Reduced Survival for Uncemented Compared to Cemented Total Hip Arthroplasty after Operatively Treated Acetabular Fractures

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Abstract

Background

Post traumatic arthritis and avascular necrosis of the femoral head are common complications after operatively treated acetabular fractures. This may cause severe disabilities for the patient, necessitating a total hip arthroplasty. Even though an arthroplasty may provide good symptomatic relief, the long-term results are more uncertain and no consensus exists according to preferred prosthetic designs. With this cohort study, we aimed to investigate the medium to long term arthroplasty survival and clinical results of total hip arthroplasty after operatively treated acetabular fractures.

Methods

We included 52 patients treated with a secondary total hip arthroplasty at a median of 2.4 (0.1-14.1) years after an operatively treated acetabular fracture. The median age was 54 (11-82) years. Cemented arthroplasty was used for 33 patients, 10 patients had an uncemented arthroplasty and 9 patients received a hybrid arthroplasty. Average follow up was 8.0 (SD 5.0) years.

Results

Ten-year revision free arthroplasty survival was 79%. Uncemented arthroplasties had a significantly worse 10-year survival of 57%. Arthroplasties performed at a centre without a pelvic fracture service also had a significantly worse 10-years survival of 51%. Cox regression showed similar results with an 8-fold increase in risk of revision for both uncemented arthroplasties and operations performed at a non-pelvic trauma centre.

Interpretation

Total hip arthroplasty secondary to an operatively treated acetabular fracture provides good symptomatic relief. These patients are, however, complex cases and are probably best treated at specialist centres with both pelvic trauma surgeons and arthroplasty surgeons proficient in complex revisions present.

Introduction

Acetabular fractures are severe injuries and may result in life long disability. Undisplaced and less displaced fractures can generally be treated non-operatively with good to excellent results [3]. For the displaced fractures, operative treatment with open reduction and internal fixation (ORIF) is recommended [17, 22, 28], and the clinical results are reported to be successful in 76 %-80 % of the cases. Good results are, however, closely associated with the fracture reduction, and a residual step-off over 2-3 mm will lead to significantly reduced hip joint survival and clinical results. It is suggested that approximately 11-19% of the acetabular fracture patients will develop symptomatic arthritis [8, 23-25] and 6% –11% will eventually receive a total hip arthroplasty (THA) [8, 23-25]. The reported results of delayed THA after operatively treated acetabular fractures vary widely as do the type of arthroplasties performed. Romness and colleagues reported up to 18.2% revisions after 10 years for cemented cups in their study [31]. More recent reports have almost exclusively focused on the use of uncemented arthroplasties and have described excellent short to mid-term results, with survival rates approaching 100% [7, 16, 30]. Other authors have not confirmed these excellent results, i.e. Morrison showed a 10-year survival rate of 70% for uncemented acetabular components [26]. A review from 2014 could not show statistically significant differences in survival between cemented and uncemented components [20].

The aim of the present study was to investigate the medium to long term implant survival and clinical results of a secondary THA after ORIF for acetabular fractures. Furthermore, we aimed to investigate any differences between cemented and uncemented components.

Patients and methods

In 1993 one of the senior authors (O.R.) established a database to prospectively register all acetabular fractures seen in our department. The department is treating all acetabular fractures in the region, with a catchment area of approximately 2.8 million inhabitants [19]. The database contains information on fracture characteristics, treatment, results and data on follow up (FU), with scheduled visits at 3,6 and 12 months, as well as 2,5,10,15 and 20 years. The follow up data include Harris Hip score (HHS) and Merle d'Aubigné score (MMA), and from 2015 also the Eq-5D and Hip disability and Osteoarthritis Outcome Score (HOOS) which also includes the Western Ontario and McMaster universities Osteoarthritis Outcome Score (WOMAC). Patients who received a secondary THA between 1995 and 2014 after failed ORIF for an acetabular fracture were included into the present study. The study was approved by the regional ethics committee.

A total of 55 patients were identified from the registry; 2 patients were lost to follow up and 1 patient had deceased within the first two years after THA, leaving a total of 52 patients to be included in the survival analysis. Failure was defined as revision of the arthroplasty from any cause.

