Dual mobility cup reduces dislocation and re-operation when used to treat displaced femoral neck fractures

Anne S. Bensen · Thomas Jakobsen · Niels Krarup

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Abstract

Purpose Total hip arthroplasty (THA) as primary treatment for displaced femoral neck fractures is controversial as THA is associated with higher rates of dislocation but lower rates of re-operation compared to hemiarthroplasty (HA). A dual mobility cup (DMC) design is associated with lower dislocation and re-operation rates in elective surgery. Is this also the case when used to treat displaced femoral neck fractures? The aim of this study is to compare rates of dislocation and re-operation of any kind following treatment for displaced femoral neck fractures with either bipolar HA or THA with DMC.

Methods Two consecutive groups of patients treated for displaced femoral neck fractures at the Regional Hospital in Viborg in Denmark were included. In 2007–2008 171 patients (mean age 84.1 years) were treated with bipolar HA. In 2009–2010 175 patients (mean age 75.2 years) were treated with THA with DMC. Data regarding rates of dislocation and re-operation were obtained by retrospective review of medical records.

Results We found a statistically significant difference regarding rates of dislocation and re-operation of any kind in favour of THA with DMC. Dislocation occurred in 25/171 patients [95 % confidence interval (CI) 9.3–19.9 %] treated with bipolar HA and 8/175 patients (95 % CI 1.5–7.7 %) treated with THA with DMC ($p=0.002$). Re-operations were required in 32/171 patients (95 % CI 12.9–24.6 %) treated with bipolar HA and 16/175 patients (95 % CI 4.8–13.4 %) treated with THA with DMC ($p=0.01$).

Conclusions Our findings indicate that THA with DMC is superior to bipolar HA following treatment for displaced

femoral neck fractures in regard to rates of dislocation and re-operation.

Keywords Dual mobility cup · Displaced femoral neck fractures · Hip arthroplasty · Dislocation · Re-operation

Introduction

Femoral neck fractures represent a major public health problem worldwide, and the incidence is expected to increase in the future [1] due to continued ageing of the population in developed countries. Patients are often old and fragile and many have several medical co-morbidities. Sustaining a displaced femoral neck fracture is also associated with increased morbidity, mortality and impaired mobility and function for the patient.

Treatment of patients with displaced femoral neck fractures is a challenging and demanding task for the orthopaedic surgeon. For decades there has been an ongoing discussion about what is the optimal treatment for displaced femoral neck fractures. Arthroplasty is a widely accepted treatment as it allows early mobilisation of the patient. Often hemiarthroplasty (HA) is the preferred treatment because it is a quick and relatively simple procedure compared to total hip arthroplasty (THA). The use of THA as primary treatment for displaced femoral neck fracture is controversial. It has been reported that THA has a higher rate of dislocation than HA [2–5], that the duration of surgery is longer and that the perioperative blood loss is greater [4]. On the other hand THA is associated with a lower rate of re-operation [4–6], less pain, a better functional outcome and mobility [2, 3, 7] and lower long-term costs compared to HA [8].

Back in the 1970s the dual mobility concept was invented in France by Prof. Gilles Bousquet. The concept is based on two articulating surfaces where the prosthetic head is mobile

A. S. Bensen (✉) · T. Jakobsen · N. Krarup
Department of Orthopaedic Surgery, The Regional Hospital in
Viborg, Heibergs Allé 4, 8800 Viborg, Denmark
e-mail: asbensen@yahoo.dk

within a polyethylene liner which is also free to move within an acetabular metal cup. In theory this should increase the range of motion and provide very stable articulation. THA with a dual mobility cup (DMC) is associated with lower rates of dislocation in elective surgery and revision procedures compared to THA with a conventional cup [9, 10], but only little is known about the effect of THA with DMC when used to treat patients with displaced femoral neck fractures.

