Gene therapy and cement injection for the treatment of hip prosthesis loosening in elderly patients

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Revision Hip Arthroplasty in patients over 80 years of age. Implications on social life and activities in daily living

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Abstract

We retrospectively reviewed social outcome of all octogenarians undergoing revision total hip arthroplasty in two hospitals in the Netherlands. A total of 183 hospital admittances in 145 patients were identified. Overall in 58% of hospital admittances the patient returned to the previous social situation, 35% had a worsening in social situation, and 8% had an improvement. 59% of patients living in a house or apartment went to a nursing institution for rehabilitation after discharge. Presence of a spouse was the only predictor for returning home immediately after discharge. There was a mean rate of 1.3 medical complications per patient with statistical differences between ASA-categories. 29% of patients needed less walking aids after revision surgery.

Revision surgery gives a high rate of complications in octogenarians, with patients with a higher ASA-category having more complications. However, this does not affect returning to previous housing situations after discharge.

Introduction

The number of revision surgeries in elderly patients is likely to increase considerably in the next decades, due to the tendency to insert orthopaedic implants at younger ages and the longer life expectancy of patients. Revision surgery has a high complication rate in elderly patients[6,92,99,114] and is associated with less improvement in social outcome, compared to primary hip arthroplasty in patients of all ages.[103] The patients themselves often don't realise the technical limitations of revision surgery and expect the same result as in primary total hip arthroplasty.[51] Consequently, overall satisfaction in patients after revision total hip arthroplasty is 3.7 times lower than after primary hip arthroplasty.[36] To stress the burden of revision hip arthroplasty for elderly patients we studied the social outcome after surgery in all patients 80 years and older who had revision THP in two hospitals in the Netherlands between 1994 and 2007. Primary objective was to investigate whether hip revision surgery in elderly patients could improve social outcome (housing situation and independency in ADL (activities in daily living)). Secondary objectives were occurrence of complications during hospital stay, patient survival, and use of walking aids before and after revision surgery.

Patients and methods

To evaluate outcome of revision hip arthroplasty in octogenarians, all patients who were 80 years and older when undergoing removal and/ or insertion of an acetabular and/ or femoral component of a hip prosthesis in two hospitals in the Netherlands between 1994 and 2007 were included.

Preoperative data, surgery data and data regarding the hospital admission were collected from the patients' hospital chart. The patients' general practitioners were asked if and when the patient had died. The physical status of the patient was classified by the anaesthesiologists according to ASA-classification (American Society of Anesthesiologists)[121] (Table 1).

Information regarding complications that occurred was gathered from the hospital charts as recorded by the doctors as well as by the nurses. Prophylactic antibiotics (cephalosporin) were given routinely 30 minutes before the procedure and this was repeated when the surgery time was more than 3 h, and when blood loss was more than two litres. Post-operative antibiotics were not given routinely. Thrombosis prophylaxis was given until six weeks post-operatively, first as low-molecular-weight heparin, in some cases followed by coumarins. To study the impact of different kinds of revi-

Table 1. American Society of Anesthesiologists' Physical Status Classification

ASA-1	A normal healthy patient
ASA-2	A patient with mild systemic disease (mild diabetes mellitus, controlled hypertension, anemia, chronic bronchitis, morbid obesity)
ASA-3	A patient with severe systemic disease that limits activity (angina pectoris, obstructive pulmonary disease, prior myocardial infarction)
ASA-4	A patient with an incapacitating disease that is a constant threat to life (congestive heart failure, renal failure)
ASA-5	A moribund patient not expected to survive >24 h (ruptured aortic aneurysm, head trauma with increased intracranial pressure)

sion operations, the procedures were divided in 7 groups (liner revision, cup revision, stem revision, total hip revision, hemi-arthroplasty revised to total hip prosthesis, only components removed for infection, and other). For these groups, operative time, blood loss, number of complications, duration of hospital stay, and return to home were analysed. Also, a distinction was made in removal of cemented and uncemented stems for the same parameters as noted above.

To get an impression on pre-operative dependency the Katz-ADL-index was measured.[63] This index is a tool for assessing a patient's ability to perform activities of daily living in the areas of bathing, dressing, toileting, transferring, continence, and feeding. In each category, a score of one indicates complete independence in performing the activity and zero indicates that assistance is required, so that the total score ranges from zero to six.