For the clinical FU, all patients with complete data on HHS, EQ-5D, HOOS and WOMAC score, at a minimum of 2 years after THA, were included. These 45 patients with complete data were followed for a median of 7.7 (2-21) years. The HHS was considered excellent (100-90 points), good (89-80 points), fair (79-70 points) or poor (<70 points). The EQ-5D index and the individual HOOS scores (pains, symptoms, activities of daily living, sports & recreation and quality of life) were calculated.

Radiographs of the non-revised hips were assessed by two of the authors for signs of radiographic loosening according to Gruen [9] for cemented stems and Engh [5] for uncemented stems, while Charnley zones [4] were used to assess the cups.

Statistics

The survival analysis was performed on STATA software (Version 14.2; StataCorp), using the Kaplan-Meier method with censoring. Differences in survivorship between groups were analysed with the log-rank test. Cox-regression was applied to identify negative predictors for survival and estimate hazard ratios. Clinical data was analysed with SPSS software (Version 22; IBM). The clinical data were normally distributed and ANOVA was used when three groups or more were compared, and students T-test for continuous parameters such as clinical scores. Level of significance was set at $p=0.05$.

Results

THA survival

For the survival analysis, all patients with a minimum of 1 year FU were included; this left a total of 52 patients. Two were lost to FU and one patient had deceased within 1 year. There were 17 (33%) females and 35 (67%) males, with a median age of 54 (range 11-82) years. The median FU was 7.3 (1-21) years.

The mean time to THA from the index operation was 4 (SD 3.8) years and median 2.4 (range 0.1-14.1) years. In total, 16 patients needed impaction bone grafting in the acetabulum.

There was an overweight of fracture patterns affecting the posterior part of the joint, with one third of the fractures being transverse with posterior wall (Table 1). Forty patients received their THA in a centre with a pelvic fracture service, 11 were operated elsewhere

and 1 patient had missing data. Cemented THA was the most commonly used technique with 33 patients, 10 patients received an uncemented arthroplasty and 9 had a hybrid THA done (Table 2). Patients with uncemented arthroplasty were younger with a mean age of 42 (SD 16) years, compared with the group with hybrid articulations, mean age of 51 (SD 12) years and the cemented arthroplasty group with a mean age of 56 (SD 16) years ($p=0.057$), although not statistically significant. There were no differences in gender distribution across the groups.

The overall 10-year revision free survival for any cause was 79% (95% CI 62%-89%) (Figure 1). When dividing into cemented, uncemented and hybrid THA groups, we found that uncemented THAs (10 patients) had a statistically significant worse survival of 57% (95% CI 21%-81%) estimated at 10-years ($p=0.005$) (Figure 2). Cemented THA (33 patients) had an estimated 10-year survival of 80% (95% CI 56%-91%), and hybrid prosthesis (9 patients) had 100% 10-year survival. When dividing the data into separate arthroplasty components, we found a poorer survival for uncemented cups, with 65 % (95% CI 30%-86%) at 10 years ($p=0.025$). Patients receiving their THA at an institution that did not treat acute acetabular fractures had worse long term survival, with 51 % survival at 10-years (95%CI 19%-76%) ($p=0.025$). There was no difference in survival for cemented versus uncemented stem fixations. Regarding fracture complexity (elementary versus associated fracture patterns), we could not find any differences in THA survival, nor regarding gender or age over/under 55 years. Cox regression showed similar results; patients receiving an uncemented THA had an 8-fold increase in risk of revision after adjusting for age, gender and impaction bone grafting. (Table 3)

Clinical outcome

Of the 45 patients with clinical data, 39 patients had a complete set of HHS score pre- and post-THA, with a mean FU of 8.1 (SD 5.5) years. The average HHS increased from 53 (SD 10) prior to THA to 82 (SD 16) at the latest FU. Patients who had undergone revision of their THA had a statistically significantly lower HHS of 70 (SD 19) compared to non-revised hips, with a HHS of 86 (SD 13) ($p=0.004$). Furthermore, patients with non-revised THAs had a statistically significantly better HHS of 88 (SD 13) versus 75 (SD 6) if they were operated in an institution also performing acute pelvic trauma surgery ($p=0.038$). Also for the HOOS sub scores (Figure 3), there were statistically significant worse scores for revised arthroplasties compared to non-revised hips. There were no significant differences in clinical outcome between genders, and age above/below 55 years. WOMAC sub scores and the EQ-5D index showed the same tendencies (Table 4).

