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Dislocation rate, revisions and other complications of primary cemented hemiarthroplasty for displaced femoral neck fractures: a single-center cohort study of 743 unselected hips with a mean 2.7-year follow-up

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Abstract

Introduction Evidence of whether to use hemiarthroplasty (HA) or total hip arthroplasty for displaced femoral neck fractures (FNF) is still widely debated, especially when taking ambulatory status, age, and patient cognitive status into account. The current study aims to report the rates of dislocations, revisions and other complications for primary cemented HA in patients with displaced FNF.

Materials and methods Single-center retrospective follow-up study of an unselected historic cohort. 743 consecutive hips (551 W and 192 M) at mean (SD) age of 83.6 (8.4) years received primary cemented HA for displaced FNF by posterolateral surgical approach between January 2012 and December 2019. Patient files and radiographs were evaluated for dislocations, revisions, and other complications until death or end of the follow-up period, and the educational level of the surgeon was noted.

Results During a mean (SD) follow-up period of 2.7 (2.2) years, there were 6.1% ($n=45$) dislocations, in which 82% (first dislocation) appeared within the first 30 postoperative days, and 51% ($n=23$) of the dislocations requiring subsequent surgery. At the time of the last available follow-up, 57% ($n=421$) of the patients were dead. A non-dislocation related revision was needed in 3.4% ($n=25$) of the patients [in which infection accounted for 40% ($n=10$) and traumatic periprosthetic fracture for 32% ($n=8$)]. Thirty-day mortality was 9.2% and 1-year mortality 25.8%. There were no differences in patient's age, gender, or educational level of the surgeon between the dislocation and the no dislocation groups. Patients aged < 70 years presented with a higher dislocation rate ($p<0.001$) than the patients aged > 70 years.

Conclusion Primary HA presents a safe and robust approach with acceptable complication rates in a genuine unselected cohort of displaced FNF, particularly for patients aged > 70.

Keywords Femoral neck fracture · Hemiarthroplasty · Dislocations · Complications · Mortality

Introduction

Hip fractures are common and constitute a sizeable burden for the existing and future health care system, particularly with the increasing life expectancy [24]. By 2050, it is globally projected that more than 6 million hip fractures will be accounted for annually [4]. Femoral neck fractures (FNF) represent approximately 50% of all hip fractures. In cases of displaced FNF (classified as Garden type III or IV [11]) and when femoral head preservation is not applicable, it is generally appreciated that treatment should involve joint arthroplasty [9, 10]. Evidence of whether to apply primary HA or THA for displaced FNF is still widely debated, especially when taking ambulatory status, age, life expectancy, and patient cognitive status into account [1, 23].

Patients suffering a displaced FNF are generally considered frail with high hospital demands, decreasing mobility and function as well as an increased risk for complications,

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e.g. dislocations and revisions [22, 28]. The risk of performing secondary surgery in this patient group is a concern for both patients and surgeons and in the event of a complication, many patients may not have the capacity to withstand a subsequent procedure [23]. Therefore, it is important to continuously evaluate the existing evidence and local treatment regimens to provide the optimal treatment for displaced FNF.

At our institution, hemiarthroplasty (HA) bipolar CPT stem was introduced in 1997 as the primary treatment for all displaced FNFs in patients aged > 70 years, reasoned by less complex surgery, expected low dislocation rate, and lower initial costs than that of total hip arthroplasty (THA), enabling sufficient fast-track surgery within 24 h [14]. The current study aims to report the rates of dislocations, revisions, and other complications for primary HA used as the treatment for displaced FNF in an unselected consecutive series of patients during an 8-year period.

Materials and methods

The study design was a single-center retrospective follow-up study of an unselected historic cohort receiving standard treatment with primary cemented HA for radiologically confirmed displaced femoral neck fractures (Garden type III or IV) between January 2012 and December 2019 at Aarhus University Hospital, Denmark. Exclusion criteria were secondary HA (e.g., due to failed internal osteosynthesis), HA due to malignant cancer or metastasis, and foreign status (unable to follow-up). We identified 816 HA procedures during the study period. 73 patients were excluded according to the exclusion criteria, leaving 743 hips (17 bilateral hips, performed in separate procedures) for final evaluation.

