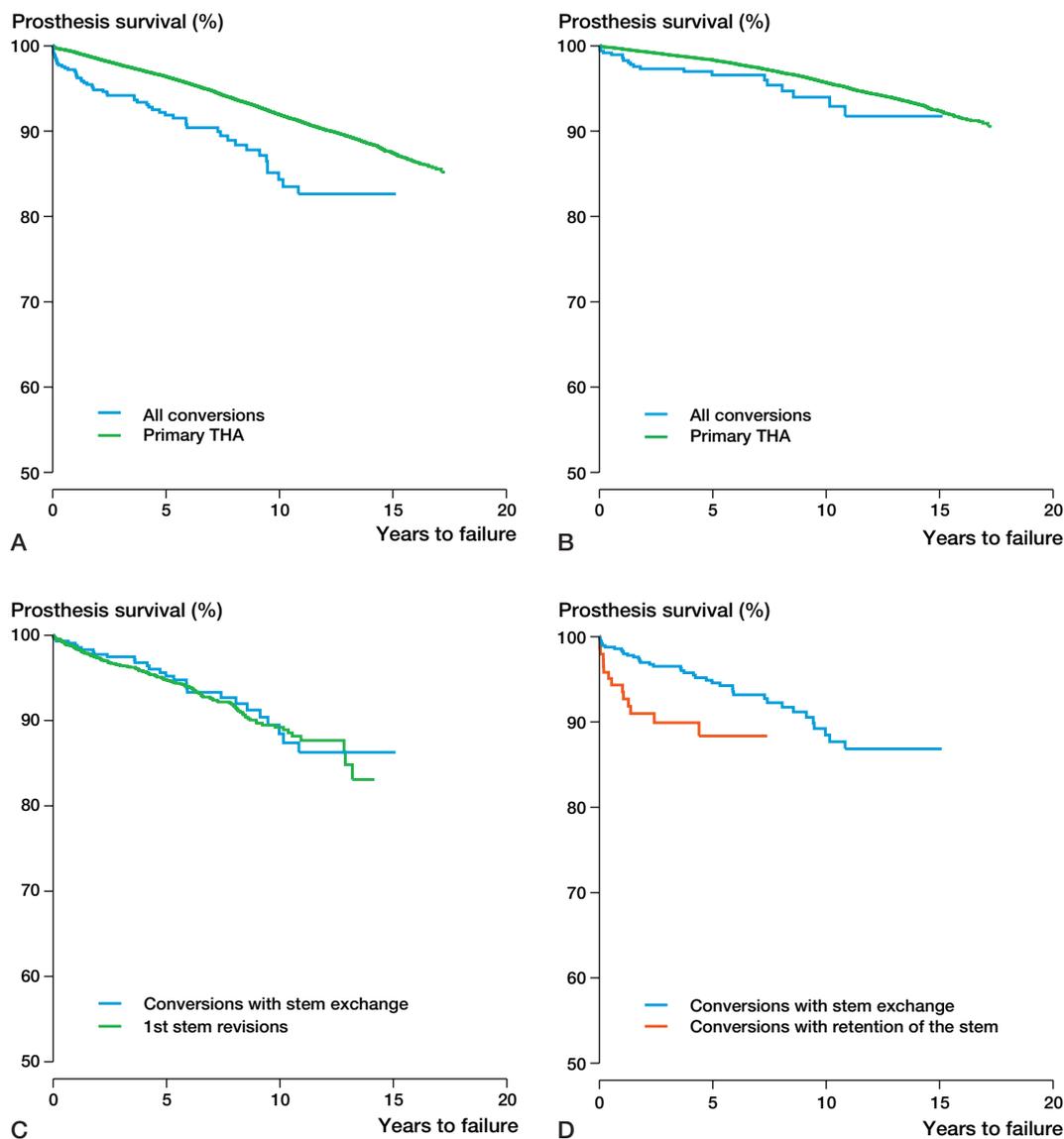
Figure 2. Survival curves for the conversion procedures and control groups from the total arthroplasty register as described in Figure 1, adjusted for age, sex, cemented or uncemented implants and indication for index operation. A. Prosthesis survival of all 595 conversions and all other primary arthroplasties. B. Acetabular cup survival of all 595 conversions and all other primary arthroplasties. C. Femoral stem survival of the 473 conversions with stem exchange and all revision stems. D. Prosthesis survival of the 122 conversions with retention of the stem and the 473 conversions with stem exchange.

Component survival

We found a lower risk of failure for the conversion procedures with stem exchange (RR = 0.4; 95% CI: 0.25–0.81) than for the conversion procedures with retention of the femoral stem.