Radiological outcome

Forty-four patients did not have their THA revised, and radiographs were available for 40 of these patients, with an average radiological FU of 6.9 years (SD 5.1). There were no signs of radiographic loosening of cemented or uncemented stems (both assessors were in perfect agreement). For the cemented cups, both reviewers agreed that two out of 33 cups showed signs of radiographic loosening. In patients with surviving uncemented cups, one assessor found signs of radiographic loosening around one cup, not seen by the other. The agreement between the reviewers was substantial for signs of radiological loosening around the cups with a kappa value of 0.79 (SD 0.20).

Complications

There were no fatalities for the first 30 days post operatively and only one during the first year. There were, however, 3 cases of infection; 2 within the first 30 days after THA and one

late after one year. One of these cases was successfully managed with soft tissue debridement and antibiotics. The remaining 2 cases needed staged revisions and one of the patient ended up with a permanent Girdlestone situation. Four patients suffered dislocations of their prosthetic joint, all multiple and therefore revised surgically to enhance joint stability. In 2 of these patients the acetabular component was exchanged, one had a constrained liner implanted and one patient had a total revision from uncemented to cemented arthroplasty components. See table 5 for complete breakdown of revisions. One patient had a non-ST-elevation myocardial infarction post-operatively, from which she recovered fully.

Discussion

In this cohort study our main aims were to describe the revision free survival of total hip arthroplasties after failed ORIF of an acetabular fracture at medium term, and to identify negative prognostic factors. We also studied the clinical results after THA in this patient group. The overall 5-year survival of the THA was 82% (95%CI 68%-91%) and the 10-year survival was 78% (95% CI, 61%-88%). This is slightly higher than previously reported by Morison et al., showing a 70% 10-year survival in a cohort of 74 patients of which 58 were treated with previous ORIF of their acetabular fracture.

In the present study, we also found a reduced survival for uncemented THAs, with a ten-year survival approaching 58%. This is in contrast with the study published by Gavaskar and colleagues, reporting 95% 10-year survival in a group of 27 patients who received uncemented THA after failed ORIF [7]. Also, Weber [34], showed an overall 10 year survival of 78% (66 patients) and 90 % survival in the uncemented group (20 patients) after an average FU of 9.6 years [34]. However, their FU of the uncemented THAs was only 4.2 years,

probably contributing to their excellent survival data. In a systematic review, Makridis et al. reviewed 422 delayed THAs with an average FU of 6.3 years [20]. In this review, there were no statistical differences in survival between cemented or uncemented implants, with a 10-year survival of 87% for uncemented cups and 81% for cemented ones, and 91% versus 89%, respectively, for the stems. Several other authors have pointed out age under 50-60 years as a risk factor for revision [2, 31]. We could not verify this association in our series.

A total of 11 arthroplasties were revised in the present cohort (Table 5). For the uncemented group 5 out of 6 revisions were acetabular components. A high rate of acetabular revisions was also noted by Morison and colleagues in their matched cohort study where they compared THA in primary OA with OA after acetabular fractures. Interestingly, they found no difference between patients that had previous acetabular fracture surgery and those who had non-operative treatment [26]. Furthermore, 4 out of 6 of our revised uncemented arthroplasties were operated at a centre with no pelvic fracture service. The uncemented acetabular components used were mostly of proven design, except one Igloo cup, which is proven inferior. There was no difference between the cemented and uncemented arthroplasties needing revision when it came to; age, gender, time to revision or the need for acetabular bone grafting. In our study, the combination of an uncemented acetabular cup operated at an institution with no pelvic fracture service rendered inferior results.