The aim of this study is to compare the rates of dislocation and re-operation after treatment of displaced femoral neck fracture with either bipolar HA or THA with DMC. Our hypothesis is that THA with DMC has a lower rate of dislocation and re-operation compared to bipolar HA.

Materials and methods

This is a retrospective study. The population consists of two consecutive groups of patients who were all treated for displaced femoral neck fractures with primary arthroplasty in our department at the Regional Hospital in Viborg in Denmark in the period from 1 January 2007 to 31 December 2010. In 2007–2008 the standard treatment for a displaced femoral neck fracture in our department was cementless bipolar HA. However, patients with osteoarthritis on radiographs were treated with THA with DMC instead of bipolar HA. Due to a high dislocation rate for HA we decided to change our treatment in 2009 so that all patients were treated with cementless THA with DMC to provide a more stable articulation. Initially, some patients were treated with bipolar HA instead of THA with DMC because not all surgeons followed the standard treatment or were comfortable with performing THA.

All patients were operated on through a posterolateral approach including reconstruction of the posterior capsule and reinsertion of the external rotators during closing. Post-operatively all patients were mobilised and trained by physiotherapists in our department and given the same advice on movements of the hip to be avoided to prevent dislocation. All patients were given cefuroxime 1.5 g pre-operatively and 1.5 g $\times$ 3 the first day post-operatively as a prophylactic antibiotic.

The primary and secondary parameters of this study are listed in Table 1. Data regarding rates of dislocation and re-operation in the follow-up period, secondary parameters and patients' characteristics were obtained by retrospective review of medical records. We have defined a re-operation as an operation of any kind after primary surgery exclusive of closed reduction of the dislocated arthroplasties. We have cross-checked all our data with data from the Danish National Patient Registry to ensure the inclusion of all patients who had been treated for dislocation or re-operation in other hospitals in Denmark in the follow-up period. Data on

Table 1 Study parameters

	Parameter
Primary	Dislocation
	Re-operation of any kind (excl. closed reduction of dislocated arthroplasties)
Secondary	Waiting time for surgery
	Length of surgery
	Perioperative blood loss
	Surgeon's experience
	Duration of stay
	3-month and 1-year mortality

mortality was obtained from the Danish Civil Registration System. The date for data extraction was 1 March 2012. Approval from the Danish Data Protection Agency and the Danish Health and Medicines Authority was obtained before initiation of the study.

Statistics

Results are reported as means with standard deviations or frequencies with 95 % confidence intervals (CI). When appropriate, ranges are supplied. Differences between categorical data were analysed using the chi-square test. Differences between continuous data were normally distributed and analysed using Student's *t* test. Intercooled Stata 9.0 (Stata Inc., College Station, TX, USA) was used for statistical analysis. The level of significance was set at $p < 0.05$.

Results

Results for primary and secondary parameters are listed in Table 2.

We found a statistically significant difference regarding rates of dislocation in favour of THA with DMC ($p = 0.002$). Dislocation occurred in 25/171 patients (14.6 %) (95 % CI 9.3 %–19.9 %) treated with bipolar HA and 8/175 patients (4.6 %) (95 % CI 1.5 %–7.7 %) treated with THA with DMC. All dislocations in both groups happened within the first 50 days after primary surgery with 11 and four patients, respectively, dislocated in relation to simple falls. Many patients suffered from recurrent dislocations. Nineteen and three patients, respectively, had two or more dislocations. One patient treated with bipolar HA had the maximum of five dislocations.