Primary objective

Social situation of the patients was pre-operatively recorded by the nurses. They recorded housing situation (house/apartment, home for the elderly or nursing home), the presence or absence of a spouse or child living with the patient, and the kind of help the patient received in activities of daily living (no help, informal care from children living nearby, house keeper, or home care). The postoperative situation was defined as the most favourable situation the patient achieved in social situation after the revision surgery. These data were gathered from post-operative correspondence between general practitioner and hospital and from the nurses' charts on consecutive hospital admittances. For patients who went to a nursing home for rehabilitation the nursing homes were called to ask for how long the patient had stayed there and whether they could return to their own homes after rehabilitation.

Secondary objectives

Survival after revision surgery was measured for each patient. For patients who had multiple revisions only the latest revision was taken into account for the survival analysis. Kaplan Meier-analysis was performed to compare survival in different ASA-groups (American Society of Anesthesiologists) (Table 1)[121], with date of death as end point, and date of end of follow-up as sensored data.

The hospital charts were studied for occurrence of complications. The charts made by the doctors as well as the charts made by the nurses were studied. A distinction was made between orthopaedic complications and medical complications. The list of medical complications was subdivided in cardiovascular, renal, gastro-intestinal, pulmonary, neurological, and other complications. Some complications were defined as major: death, pulmonary embolism, myocardial infarction, pneumonia, stroke, deep infection, shock, peri-prosthetic fractures, and renal failure. The patient group was divided by ASA-category to determine the differences in occurrence of complications in the comorbidity-groups. Pressure sores were registered as such when there was at least disruption of the skin (grade II pressure ulcer, according to the National Pressure Ulcer Advisory Panel).[1] Delirium was defined as severe confusion (with interference of normal function) during at least one day, that could not be corrected, and with inaccessibility to normal contact. Anorexia, and nausea and vomiting were only registered when parenteral feeding was necessary.

The use of walking-aids by the patients was registered by the nurse at hospital admittance. For the post-operative use of walking aids the most favourable situation was recorded. These data were gathered from the outpatients' clinic's chart, regarding post-operative controls and follow-ups. The categories for walking aids were: no aids, cane, one crutch, two crutches, walker, wheelchair, or bedridden.

Statistical Methods

Kaplan Meier analysis was performed for analysis of patient survival after revision surgery, with date of death as the end point and end of follow-up as sensored data. Log-rank test was used to compare between ASA-categories. A oneway ANOVA with Bonferroni test was used to compare between different revision operations. A Student T-test was used to compare parameters between cemented and uncemented stems. Logistic regression was used to find predictive factors for patients living in a house or apartment to return to their own homes.

A statistical p-value of <0.05 was chosen as the level of significance. SPSS version 16.0 was used for statistical analyses.

Results

Patients and hospital admittances

183 hospital admittances for revision hip arthroplasties were reported between 1994 and 2007 in the two Dutch hospitals. A total number of 145 patients had 183 hospital admittances (1.26 admittances per patient).Table 2 shows demographic characteristics for hospital admittances where at least one component of the hip prosthesis was removed or placed. In 41 of 183 admittances the patient went to the ICU (Intensive Care Unit) postoperatively, mean length of stay was 2.3 days. Figure 1 shows means (and standard deviations) for operative time, blood loss, number of complications and duration of hospital stay per type of revision. Operative time was longer in patients where a cemented stem had to be removed (mean 190 min, sd 75 min), compared to an uncemented stem (mean 149 min, sd 86 min) ($p = 0.01$). No differences were found in blood loss, number of complications, and length of hospital stay, between removal of cemented and uncemented stems.

Social outcome

Figure 2 shows social housing situation before and after hospital admittance for hip revision surgery. For the post-operative situation the most favourable situation was taken. For example, when patients went post-operatively to a nursing home for rehabilitation and returned to home after several months, the latter situation was recorded. For all patients information on pre-operative situation was available. In 143 of 183 hospital admittances patients lived pre-operatively in a house or apartment (78%), in 21 the patient lived in a home for the elderly (10%), and in 19 the patient lived in a nursing home (11%). Four patients died during hospital stay. In the remaining of hospital admittances 138 times (75%) the patient could return to their previous housing situation, in 22 cases (12%) there was a worsening in the housing situation, and in 7 cases (4%) there was an improvement.

In the cases where the patient was living alone in a house or apartment, 39% returned to the same social situation regarding outside help, 58% had a worsening in the situation and 3% had an improvement. In the cases where the patient lived with a spouse in a house or apartment, 70% returned to the same social situation regarding outside help, in 24% there was a worsening in the situation, and in 5% there was an improvement.

Overall (housing situations and help in activities of daily living) 58% remained in the same social situation, 35% had a worsening in social situation, and 8% had an improvement.