The 10-year survival rate for THA after primary OA is excellent, generally around 95% for both cemented and uncemented implants according to different arthroplasty registries [6, 10]. For THA after operatively treated acetabular fractures, the long-term survival is obviously less satisfying and compare with the survival of revision arthroplasties, generally reported to be around 80% [11, 14]. The relatively high number of patients needing

impaction bone grafting and the fact that these hips have been operated on before contribute to this, resulting in increased rates of component loosening and other complications like dislocations and infections.

The clinical results for the patients in the present series improved markedly after THA and the average HHS was 82 after 8 years FU. For the non-revised cases the average HHS was 86 (SD 12). This is similar to the long-term results for THA after idiopathic OA [21, 32]. Ranawat and colleagues reported similar outcomes to ours at 4.7 years in their study of 32 uncemented THA after acetabular fractures [30], and other studies have also shown fairly similar clinical outcomes [13, 15, 18].

We included WOMAC and HOOS scores in our patients because they are better validated [1, 12] and less prone to the ceiling effect observed with the HHS [29, 33]. The WOMAC scores after 8 years FU for non-revised hips, were 77 for the pain sub score, 71 for stiffness and 73 for the function sub score. This is slightly lower than Nilsson and colleagues reported on 75 patients with an average FU of 7 years in a cohort comprising of THA for primary OA [27]. They found a pain score of 86, stiffness score of 78 and a function score of 76.

Radiological FU of the non-revised prostheses revealed that none of the stems showed signs of radiographic loosening. Three patients in which the cups showed loosening signs had a HHS of 80, 83 and 84, respectively, and had no evident clinical evidence of loosening. These patients were therefore not included as failures in the Kaplan-Meier analysis.

The present study has many inherent weaknesses. It represents a cohort including patients from a 20-year timespan (1995-2014). Therefore, many different prosthetic designs are included and some of these are hampered with inferior results also in primary hip replacements. Our results must be interpreted with this in mind. Furthermore, our registry

includes patients operated with secondary THAs at several different hospitals with different treatment philosophies; probably reflecting the normal clinical practice in our country at the time. The total number of patients and the numbers in each group are quite small, and even though some of our findings are statistically significant this must be borne in mind when interpreting the results.

Nevertheless, our cohort represents one of the larger series of delayed THA in patients after operatively treated acetabular fractures. Also, the patients have participated in a uniform FU system and few were lost to FU. We therefore believe that this cohort is representative for this complex patient group.

In conclusion, post traumatic OA after operatively treated acetabular fractures are successfully treated with a THA. The medium and long term results, however, are inferior to what is observed after primary THAs, underlining the complexity of this patient group. In our study, uncemented hip arthroplasty was associated with an increased risk for revision. Furthermore, patients who had their THA performed in a centre without a pelvic fracture service did have a significantly reduced 10-year survival of 51%, and inferior functional results. This leads us to believe that joint replacement after failed operatively treated acetabular fractures is best performed in specialist centres with both acute pelvic trauma and joint replacement services present.

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Fracture type (Letournel's classification)	Number
Posterior wall	12
Posterior column	2
Anterior wall	1
Anterior column	2
Transverse	1
Posterior column+wall	2
Transverse and posterior wall	16
T-fracture	1
Anterior column + posterior hemitransverse	9
Both column	6
Total	52

Table 1: Distribution of fracture types according to the Letournel classification in 52 patients operated with secondary THA.

Stems		Cups		Head	
Cemented					
	Number		Number		Number
Charnely	20	Ogee	19	Co-Cr 32mm	14
Exeter	10	Marathon	9	Co-Cr 28mm	9
Lubinius	1	Exeter	3	Monoblock 22mm	8
Elite Plus	1	Lubinius	1	Co-Cr 22mm	2
CPT	1	Elite	1		
Total	33		33		33
Uncemented					
Corail	5	Trilogy	5	Ceramic 28mm	3
SCP	2	Duraloc	2	Ceramic 32mm	3
HActiv	2	TM	1	Zirconium 28mm	2
Landos	1	Pinnacle	1	Co-Cr 32mm	1
		Igloo	1	Co-Cr 36mm	1
Total	10		10		10
Hybrid					
Corail	6	Ogee	2	Co-Cr 32mm	4
Exeter	2	Marathon	2	Co-Cr 28mm	2
CPT	1	TM	2	Ceramic 32mm	2
		Exeter	1	Monoblock 22mm	1
		Trilogy	1		
		Elite	1		
Total	9		9		9