In compliance with the Danish hip fracture reference program, primary HA or THA is the standard treatment in Denmark in patients aged > 70 years and in younger patients where the fracture cannot be acceptably reduced for osteosynthesis [6]. Using this age as cut-off, a dislocation subanalysis was performed for patients aged above and below 70 years. Our business intelligence system was searched for the surgical procedure code for insertion of distal cemented hemiarthroplasty component (KNFB12). Retrospective analysis of patient records and radiology were retrieved in October 2020 from the electronic medical report and the radiology program Impax v. 6.5 allowing for retrieval of data of complications encountered from four out of five hospitals with acute orthopedic intake in the Central Denmark Region. All patient files were crosschecked for dislocations, revisions, and other complications until death or end of the follow-up period, and the educational level (residents and specialists) of the surgeon was noted. Pulmonary embolism and deep vein thrombosis were considered to be in relation to HA surgery when occurring within 3 months after the operation.

The surgical procedure was performed by supervised residents in 55% of cases ($n = 406$) and by an orthopedic specialist in 45% of cases ($n = 337$). All patients were operated with the posterolateral approach and completed with capsule repair and resuturing of the external rotators in all cases. All patients received cemented (Palacos bone cement, Haereus Medical GmbH, Wehrheim, Germany) bipolar CPT stem (Zimmer Biomet, Warsaw, Indiana, USA), with a head size (range 22–28 mm) and corresponding shell according to the anatomical size of the extracted femoral head. All patients received a single dose of either dicloxacillin or cefuroxime as intravenous antibiotic prophylaxis before surgery. Tranexamic acid according to weight (10 mg/kg) was used preoperative if preferred. Full weight bearing was initiated as soon as possible after surgery. Postoperative radiographs were taken on the first day after index surgery.

Statistical analysis

The dislocation rate was the primary endpoint. Secondary endpoints included revision rates, mortality (30 days and 1 year), postoperative deep vein thrombosis and pulmonary embolism, associations between dislocation rate and patient age, and the influence of the educational level of the surgeon. A two-sample t test with equal variances was used to test for age differences between the dislocation and non-dislocation groups. The distribution of dislocations related to the educational level of the surgeon and patient gender was tested using a Chi-squared test. Statistical tests were performed using Stata (v. 14.1, StataCorp LLC, College Station, TX, USA).

Ethics

The study was approved by the Danish Patient Safety Authority (registration number 31-1521-407).

Results

Mean (range) follow-up time was 2.7 (0–8.4) years, and mean (range) age at the time of surgery was 82.6 (53.4–103.5) years. Gender distribution; female 74% ($n = 551$), male 26% ($n = 192$) hips. At the time of the last available follow-up, 57% ($n = 421$) of the patients were dead. 30-day mortality was 9.2% ($n = 43$) and 1-year mortality 25.8% ($n = 192$). No iatrogenic fracture was found on the primary postoperative X-ray.

Dislocations

6.1% ($n=45$) of the hips had an event of dislocation with a mean (SD) time to first dislocation of 18 (17) days. Dislocation demographics are presented in Table 1. The mean (range) number of dislocations was 2 (1–5). 49% ($n=22$) of the hips in the dislocation group were solely treated with closed reduction(s). In the remaining 51% ($n=23$) of the hips in the dislocation group, subsequent surgery was needed either with open reduction with/without component replacement ($n=4$), conversion to THA due to recurrent dislocation ($n=14$), Girdlestone procedure ($n=2$) or fractured after closed reduction require conversion to THA ($n=1$). In two cases, we found complication with deep infection and performed revision to THA (Fig. 1). 82% ($n=37$) of the dislocations (first dislocation) occurred within the first 30 postoperative days. No differences in patient's age, gender, or educational level of the surgeon were found between the dislocation and no dislocation group (Table 1).