We found a statistically significant difference regarding rates of reoperation of any kind in favour of THA with DMC ($p = 0.01$). Re-operations were required in 32/171 patients (18.7 %) (95 % CI 12.9 %–24.6 %) treated with bipolar

Table 2 Results

Parameter	Bipolar HA	95 % CI	SD	THA with DMC	95 % CI	SD	<i>p</i> value
Dislocation	25/171	9.3–19.9 %	–	8/175	1.5–7.7 %	–	0.002
Re-operation	32/171	12.9–24.6 %	–	16/175	4.8–13.4 %	–	0.01
Waiting time for surgery, mean (h)	22	20–25	15	29	27–32	18	<0.001
Length of surgery, mean (min)	68	65–72	23	74	70–78	27	0.04
Perioperative blood loss, mean (ml)	310	268–352	241	424	266–481	338	0.002
Duration of stay, mean (days)	7.4	6.9–7.9	3.5	7.3	6.8–7.8	3.1	0.76
Mortality 3 months post-operatively	26/171	9.8–21 %	–	18/175	5.8–15 %	–	0.17
Mortality 1 year post-operatively	50/171	22–36 %	–	30/175	12–23 %	–	0.008

HA and 16/175 patients (9.1 %) (95 % CI 4.8 %–13.4 %) treated with THA with DMC. Six and three patients, respectively, were re-operated more than once. There were no re-operations due to erosion of the acetabular cartilage even though this is a well-known complication of HA. Causes for the first re-operation and for the different types of re-operations made are listed in Tables 3 and 4.

We found a statistically significant difference regarding waiting time for surgery ($p<0.001$), length of surgery ($p=0.04$) and perioperative blood loss ($p=0.002$) in favour of bipolar HA. There was no difference in three month mortality, but there was a statistically significant difference after one year in favour of THA with DMC ($p=0.008$). No patients died perioperatively. There was no difference in duration of hospital stay between the two groups of patients.

We found no obvious relation between the surgeon's level of experience and the number of dislocations in both groups (Table 5). The dislocations were evenly divided between junior and senior surgeons compared to the number of operations made. Furthermore, in most cases the junior surgeons had a senior surgeon as supervisor.

The characteristics of the population are listed in Table 6. The two groups are comparable to each other except for age ($p<0.001$). The mean follow-up time was 25.3 months (range 0.3–62.4 months) for bipolar HA and 21.7 months (range 0.3–62.2 months) for THA with DMC.

Discussion

Our results indicate that THA with DMC may be a better alternative to bipolar HA as they suggest that the DMC design can prevent and reduce the number of dislocations and re-operations in our population. By changing our regimen of treatment from bipolar HA to THA with DMC we effectively reduced the number of dislocations in our population from 14.6 to 4.6 %. However, our dislocation rate is higher than reported in the literature. This may be partly explained by a possible “learning curve” with the introduction of a new implant. There are very few studies investigating THA with DMC as treatment for displaced femoral neck fractures. A French prospective multicentre study [11] of 214 patients found a dislocation rate of 1.4 % (three patients), while another study [12] observed no dislocations at all one year post-operatively when comparing 42 consecutive patients with another 56 consecutive patients treated with THA with a conventional cup.

Many surgeons prefer HA instead of THA as treatment for displaced femoral neck fractures because THA with a conventional cup apparently has a higher rate of dislocation compared with HA. Comparing our results with reported rates of dislocation in meta-analyses, our dislocation rate for THA with DMC is lower than for THA with a conventional cup where dislocation rates of 8 %–11 % have been reported [2–5].

Table 3 Causes for re-operation

Causes for re-operation	Bipolar HA (<i>n</i>)	THA with DMC (<i>n</i>)
Dislocation	21	3
Post-operative periprosthetic fracture	4	6
Loosening of components	2	1
Deep infection	5	4
Haematoma post-operatively	0	1
Other causes	0	1

Table 4 Type of re-operation

Type of re-operation	Bipolar HA (<i>n</i>)	THA with DMC (<i>n</i>)
Revision HA	1	0
Revision THA	23	9
Girdlestone	2	0
Operation for deep infection	5	4
Osteosynthesis of periprosthetic fracture	1	2
Haemostasis	0	1

Table 5 Surgeon's experience compared to number of dislocations

	Bipolar HA				THA with DMC			
	Total		Dislocation		Total		Dislocation	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Junior surgeons	112	65.5	15	60	81	46.3	3	37.5
Senior surgeons	59	35.5	10	40	94	53.7	5	62.5

We believe that the observed difference can be attributed the DMC design.