Table 2: The different types of prosthetic components used in the 52 patients who received secondary THA after failed operative treatment for an acetabular fracture

Variable	HR (95% CI)	p-value	Adjusted* HR (95%CI)	p-Value
Age	0.98 (0.94-1.02)	0.289	0.97 (0.92-1.02)	0.300
Gender	2.18(0.47-10.10)	0.320	1.96 (0.41-9.44)	0.398
Bone grafting	0.36 (0.08-1.73)	0.203	0.25 (0.05-1.42)	0.119
Hybrid THA	No failures		No failures	
Cemented THA	0.35 (0.10-1.20)	0.096	0.25 (0.06-1.06)	0.060
Uncemented THA	5.51 (1.66-18.32)	0.005	8.23(2.07-32.74)	0.003
Uncemented cup	3.65 (1.09-12.18)	0.035	5.42 (1.35-21.69)	0.017
Uncemented stem	2.93 (0.89-9.63)	0.076	5.79 (1.40-23.92)	0.015
Non-pelvic center	3.59 (1.09-11.81)	0.036	8.56 (1.91-38.31)	0.005

Table 3: Crude and adjusted hazard ratios (HR) for revision.

(Adjusted for gender, age and impaction bone grafting)*

Clinical score	Not revised (n=33)	Revised (n=11)	p-Value
WOMAC pain	77 (SD 23)	51 (SD 17)	0.002
WOMAC Stiffness	71 (SD 22)	45 (SD 23)	0.006
WOMAC Function	73 (SD 24)	48 (SD 20)	0.006
Harris Hip Score	86 (SD 13)	70 (19)	0.011
EQ-5D Index	0.702 (SD 0.232)	0.453 (SD 0.307)	0.013

Table 4: Clinical scores for revised and non-revised patients, a median of 9 (2-21) years after initial THA surgery

Overview over revised prosthesis							
Patient number	Revision cause	Primary prosthesis	Primary cup	Primary stem	Primary head	Revision cup	Revision stem
1	Aseptic loosening	Uncemented	Duraloc	SCP	Zirconium 28mm	Duraloc	N/A
2	Aseptic loosening	Cemented	OGEE	Charnley	Monobloc 22mm	Trophic	KAR
3	Infection	Uncemented	Trilogy	Corail	Ceramic 32mm	TM	Corail
4	Infection	Cemented	Marathon	Charnley	Co-Cr 28mm	N/A	N/A
5	Infection	Cemented	OGEE	Charnley	Co-Cr 28mm	Girdlestone	Girdlestone
6	Dislocation	Cemented	Elite	Charnley	Co-Cr 32mm	Trilogy	KAR
7	Dislocation	Uncemented	Trilogy	HActive	Ceramic 28mm	Constrained liner	N/A
8	Dislocation	Uncemented	Trilogy	Landos	Ceramic 32mm	Landos Screw	N/A
9	Dislocation	Uncemented	Igloo	Corail	Zirconium 28mm	Ogee	N/A
10	Broken stem	Cemented	OGEE	Charnley	Co-Cr 28mm	Marathon	Revitan
11	Pseudotumor	Uncemented	Duraloc	Corail	Co-Cr 32mm	Liner	N/A

Table 5: Table showing the individual causes for revisions and the different prosthetic components used.

Figure 1

Figure 1: Kaplan-Meier plot of overall survival of the THAs in the 52 patients operated with secondary arthroplasties after failed ORIF for acetabular fracture.

Figure 2

Figure 2: Kaplan-Meier plot of THA survival according to prosthetic technique.

Figure 3

Figure 3: HOOS score comparing revised (n=8) and non-revised (n=33) patients