Table 2. Demographic Characteristics of the Patients and Outcomes

Parameter	Total 183 Hips
Age (years)*	83.9 (Range 80.1 – 97.9; sd 2.9)
Men / women	24 / 159 (13.1% / 86.9%)
ASA score	
ASA – 1	4 (2.2%)
ASA – 2	105 (57.4%)
ASA – 3	67 (36.1%)
ASA – 4	7 (3.8%)
Indication for revision	
Aseptic loosening	121 (66.1%)
Periprosthetic infection	29 (15.8%)
(Periprosthetic) fracture	12 (6.6%)
(Recurrent) dislocations	18 (9.8%)
Fausse route	1 (0.5%)
Persisting pain	1 (0.5%)
Titanium debris	1 (0.5%)
Component removed	
None	15 (8.2%)
Stem	45 (24.6%)
Cup	46 (25.1%)
Both components	77 (42.1%)
Component inserted	
None	35 (19.1%)
Stem	19 (10.4%)
Cup	47 (25.7%)
Both components	82 (44.8%)
Operative time (hours)*	2.7 (Range 0.6 – 8.0; sd 1.3)
Blood loss (Liter)*	1.6 (Range 0.15 – 6.5; sd 1.2)
Length of hospital stay (days)*	34 (Range 2 – 197; sd 28)

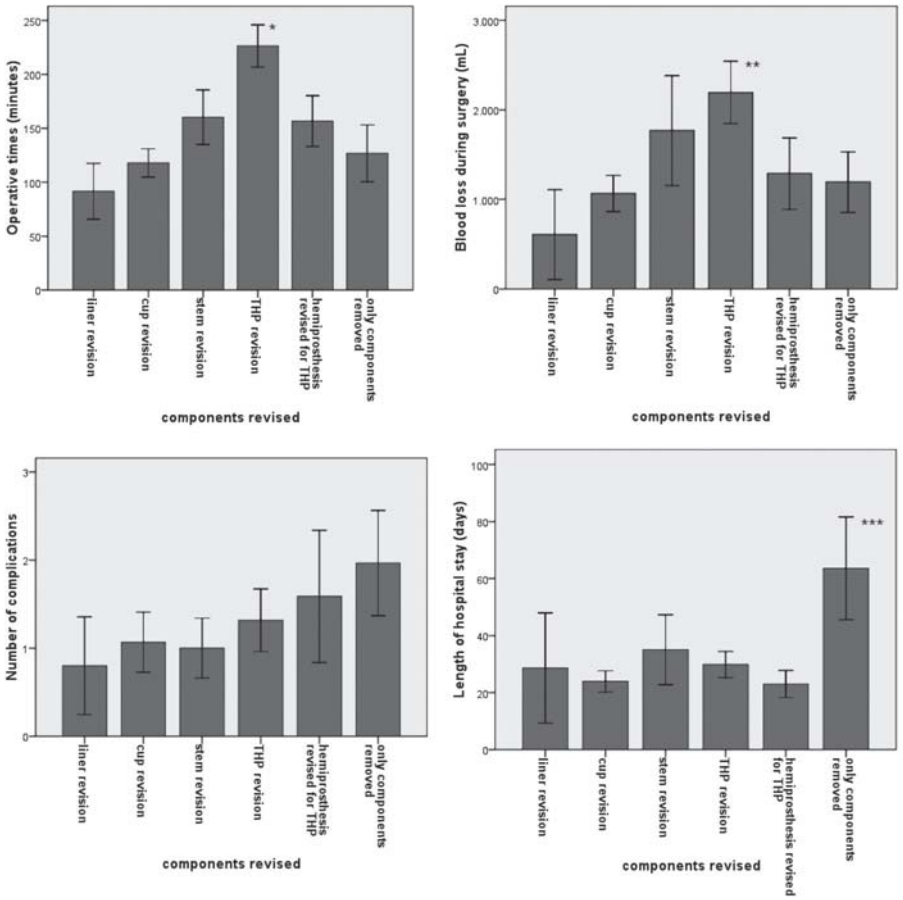
* Data are given as mean with range and standard deviations in brackets

Of the 143 hospital admittances where a patient lived in a house or apartment pre-operatively, in 84 (59%) cases the patient went post-operatively to some sort of rehabilitation facility. Of these cases 64 (76%) went to a nursing home (mean period of stay was 114 days), 19 (23%) went to a home for the elderly (mean period of stay was 44 days), and 1 patient went temporarily to her daughter's house. 11 Patients never returned to their homes.