Our dislocation rate for HA is high compared to other studies. Meta-analyses have reported dislocation rates of 3 %–5 % for HA [2–5]. We find it difficult to explain the discrepancy between our results and the rates in the latter publications. We can find no obvious reason for this difference but note that in our study almost half of the dislocations in both groups were related to traumas from falling.

Our rate of re-operation of any kind was significantly lower for THA with DMC compared to bipolar HA. The main reason for this finding is accounted for by the difference in re-operations due to dislocations. In the literature, THA is associated with lower rates of re-operation than HA when used to treat displaced femoral neck fractures. Our results support this trend. Reported rates of re-operation in meta-analyses are 9 %–14 % for HA and 5 %–11 % for conventional THA [4–6]. Deep infection rates were 2 %–3 % in both groups which accords with meta-analyses [5, 6].

All patients in this study but 5 % in each group were treated with a cementless femoral stem. The ten patients who were re-operated due to post-operative periprosthetic fracture after a simple fall (2.3 % and 3.4 %, respectively) all had a cementless femoral stem and all occurred after a simple fall. Studies have found similar or even higher rates than ours [13–16]

We found no difference in three month mortality. However, we found a statistically significant difference in one year mortality in favour of THA with DMC. Several meta-analyses have found no difference in one year mortality between HA and THA [2, 3, 5, 6]. We believe that the main reason for our finding is that our two groups of patients are not comparable to each other according to age. The difference in mean age is nine years.

Insertion of a THA is a more complicated and technically demanding procedure compared with HA. Therefore, it is of no surprise to us that we found that the length of surgery was significantly longer and the perioperative blood loss greater for THA with DMC than for bipolar HA. Similar findings are reported in the literature [4]. Even though patients treated with THA with DMC had to wait for a significantly longer time for surgery than patients treated with bipolar HA, there was no difference in duration of stay or three month mortality indicating that THA with DMC allows just as quick and safe mobilisation of the patients as bipolar HA.

This study has three main limitations. First, the strength of our results is limited because this is a retrospective study. Second, our two consecutive groups of patients were not completely separated in time. A potential risk of selection bias is therefore present. Third, we have a significant difference in mean age between the two groups. The high HA dislocation rate may be partially explained by this age difference. Older patients may be less compliant with restrictions on movements, maybe due to impaired mental status. Unfortunately, we have no registration of the patients' mental status. A study [17] found that older patients with mental dysfunction treated with THA dislocated much more often than patients with normal mental status, indicating that they may be less compliant with advice on avoiding inappropriate movements.

Table 6 Population characteristics

	Bipolar HA	THA with DMC
Patients (<i>n</i>)	171	175
Sex, <i>n</i> (male/female)	40/131	52/123
Age*, mean, years (range)	84.1 (46–100)	75.2 (43–98)
Femoral stem	Corail®	Corail®/ANCA-FIT™
Femoral stem, <i>n</i> (with/without cement)	9/162	9/166
Dual mobility cup	–	Saturne®
Dual mobility cup, <i>n</i> (with/without cement)	–	3/172
Surgical approach	Posterolateral	Posterolateral
Follow-up, mean (months)	25.3	21.7

**p*<0.001

Corail®, DePuy Orthopaedics, Inc., Warsaw, IN, USA; ANCA-FIT™, Wright Medical Technology, Inc., Arlington, TN, USA; Saturne®, Amplitude, Valence, France

Conclusion

Our results indicate that THA with DMC is superior to bipolar HA when rates of dislocation and re-operation are compared. However, further randomised controlled trials are necessary to determine the optimal treatment for displaced femoral neck fractures.

Conflict of interest The authors declare that they have no conflict of interest.

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