6.8% ($n=50$) of the hips were aged < 70 years when receiving HA. Of these, 16% ($n=8$) dislocated at least once during the follow-up period, which were higher ($p<0.001$) than the dislocation rate of 5.3% ($n=37$) in the patient group aged > 70 years.

Table 1 Dislocation demographics

	Dislocations	No dislocation	*p* value
No. of hips	45	698	
Mean (range) no. of dislocations	2 (1–5)		
Time to first dislocation Mean days (SD)	18 (17)		
Age Mean years (SD)	81.0 (8.5)	82.7 (8.3)	0.19
Gender (M/F)	15/30	177/521	0.24
Surgeon (supervised residents/orthopedic specialists)	22/23	384/314	0.42

Revisions

3.4% ($n=25$) experienced a hip-related revision due to a non-dislocation complication (Fig. 1).

Other complications

Three patients (0.4%) died during surgery. 4 patients (0.5%) experienced postoperative deep vein thrombosis

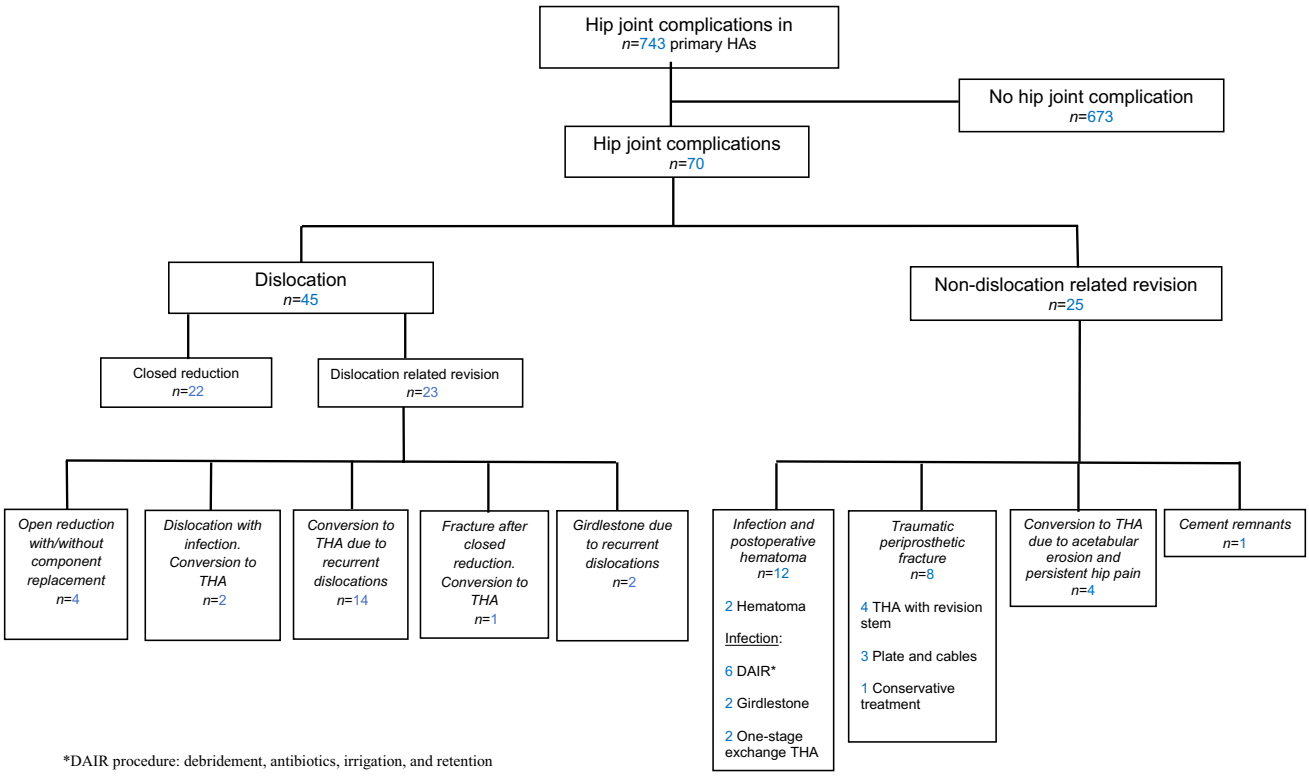

Fig. 1 Patient flow of all hip joint complications following primary hemiarthroplasty for displaced femoral neck fractures. *DAIR procedure: debridement, antibiotics, irrigation, and retention

and 7 patients (0.9%) pulmonary embolism within the first 3 months after surgery.