Predictors for returning to home in patients living in a house or apartment

To predict which patients could return to their home and which patients had to go to

Figure 1. Bar chart of means and standard deviation for operative time, blood loss during surgery, number of complications, and length of hospital stay per component revised.



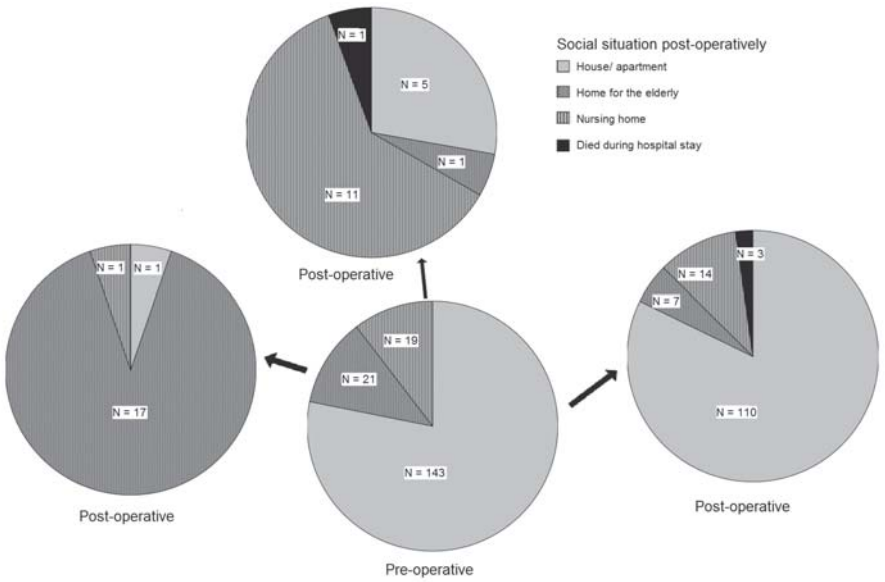
* Operative time for a total hip revision was significantly longer than for the other revisions ($p < 0.01$).

** Blood loss was significantly higher in the total hip revision group compared to all other groups ($p < 0.03$) except for stem revision only ($p > 0.95$). There were no differences in number of complications occurring between the revision groups.

*** Duration of hospital stay was significantly longer in the patients who only underwent removal of components compared to the other groups.

a nursing home or a home for the elderly for rehabilitation or permanent stay after discharge, a logistic regression analysis was performed. First, the factors we expected to be a potential predictor of returning home were tested individually with univariate logistic regression. The factors tested were: sex (male/female Odds-ratio for returning home was 6.0, p <0.01); ASA-category (ASA1-2 / ASA 3-4 OR = 0.74, $p = 0.40$);

Figure 2. Social housing situation before and after hospital admittance for revision hip arthroplasty.



The central pie shows the pre-operative situation. The pies on the side show the distribution of post-operative situations per pre-operative situation. For example the pie on the right shows the post-operative situation of the patients who pre-operatively lived in a house or apartment.

Katz-ADL-index (OR = 1.1; p = 0.47); indication for surgery (p = 0.84); surgery time (OR = 1.0; p = 0.87); blood loss during surgery (OR = 1.0; p = 0.94); components revised (p = 0.63); removal of cemented or uncemented stem (p = 0.59), presence of a spouse (with spouse/ alone OR = 24; p < 0.01); outside help (p = 0.047, with significant difference between no help/housekeeper OR = 0.34, p = 0.014; no difference between no help/home care OR = 0.65, p = 0.33; and no difference between housekeeper/ home care OR = 1.9, p = 0.13). The parameters entered in the logistic regression model were: sex, presence of a spouse, and outside help. With these three parameters in the model, only the presence of a spouse was a predictive value for return to home (OR = 36, p <0.01). As we expected sex to be a confounder of the presence of a spouse we verified this by doing a crosstabs in which we found that 87% of male patients had a spouse at home, while only 17% of female patients had a spouse. We also noticed that the coefficient for sex in the equation changed remarkably when correcting for spouse, proving that sex is a confounder of spouse. To determine whether the presence of outside help in patients without a spouse would predict returning to home

we excluded the patients with a spouse and did a logistic regression analysis in patients living alone in a house or apartment. In these patients the presence of outside help was not a predictor for returning home ($p = 0.84$). In conclusion, the only predictor for returning to their home for patients living in a house or apartment was the presence of a spouse, with sex being a strong confounder, as the majority of male patients lived with a spouse while the majority of female patients lived without a spouse.