The conversion arthroplasties with stem exchange showed similar results to all prosthe-

ses with a revised stem in the register, both in terms of prosthesis survival and stem survival (Figure 2 and Table 2). Since all 595 conversion procedures included insertion of a primary acetabular cup, the cup survival of all conversion procedures was compared to the cup survival of all primary arthroplasties in the register, which

Table 2. Kaplan–Meier survival at 5 and 10 years with relative risk (RR) of groups compared according to Figure 1

	No. of patients	No. of revisions	Median follow-up (years)	5-year survival (95% CI)	10-year survival (95% CI)	RR (95% CI)	P–value
Prosthesis survival (Figure 2a)							
All conversions	595	55	5.1	92 (89–94)	84 (79–89)	2.0 (1.5–2.7)	< 0.001
Primary THA	74,865	4,145	5.8	96 (96–96)	91 (91–92)	1	
Prosthesis survival							
All conversions	595	55	5.1	92 (89–95)	84 (79–89)	0.6 (0.4–0.9)	0.04
Revision THA	4,145	624	4.7	85 (83–86)	77 (75–79)	1	
Cup survival (Figure 2b)							
All conversions	595	20	4.8	97 (96–99)	95 (92–98)	1.7 (1.1–2.6)	0.03
Primary THA	74,865	2,255	5.7	98 (98–98)	95 (95–95)	1	
Prosthesis survival							
Conversions with stem exchange	473	39	5.8	93 (91–96)	86 (81–91)	0.8 (0.5–1.2)	0.3
First stem revisions	3,081	324	5.1	91 (89–92)	82 (80–84)	1	
Stem survival (Figure 2c)							
Conversions with stem exchange	473	28	5.6	96 (93–98)	89 (85–94)	0.9 (0.5–1.6)	0.8
First stem revisions	3,081	193	4.9	94 (93–95)	88 (86–90)	1	
Prosthesis survival							
Conversions with retention of the stem	122	16	3.6	86 (79–93)	[a]	4.6 (2.8–7.6)	< 0.001
Primary THA	74,865	4,145	5.8	96 (96–96)	91 (91–92)	1	
Cup survival							
Conversions with retention of the stem	122	7	3.1	93 (88–98)	[a]	4.8 (2.3–10)	< 0.001
Primary THA	74,865	2,255	5.7	98 (98–98)	95 (95–95)	1	
Cup survival							
Conversions with retention of the stem	122	7	3.1	93 (88–98)	[a]	0.8 (0.3–1.9)	0.6
First cup revisions	1,247	101	3.6	91 (89–93)	83 (79–87)	1	
Prosthesis survival (Figure 2d)							
Conversions with stem exchange	473	39	5.8	93 (91–96)	86 (81–91)	0.4 (0.3–0.8)	0.008
Conversions with retention of the stem	122	16	3.6	86 (79–93)	[a]	1	
Stem survival							
Conversions with stem exchange	473	28	5.6	96 (93–98)	89 (85–94)	0.8 (0.3–1.9)	0.6
Conversions with retention of the stem	122	6	3.1	94 (89–100)	[a]	1	
Cup survival							
Conversions with stem exchange	473	13	5.4	98 (97–100)	96 (93–98)	0.4 (0.1–0.9)	0.03
Conversions with retention of the stem	122	7	3.1	93 (88–98)	[a]	1	

[a] denotes follow–up data not available or less than 20 hips left at risk.

showed inferior results for the conversion procedures (Table 2).

The 122 conversion procedures with insertion of a cup/head only showed inferior results for the survival of the complete prosthesis and for the isolated survival of the acetabular cup, compared to all other primary operations in the register (Figure 2 and Table 2). There was no significant difference in cup survival when comparing the group of 122 procedures involving retention of the femoral stem with all first cup revisions in the register involving retention of the stem (Table 2). In this group, 9 hips (7%) underwent a subsequent revision involving the femoral stem.

Table 3. 39 revisions in 473 conversions with stem exchange. Procedures are listed by indication for revision surgery (with multiple entries allowed)

Revision procedure	A	B	C	D	E	F	G	H
Stem exchange, acetabular cup retained	14		2	1	6	1	1	2
Cup exchange, femoral stem retained		1	5					
Exchange of all components	7	4	1					1
Girdlestone			1					
Other	1	1	1	2	1			2
Total	22	6	10	3	7	1	1	5

Indication for revision surgery:
A Aseptic loosening of the femoral stem
B Aseptic loosening of the acetabular cup
C One or more dislocations
D Deep infection
E Fracture
F Pain
G Osteolysis
H Other

Table 4. 16 revisions in 122 conversions with retention of the stem. Procedures are listed by indication for revision surgery (with multiple entries allowed)

Revision procedure	A	B	C	D	E
Stem exchange, acetabular cup retained	2		2		
Cup exchange, femoral stem retained		2	4		
Exchange of all components	1		2		
Girdlestone	1	1		2	
Other			1		1
Total	4	3	9	2	1

Indication for revision surgery:
A Aseptic loosening of the femoral stem
B Aseptic loosening of the acetabular cup
C One or more dislocations
D Deep infection
E Other

Discussion

The most important finding in this study was the significantly lower risk of failure (revision surgery for any reason) for the conversion procedures involving stem exchange than for the conversion procedures in which the femoral stem was retained.