Discussion

In this consecutive single cohort study of 743 unselected FNF treated with primary cemented HA, we report a dislocation rate of 6.1% ($n=45$) during a mean follow-up period of 2.7 years. Of those, 49% ($n=22$) were solely treated with closed reduction(s), and of the remaining 51% ($n=23$) subsequent surgery was needed. Patients aged < 70 years presented with a higher dislocation rate than the patients aged > 70 years.

HA dislocation rate

Our dislocation rate findings are comparable to a similar retrospective study of 602 consecutive cemented HA hips performed by both supervised residents and orthopedic specialists applying the posterolateral approach (dislocation rate 5.6%) [19]. However, other posterolateral approach cemented HA studies of unselected cohorts report higher dislocation rates; 10% in 101 HA hips (mean age 83.3, mean follow-up 25.4 months) [2], and 10.7% in 373 HA hips (mean age 84, follow-up range 6 months to 7 years) [21]. In turn, one systematic review (411 HA hips), and one multi-center randomized trial comparing THA with HA (723 HA hips), demonstrate dislocation rates as low as 2.4–3% [1, 3]. Notably, Bhandari et al. excluded patients with dementia and only allowed experienced surgeons to participate, while the results from Burgers et al. represent the fit elderly population, and none of these two studies reports or discuss the implication of the surgical approach. As our findings represent a genuine unselected cohort, irrespective of comorbidities and surgeon skill level, and only apply to the posterolateral surgical approach, a direct comparison to these two latter studies seems unequal. At our institution, we apply the posterolateral approach for HA surgery given its advantages of providing a good surgical field overview and simple femur preparation and instrumentation. Furthermore, it is the standard approach used by our hip surgeons performing primary THA and used in approximately 96% of primary THAs in Denmark [5]. The essential limitations of the approach remain an obligate injury of the posterior soft tissue in the hip. For HA surgery, the anterolateral approach has been associated with a lower risk of dislocation in comparison to the posterolateral approach (3% vs 8.5%) [8]. A recent systematic review concluded that the posterolateral approach may be associated with more dislocations in comparison to the direct lateral approach, but presented with less walking problems and lower tendency to abductor insufficiency [27]. Prudently, these differences in dislocation rates across the surgical approaches may be reasoned by the differences in soft tissue damage and thus the stability of the hip. Although the literature might indicate otherwise, the ideal surgical approach remains an interesting and ongoing matter of dispute, and to a wide extent continues to rely on local tradition and surgeon preferences.

The patients < 70 years in our study displayed a higher dislocation rate (16%) in comparison to the patient group aged > 70 years (5.3%), which may be explained by a lower physical activity level and/or higher grade of comorbidities in the patients aged > 70 years [13]. Although this difference was significant, there may be a risk of overestimating this complication due to the low number of patients aged < 70.

Mortality, infections, periprosthetic fractures, and educational level of the surgeon

Our mortality rates are within the recommendations from the Danish National Guideline for Hip Fracture Treatment aiming for 30-day mortality below 10% after hip fractures in general [5]. Notably, our mortality rates are consistent with a comparable Danish cohort treating displaced FNF with primary dual-mobility THA [26] and parallels the Danish Multidisciplinary Hip Fracture Registry of all types of hip fractures, reporting 30-day mortality rates in the range of 10–12% [15].