Patient survival

54 Patients died during follow-up. Mean survival after revision surgery in these patients was 44 months (range 0 – 135, sd 42). 8 Patients (5.5%) died within 90 days of surgery. Figure 3 shows the survival curve of all patients after their latest revision surgery per ASA-category. Differences in patient survival between the ASA-categories were significant for all groups (Log-rank test: $p < 0.01$).

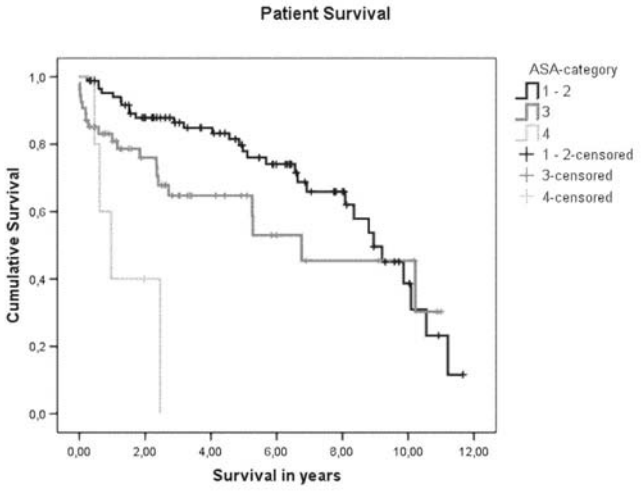
Complications

Table 3 shows the incidence of medical complications during hospital stay per ASA-group. A total number of 239 complications occurred during 183 hospital admittances (mean: 1.3 complications per admittance). Patients in ASA 1 and 2 had 1.0 complication per admittance, patients in ASA 3 had 1.7, and patients in ASA 4 had 2.6 complications per hospital admittance. This difference in number of complications between ASA-groups was statistically significant ($p < 0.01$). In 22% of hospital admittances for revision hips arthroplasty no complications occurred. Table 4 shows the incidence of orthopaedic complications in the first six months after surgery. Orthopaedic complications occurred in 25% of hospital admittances with no statistical difference in total of complications between the ASA-groups ($p = 0.61$). The differences in kind of orthopaedic complications was not statistically significant (Chi-square) between the ASA-groups (dislocations $p = 0.07$; fractures $p = 0.10$)

Walking aids

Table 5 shows pre-operative and post-operative use of walking aids by the patients. For post-operative use of walking aids the most favourable situation was registered. For example, when the patient used a walker after discharge from the hospital and used a cane six months after surgery until the end of follow-up, 'cane' was chosen as the post-operative use of walking aids. The table shows changes in the use of walking aids after revision surgery. In 1 patient the use of walking aids before revision surgery was

Figure 3. Kaplan Meier analysis of patient survival per ASA-category. ASA-1 and ASA-2 are taken together as 1 category. Differences in survival between ASA-categories was statistically significant ($p < 0.01$).



unknown and in 6 patients the post-operative data were missing. In 86 of 176 cases (49%) the use of walking aids remained the same before and after revision surgery, in 39 cases (22%) the situation in use of walking aids had worsened, and in 51 cases (29%) the situation improved.

Discussion

This study describes the social outcome of patients 80 years and older after hospital admittance for revision hip arthroplasty. In total there were 183 hospital admittances in 145 patients. Table 2 shows peri-operative data of the current study. Mean operative time was 2.7 h, mean blood loss was 1.6 litres, and mean length of hospital stay was 34 days. These data resemble the data in previous studies[6,99,114], except for the study by Parvizi which showed a much shorter hospital stay.[92] Patients who had revision of both components had a longer operative time and more blood loss, than patients who had revision of 1 component or only removal of components. Patients who only had removal of components, due to infection of the prosthesis, had a longer hospital stay than patients who had a revision. This can be explained by the fact that in these

Table 3. Incidence of medical complications during hospital stays, per ASA-category and in total. Complications are divided per organ system. The table shows the incidence of the complication, with the percentage in the patient group in brackets.

