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Do Dual-Mobility Cups Reduce the Risk of Dislocation in Total Hip Arthroplasty for Fractured Neck of Femur in Patients Aged Older Than 75 Years?

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ABSTRACT

Background: Total hip arthroplasty (THA) for intracapsular neck of femur (NOF) fracture remains debatable as it is associated with higher rates of dislocation, notably in the older part of the population. We hypothesized this risk could be limited using dual-mobility cups (DMCs).
Methods: Eighty-two patients (83 hips) aged older than 75 years underwent DMC-THA using a posterolateral approach for an intracapsular NOF fracture.
Results: Clinical data were collected in 45 patients at a mean of 23.8 ± 9.4 months (12.1-42 months). The mortality rates were 19% (16 patients) and 36.5% (30 patients) at 1 year postoperatively and at the last follow-up, respectively. Postoperatively, there were 2 dislocations of the large articulation (4.4%) and one intraprosthetic dislocation (2.2%), all related to technical errors. Functional results were rated at least good in 71% cases, whereas the Parker and Devane scores were stable, indicating optimal restoration of autonomy and physical activity.
Conclusion: Although technically demanding, DMC-THA may prevent dislocation in intracapsular NOF fracture in elderly patients, while consistently limiting the risk of loss of independence.

The number of hip fractures is increasing in parallel with both population aging and with prevalence of osteoporosis in developed countries [1]. It is expected to increase from less than 2 million in 1990 to 3.9 to 6 million by 2050 worldwide, with more than 700,000 in the United States [1,2]. Fragility neck of femur (NOF) fractures are not only associated with increased morbidity and mortality but also with consistent risks of loss of independence, as a result of impaired mobility and function.

Treatment of patients with displaced intracapsular NOF fractures represents a challenge for the orthopedic surgeon. Various treatment modalities have been proposed, including internal fixation, unipolar or bipolar hemiarthroplasties (HAs) and total hip arthroplasties (THAs). Today, it is accepted that replacement arthroplasty is the treatment of choice for patients sustaining a displaced fragility NOF fracture because it allows early mobilization and full weight bearing [3,4]. HA is associated with shorter operative times and less perioperative blood loss, as compared with THA. On the other hand, THA results in better function with increased walking distance and improved Harris Hip Score [5] and is reportedly associated with decreased reoperation rates [6-9]; however, the use of THA as primary treatment for displaced NOF fracture is associated with higher dislocation rates than HA [8]. Specifically, older patients with mental dysfunction and potential muscle impairment treated with THA are at increased risk of prosthetic instability [10].

The dual-mobility cup (DMC) was designed in the 1970s by Pr G.Bousquet for patients at high risk of postoperative instability [11]. A DMC combines a large articulation, between the metallic shell and the mobile polyethylene (PE) insert, with a small articulation between the insert and the prosthetic head. This concept allows greater range of motion, while reducing the risk for instability by limiting the impingement between the head and the cup. The DMC concept has been proven efficient in the treatment and prevention of instability both in primary and revision THA [12,13]. Cemented and cementless methods of fixation of the cup are available [12,14,15]. Although the original Bousquet design was abandoned because of an unacceptable loosening rate [16-19], current cementless DMC designs have provided reliable results with no radiographic loosening of the cup at 3- to 6-year follow-up in primary THA [14,20,21].

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Little is currently known about the potential benefit of using a DMC-THA combining a cementless cup and a cemented stem in patients with a NOF fracture, specifically older patients with higher risk of prosthetic instability. We therefore asked whether DMCs would result in low THA dislocation rates in the treatment of patients aged older than 75 years with a NOF fracture. We also examined the specific complications of the DMC-THA in this group, as well as the postoperative function and restoration of autonomy.

Patients and Methods

Investigational review board approval was not required for this study because it was a retrospective review of patients who were followed up as part of routine clinical care. From December 2009 to December 2011, 155 hip arthroplasties were performed for a fragility NOF fracture at our institution. Inclusion criteria for the present study were as follows: (1) a displaced intracapsular NOF fracture Garden class III or IV treated with a DMC-THA combining a cementless cup and a cemented stem; (2) age older than 75 years; and (3) a minimum 1-year follow-up. All patients or their representatives gave informed consent for participation in this study.

Eighty-two patients (83 hips) were enrolled, including 59 women and 23 men, with a mean age of 86.7 ± 5 years (range, 76.4-98.3 years). One patient underwent a bilateral procedure. No hip in the study had undergone surgery previously. Mean body mass index (BMI) was 22.3 ± 3.8 kg/m^2 (range, 15.4-35.2 kg/m^2). The mean American Society of Anesthesiologists (ASA) score was 2.44 ± 0.57 (range, 1-4). Fifty patients (60%) had at least one severe medical condition, such as Alzheimer disease, dementia, or chronic heart failure. Mean preoperative Parker mobility score was 5.6 ± 2.6 (1-9) [22], whereas the mean Devane activity score was 1.8 ± 0.8 (1-3) [23]. Using Charnley classification [24], 57 patients were classified as "A", 15 as "B," and 10 as "C."