We found no iatrogenic fractures on the primary postoperative X-ray, traumatic periprosthetic fracture in 1.1% ($n=8$) and revision due to infection in 1.6% ($n=12$) of all operated hips. While several studies fail to report infection rates, our rate of traumatic periprosthetic fracture is considerably lower than reported otherwise [1]. For uncemented HA, a hazard risk ratio of 5.1 on reoperation due to periprosthetic fracture has been reported in comparison to cemented HA [16]. This may partly explain our low traumatic periprosthetic fracture rates as exclusively cemented stems were applied.

Supported by previous HA studies [8, 19], we found no association between the educational level of the surgeon and dislocation rates. As standard practice at our institution, we perform no selection between supervised residents and orthopedic specialists conducting the surgery, and the surgery is often conducted by surgeons from several different orthopedic subspecialties performing on-call duties. Although our practice present acceptable complication rates paralleling the existing literature, pure involvement of experienced surgeons conducting the HA surgery or more structured education of residents, might result in fewer complications [7].

HA vs THA for FNF

In comparison to THA, HA is a faster, less invasive procedure with lower initial costs and has also been associated with lower dislocation rates [3, 14, 20]. However, a recent retrospective study of a comparable patient cohort ($n = 966$ displaced FNF) treated with an anti-dislocation THA dual-mobility cup and primarily by experienced hip surgeons, demonstrated a dislocation rate of only 4.7%. In addition, 0.8% had intraprosthetic dislocation requiring open reduction and liner replacement [26]. Evaluated by the risk of revision, Harris Hip Score and Quality of Life (Short Form 36), a recent review concluded that THA appears to be superior to HA, especially in patients < 80 years and with a life expectancy > 4 years [18].

In total, 3.6% ($n = 27$ hips) were converted to a THA in our follow-up period. It has recently been demonstrated that converting a HA to THA has poorer outcome than primary THA evaluated by adverse outcomes and costs [12]. In our cohort, 0.5% hips ($n = 4$) in the non-dislocation group were converted to THA due to radiological visible acetabular erosion and persistent hip pain, which is lower than reported by Schmitz et al. demonstrating acetabulum wear and a pain conversion rate of 5.6%, although only reported for patients aged under 75 [25]. As patients with FNF are considered frail and the mean age of the patients included in our study is rather high, there is a judicious risk of underestimating this complication [17].

Limitations

The retrospective design may result in a risk of underestimating the complications, as some complications may have encountered outside the four hospitals in the Central Denmark Region and, therefore, not registered. However, given the rather high age and the general frailty of patients with FNF, only a few patients are expected to move outside the Central Denmark Region. Moreover, no control group was included for comparison with a different treatment modality, e.g. THA, and the design did not allow for the registration of patient-reported outcome measures (pain, functional outcome, or quality of life), excluding qualitative assessment of the inserted HA nor any assessment of postoperative walking capabilities. Also, we were not able to evaluate the influence of patient cognitive status and patient specified demographics (e.g. body mass index, osteoporosis status, ASA-classification, etc.) as this was inconsistently described in the electronic medical report. Lastly, diagnosis of pulmonary embolism and deep vein thrombosis were only crosschecked for in the patient files, which introduces an obligate risk of underestimating these complications.

Conclusion

In summary, this study adds further to the evidence of treating displaced FNF. Primary HA presents a safe and robust treatment option, particularly for patients aged > 70, with acceptable complication rates in a normal clinical practice set-up, allowing for supervised residents to perform the surgery without increasing the dislocation risk. Our study promotes further curious discussion to the continuous debate regarding the optimal treatment for FNF, and to the definition of an exact optimal cut-off in which clinical situations HA is superior to THA, and vice versa. As our study population represents a genuine unselected cohort, our findings may readily be extrapolated, but we encourage future high-quality prospective studies conducting strict, thorough, and individual preoperative patient assessments when evaluating various treatment arms for the heterogeneous group of patients with displaced FNF rather than local preferences and traditions [23].

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Declarations

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

Ethical approval The study was approved by the Danish Patient Safety Authority (registration number 31–1521-407).

Informed consent Not applicable.

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