Medical complications during hospital stay	ASA 1-2 (109 hips)	ASA 3 (67 hips)	ASA 4 (7 hips)	Total (183 hips)
No complications (medical or orthopaedic)	29 (27%)	12 (18%)	0	41 (22%)
Cardiovascular	13 (12%)	20 (30%)	1 (14%)	34 (19%)
Myocardial infarction	3 (2.8%)	2 (3.0%)	0	5 (2.7%)
Congestive cardiac failure	3 (2.8%)	8 (12%)	0	11 (6.0%)
Shock	2 (1.8%)	6 (9.0%)	0	8 (4.4%)
Hypovolemic	1 (0.9%)	4 (6.0%)	0	5 (2.7%)
Septic	1 (0.9%)	2 (3.0%)	0	3 (1.6%)
Hypotension	1 (0.9%)	2 (3.0%)	0	3 (1.6%)
Arrhythmia	2 (1.8%)	1 (1.5%)	1 (14%)	4 (2.2%)
Arterial occlusion in both legs	0	1 (1.5%)	0	1 (0.5%)
Collaps	1 (0.9%)	0	0	1 (0.5%)
Pulmonary embolism	1 (0.9%)	0	0	1 (0.5%)
Renal	8 (7.3%)	14 (21%)	2 (29%)	24 (13%)
Urinary retention	4 (3.7%)	5 (7.5%)	2 (29%)	11 (6.0%)
Urinary tract infection	4 (3.7%)	6 (9.0%)	0	10 (5.5%)
Kidney failure	0	2 (3.0%)	0	2 (1.1%)
Decrease in renal function	0	1 (1.5%)	0	1 (0.5%)
Gastrointestinal	3 (2.8%)	8 (12%)	3 (43%)	14 (7.7%)
Bleeding	1 (0.9%)	2 (3.0%)	0	3 (1.6%)
Severe nausea and vomiting	2 (1.8%)	0	1 (14%)	3 (1.6%)
Anorexia	0	2 (3.0%)	0	2 (1.1%)
Pancreatitis	0	2 (3.0%)	0	2 (1.1%)
Diarrhea	0	1 (1.5%)	2 (29%)	3 (1.6%)
Ileus	0	1 (1.5%)	0	1 (0.5%)
Pulmonary	2 (1.8%)	2 (3.0%)	0	4 (2.2%)
Pneumonia	1 (0.9%)	2 (3.0%)	0	3 (1.6%)
Exacerbation of bronchitis	1 (0.9%)	0	0	1 (0.5%)
Neurological	30 (28%)	23 (34%)	5 (71%)	58 (32%)
Delirium	25 (23%)	19 (28%)	4 (57%)	48 (26%)
Foot drop	3 (2.8%)	1 (1.5%)	0	4 (2.2%)
Femoral neuropathy	1 (0.9%)	1 (1.5%)	0	2 (1.1%)
Transient ischemic attack (TIA)	0	1 (1.5%)	1 (14%)	2 (1.1%)
Cerebrovascular accident (CVA)	0	1 (1.5%)	0	1 (0.5%)
Carpal tunnel syndrome (CTS)	1 (0.9%)	0	0	1 (0.5%)

Table 3. *Continued*

Medical complications during hospital stay	ASA 1-2 (109 hips)	ASA 3 (67 hips)	ASA 4 (7 hips)	Total (183 hips)
Other	53 (49%)	45 (67%)	7 (100%)	105 (57%)
Pressure sore	50 (46%)	35 (52%)	5 (71%)	90 (50%)
Death	0	4 (6.0%)	0	4 (2.2%)
Hyponatremia	1 (0.9%)	2 (3.0%)	1 (14%)	4 (2.2%)
Vaginal infection	0	1 (1.5%)	1 (14%)	2 (1.1%)
Hypokalemia	0	1 (1.5%)	0	1 (0.5%)
Osteomyelitis of MT5	1 (0.9%)	0	0	1 (0.5%)
Polyarthritis	1 (0.9%)	0	0	1 (0.5%)
Allergic reaction to antibiotics	0	1 (1.5%)	0	1 (0.5%)
Tung necrosis	0	1 (1.5%)	0	1 (0.5%)
Total	**109 (100%)**	**112 (167%)**	**18 (257%)**	**239 (131%)**

Table 4. Incidence of orthopedic complications within the first six months after surgery, per ASA-category and in total. The table shows the incidence of the complication, with the percentage in the patient group in brackets.