These results may seem surprising, considering the higher rate of perioperative complications in the group with stem exchange. Several series have shown high rates of major complications after conversion total hip replacements (Stambough et al. 1986, Suominen 1989, Llinas et al. 1991, Bilgen et al. 2000, Sierra and Cabanela 2002, Champion and McNally 2004). For the conversion procedures in our study, we found a higher risk of failure compared to all primary operations in the register, but a lower risk of failure compared to all revision procedures in the register. We did not find any difference in survival of the prosthesis or femoral stem when comparing conversions involving stem exchange to all revision arthroplasties in the register. However, there was a significantly increased risk of failure associated with conversion procedures involving retention of the femoral stem, for both the complete prosthesis and for the acetabular cups, compared to primary total hip arthroplasties in the register. This type of comparison may be debatable, since the conversion group consists of patients who have undergone more than one procedure and the control group consists of patients who have been operated only once. The acetabular cups are, however, primary arthroplasty components in both groups, which we believe justifies such an analysis.

The results of conversion total hip arthroplasties may be related to the type of initial surgery, as several types of hemiarthroplasties do not allow separate replacement of individual components. A failed bipolar hemiarthroplasty with a well-fixed non-modular femoral stem does allow the simpler procedure of inserting a primary acetabular cup, but does not allow adjustment of the diameter of the femoral head or the length of the neck. Also, insertion of an acetabular cup while a femoral stem is already present is sometimes a difficult procedure, which may also explain the inferior results in this group.

Modular implants have three theoretical advantages: the head size may be increased to reduce the risk of dislocation, the neck length may be adjusted to accommodate optimal soft tissue tension and leg length, and a worn head may be replaced. Dislocation was the most common mechanism of failure in the group of 122 conversions with retention of the femoral stem, suggesting that there may be difficulties in assessing these factors when performing this type of conversion.

The median time from conversion procedure to the next revision was 3.6 years in the group with stem exchange and only 0.5 years in the group with retention of the femoral stem. This may reflect the fact that the predominant cause of revision was stem loosening in the group with stem exchange and dislocation in the group with retention of the stem.

The mortality of the 595 patients in this study was higher than for the 74,868 primary operations in the register, when adjusted for age and sex. Considering that patients with femoral neck fractures are generally more frail than patients receiving primary total hip arthroplasties for osteoarthritis, this may not be surprising—but we would have expected the mortality in the conversion group to be even higher. We do know that these patients had had at least one previous hip surgery, and we must also assume that many of these patients had initially been treated with cannulated screws for a femoral neck fracture, making the conversion procedure at least the third hip surgery. The mean age in the conversion group was higher, and patient selection may thus have contributed as a confounding factor, even though it was adjusted for in the Cox analysis. The patients in this study had, however, been found fit enough for a revison procedure and were probably more fit than the average patient with a femoral neck fracture. This represents a selection bias, which may have influenced our mortality analyses. This viewpoint is in line with that of a previous report from the same register including all total hip arthroplasties that showed a lower mortality in patients with total hip replacement than in the Norwegian general population (Lie et al. 2000).

The question of which type of hemiarthroplasty is preferable for the treatment of femoral neck fractures should be addressed by randomized trials of different hemiarthroplasties, and not by determining the success rates after conversion to THR. There is some, albeit weak, evidence in the literature of better results with bipolar hemiarthroplasties than with unipolar designs, and there is also some evidence of better results with THR in fit and active patients. We cannot recommend a specific type of hemiarthroplasty based on the results of this study, but we do hope that the Norwegian hip fracture register will be able to help answer these questions in the future. It may also provide better data for comparing survival rates of hemiarthroplasties and primary total hip arthroplasties for the treatment of femoral neck fractures.

Most implants used in our study were regular primary arthroplasty components; few patients received acetabular cups or femoral stems designed specifically for revision arthroplasty. All data in the literature regarding revision total hip arthroplasty should probably be taken into account also for patients with failed hemiarthroplasties. Our findings suggest that the assumed simple revision of a hemiarthroplasty to a total hip arthroplasty by implanting an acetabular cup may not be all that simple, and the threshold for inserting also a new femoral stem should probably be low. Further studies are required to investigate the possible advantages of modular designs in hemiarthroplasty, and the role of acetabular cups specifically designed for conversion from hemiarthroplasty.

Contributions of authors

WF: first author, initiation of project, planning of protocol, data analysis, and manuscript preparation. ED, FF, OF, JEM, and LIH: planning of protocol, data analysis, and manuscript preparation. LN: planning of protocol and manuscript preparation.

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