Ten orthopedic surgeons in one institution participated in the study. The mean delay between hospital admission and surgery was 1.34 ± 1.04 day (range, 0-6 days). The surgical approach was posterolateral in all cases. The piriformis tendon insertion was systematically preserved. Neither reconstruction of the posterior capsule nor reinsertion of the other external rotators was done during closing. All patients received a hemispherical cementless DMC. Two types of DMCs were used in this series: Stafit (titanium spray on cobalt-chromium; Zimmer, Warsaw, IN; n = 55) and ADM (anatomic design, porous coating of hydroxyapatite, and titanium spray on cobalt-chromium; Stryker, Mahwah, NJ; n = 28). The mean external diameter of the shell was 50.6 ± 3 mm (median, 50 mm; range, 46-58 mm). The mobile insert was hemispherical, of ultra-high molecular weight PE, and sterilized under vacuum. The inner diameter (the small articulation) was 28 mm in all but 3 cases. In the latter, a 22.2-mm diameter head was used in small-diameter shells (46 mm) to obtain a minimal 10-mm PE thickness. A skirtless cobalt–chromium head was used in 80 cases, and a ceramic head in 3 cases (Zimmer), depending on the preference of the surgeon. A cemented femoral stem (Exafit, Zimmer), with a 10/12 Morse cone, was systematically used. The insert and the prosthetic head were articulated on the operating table according to the manufacturer's recommendations. The mean length of surgery was 82 ± 27 minutes (median, 79 minutes; range, 46-97 minutes). All patients were given a second generation cephalosporin (Cefamandol) preoperatively and for 24 hours after surgery as a prophylaxis for infection. In the absence of contraindication, patients received thrombosis prophylaxis using low-molecular-weight heparin for a 35-day period after surgery, as well as stockings and early mobilization. Full weight bearing was allowed from the day after surgery. Patients were trained by physiotherapists in our department. Patients were discharged from the hospital after a mean stay of 14.1 ± 11.1 days (median 11 days, range, 1-87 days) and admitted to a postoperative care center.

Clinical evaluation was conducted at the last follow-up by one observer (J.S.) who did not participate in surgery, using the Merle d'Aubigné hip score [25] and the Charnley classification. Mobility was evaluated using Parker mobility score. Level of activity was assessed using Deane activity scale. General and specific complications, such as intraprosthetic dislocation (IPD), were recorded from the medical records.

Serial radiographs (anteroposterior pelvis and lateral view of the hip) were analyzed by the same independent observer. Last follow-up radiographs were compared with the immediate postoperative and intermediate radiographs. The position of the cup relative to the horizontal and vertical teardrop lines, the inclination of the cup (measured as the angle between a line through the long axis of the cup and the inter-tear drop line on the anteroposterior radiographs), and the presence and progression of radiolucent lines according to the zones described by DeLee and Charnley [26] were evaluated on the pelvic side. Cup anteversion was evaluated on the lateral radiograph as the angle formed by the intersection of a line drawn across the face of the acetabulum and a line perpendicular to the horizontal plane [27]. In case of dislocation, cup anteversion was systematically measured on a computed tomography (CT) scan. Loosening of the cup was defined as cup migration exceeding 3 mm, angular rotation exceeding 3°, or a continuous radiolucent line wider than 2 mm. On the femoral side, the progression of radiolucent lines if present were noted, according to the 7 zones described by Gruen et al [28], as well as calcar resorption, and subsidence of the stem. Loosening of the stem was defined using Engh criteria [29]. Periprosthetic darkened and expanding areas in which no trabeculae were visible were defined as osteolytic lesions. Heterotopic ossifications were graded according to the Brooker classification [30].

Continuous variables (age, BMI, cup inclination and anteversion, autonomy, activity, and functional scores) were expressed as mean ± standard deviation and range. Categorical variables (sex, complications, Charnley classification, and radiolucent lines) were expressed as frequency and percentage. We evaluated differences in categorical variables using the chi-square test or Fisher's exact test where appropriate. The differences between preoperative and postoperative functional scores, activity, and mobility scores were analyzed using the paired Wilcoxon test. The level of statistical significance was set at $P < .05$. Univariate and multivariate logistic regression analysis was used to determine the influence of patient-based factors such as age, gender, BMI, comorbidity, and technical factors such as implant positioning on the occurrence of postoperative surgical and medical complications.

Results

Of the initial group, 30 patients (31 hips; 36.5%) died, at a mean 13.7 ± 11 months after surgery (range, 0-36 months), with 16 patients (16 hips; 19%) deceased within the first postoperative year. The vast majority of deaths were caused by cardiac or respiratory failure. Seven patients (7 hips) were lost to follow-up, leaving 45 patients available for the present study. The minimum follow-up was 12 months (mean, 24 months; median, 23 months; range, 12-42 months).

Complications

There were 3 dislocations in the current series (6.7%): 2 dislocations of the large articulation (4.4%) and 1 IPD (2.2%; Fig. 1). Large-articulation dislocations occurred in 2 female patients, aged 79 and 88 years, 6 and 10 days after surgery, respectively. Both