Orthopaedic complications within six months	ASA 1-2 (109 hips)	ASA 3 (67 hips)	ASA 4 (7 hips)	Total (183 hips)
No complications (orthopaedic)	82 (75%)	51 (75%)	4 (57%)	137 (75%)
Peri-prosthetic fracture	5 (4.6%)	9 (13%)	1 (14%)	15 (8.2%)
Wrong head-size	0	1 (1.5%)	0	1 (0.5%)
Dislocation	17 (16%)	4 (6.0%)	2 (29%)	23 (13%)
Infection	3 (2.8%)	3 (4.5%)	0	6 (3.3%)
Superficial	2 (1.8%)	0	0	2 (1.1%)
Deep	1 (0.9%)	3 (4.5%)	0	4 (2.2%)
Arterial bleeding (embolisation needed)	1 (0.9%)	0	0	1 (0.5%)
Total	**27 (25%)**	**17 (25%)**	**3 (43%)**	**47 (26%)**

cases repeated surgery for debridement of the infected area was performed, weight bearing was usually not allowed and even impossible due to leg length discrepancy. Furthermore, most of these patients had bed-rest with their leg in traction to prevent shortening of the leg. In our study neither blood loss, nor operation time correlated with social outcome.

In the current study four patients died during hospital stay. In the remaining of hospital admittances 138 times (75%) the patient could return to their previous housing

Table 5. Pre- and postoperative use of walking aids by the patients. The numbers in the light gray cells represent no change in use of walking aids. The numbers in darker gray cells represent worsening in the use of walking aids and the numbers in white cells represent improvement in use of walking aids.

	Support post-operatively									
Support preoperatively	None	Cane	crutch	2 crutches	Walker	Wheel-chair	bedridden	Died during hospital stay	Unknown	Total
None	2	2	0	1	1	1	0	0	0	7
Cane	2	14	3	3	9	1	0	1	1	34
Crutch	2	2	1	1	1	0	0	0	0	7
2 Crutches	1	10	5	6	6	1	0	1	1	31
Walker	0	5	2	5	48	6	0	1	4	71
Wheelchair	1	2	1	0	10	15	0	0	0	29
Bedridden	0	1	1	0	0	1	0	0	0	3
Unknown	0	0	0	0	0	1	0	0	0	1
Total	8	36	13	16	75	26	0	3	6	183

situation, in 22 cases (12%) there was a worsening in the housing situation, and in 7 cases (4%) there was an improvement. In 12 cases the post-operative situation was unknown. Strehle *et al*. [114] also compared pre-operative and ultimate post-operative situations. They reported that 80% of patients could return to their original environment eventually and 20% (all patients pre-operatively living in a house or apartment) had to move to a home for the elderly or nursing home. Ballard *et al*. [6] reported that of 27 octogenarians 11 went to a nursing care institution after discharge for revision hip arthroplasty, none of them could return home after rehabilitation.

The only predictor for returning home in patients living in a house or apartment in the current study was the presence of a spouse, with gender being a strong confounder as most of the male patients lived with a spouse and only a minority of female patients did. Strehle *et al*. [114] also compared social situation in patients living with and without a spouse. They found that 95% of patients living with a spouse could return to their homes compared to 70% of patients living without a spouse. No statistical testing was reported.

Several studies reported where patients went after discharge from the hospital, which was not always the ultimate situation. In the current study 59% of patients living in a house or apartment pre-operatively went to a nursing home or home for the elderly after discharge from the hospital for rehabilitation. The majority of these patients could return to their own homes after a mean rehabilitation period of 106 days.

In the current study, 8 patients (5.5%) died within 90 days of surgery. This corresponds with the findings by Mahomed *et al*. [77] who studied survival of octogenarians after revision hip arthroplasty and found that 168 of 3165 patients (5.3%) died within 90 days of surgery and with the findings of Parvizi *et al*., [92] who had 7 deaths in 159 patients (4.4%) within 90 days.

Patient survival differed significantly between ASA-groups, with all the patients in ASA-4 having died within two and a half years after surgery and the biggest differences in survival between patients in ASA-2 and ASA-3 occurring in the first six months post-operatively. Prause *et al*. [98] showed in a large study of over 16,000 patients that ASA-category is a good predictor for peri-operative mortality.

In our study there were 239 medical complications in 183 hospital admittances (1.3 complications per case), with 1.0 complication per hospital admittance in patients in ASA-1 and ASA-2, 1.7 in ASA-3 and 2.6 in ASA-4. There was no difference in the number of complications observed between various kinds (i.e. total hip versus partial components) of revision surgery. Delirium (26% of cases) and pressure sore grade 2 or more (50%) were the most common complications, followed by urinary retention, urinary tract infection and congestive cardiac failure (all in 6% of cases). In a study

on primary THP and TKP in patients 89 years and older all patients had a delirium post-operatively.[10] Ballard *et al*. [6] found 1.5 medical complications per patient (41 in 27 patients), with urinary retention as the most common (56% of patients). Raut *et al*.[99] found 42 complications in 56 patients (0.8 complications per patient), with major complications only occurring in patients with ASA-3. They observed a correlation between seriousness of complications and ASA-category. Brander *et al*. [16] studied primary hip and knee arthroplasty in octogenarians compared to patients aged 65-80 years. They concluded that the number of comorbidities did not correlate with the occurrence of complications. However, patients 80 years and older who had no comorbidities had a lower chance to have complications. Parvizi *et al*. [92] studied 170 hips in 159 patients aged 80 or older undergoing revision hip arthroplasty and compared them to a gender-matched control group of patients aged less than 70 years. They found a mean complication rate of 0.3 complications per patient, with arrhythmia as the most common (3.5%). Leung *et al*. [71] found ASA-classification to be a predictor for complications in a multivariate analysis (besides emergency surgery and pre-operative tachycardia. Compared to previous studies our study shows a high percentage of delirium and pressure sores. Probably, these complications can be prevented. Pressure sores can sometimes be prevented by using a special mattress. In the two hospitals where the study was done these special mattresses were only used when pressure sores were already present (as a hospital policy), but because of the high occurrence of pressure sores in these octogenarians with a relatively long period of bed rest it would be worthwhile to use an anti-pressure sore mattress as a preventive measure instead of a treatment. Delirium can sometimes be prevented by keeping the patient in an as best as possible condition. In a randomised controlled trial by Marcantonio *et al.*, [80] the occurrence of delirium in patients after orthopaedic surgery could be reduced significantly by proactive geriatrics consultation. A geriatrician made daily visits and made targeted recommendations based on a structured protocol. Introducing these measures will probably reduce the occurrence and seriousness of delirium.

In the current study orthopaedic complications occurred in 25% of cases. 13% of hips had one or more dislocations post-operatively within 6 months, 8.2% had peri-prosthetic fractures (mostly per-operatively), and 2.2% had a deep infection. A large study of complications after revision hip arthroplasty within 6 months in almost 13,000 patients of all ages showed 1.1% infections and 14% dislocations.[94] In Ballard's study 4 of 27 octogenarians (15%) had dislocations post-operatively and there were no infections.[6] Raut *et al*.[99] found dislocations in 4 (7%) patients and infections in 2 (4%). There were no periprosthetic fractures. In the study by Parvizi *et al*. [92] 1.8% periprosthetic infections occurred in the octogenarians group, which was the same amount for the con-

trol group of patients aged 70 years and younger. Fractures occurred in 7.6% of elderly patients compared to 1.8% in the younger group ($p = 0.006$), and this difference was attributed to a lower bone stock in elderly patients, predisposing to fractures. On the other hand dislocations occurred more in the younger patient group (9.4%, compared to 2.4% in the elderly patients) ($p = 0.01$), and this was explained by the fact that for the elderly patients more constrained liners were used. In our study there seemed to be a difference in occurrence of the kind of complications between the ASA-groups, but this was not statistically significant. There were 16 hips (16%) with dislocations in the ASA-2 group and 4 (6%) in the ASA-3 group ($p = 0.07$). In contradistinction to Parvizi's study the same liners were used in all ASA-categories. We explain the higher percentage of dislocations in the ASA-2 group by the supposition that these people are usually more active in physical activities. In our study there were 5 hips (4.6%) with periprosthetic fractures in the ASA-2 group and 9 (13%) in the ASA-3 group ($p = 0.10$). We agree with Parvizi that peri-prosthetic fractures are more likely to occur in patients with a poor bone-quality and these patients are probably more represented in the higher ASA-groups. Probably, a larger group of patients would have given significant differences in the kind of complications in our study.

In the current study the use of walking aids was reported pre- and postoperatively. In 49% of cases the use of walking aids remained the same before and after revision surgery, in 22% the situation in use of walking aids had worsened, and in 29% the situation improved. This implicates that there may be a slight improvement in use of walking aids after revision surgery. No other study reported on difference in use of walking aids before and after revision hip arthroplasty in octogenarians.

Conclusion

Revision hip arthroplasty can be a heavy burden in octogenarians. This study reports the social outcome of 183 hospital admittances for revision hip arthroplasty in 145 patients over 80 years. Some of the very common complications occurring in this study (pressure sores and delirium) can probably be minimised by preventive measures such as special mattresses and early consultation of a geriatrician.

Patients with higher ASA-categories had a higher number of complications. However, this had no influence on whether the patient could be discharged to his or her own home or that the patient had to be discharged to a home for the elderly or nursing home for rehabilitation or definitive stay. The only predictor for returning home was the presence of a spouse at home with gender being a strong confounder.