Short-term results after total hip arthroplasty using dual-mobility acetabular cup on geriatric patients with femoral neck fracture

Abstract—Rate of femoral neck fractures (FNF) increases exponentially with age, meanwhile when they affect geriatric patients, they are associated with high levels of functional deficiency and mortality. Studies find that hip arthroplasty is the method of choice for treatment of displaced FNF. One option regarding the increased risk of postoperative dislocation in these patients is the dual-mobility acetabular cup (DMAC). The aim of our study is to assess the functional outcome, joint stability and complication rate after total hip arthroplasty (THA) using DMAC on geriatric patients with FNF. In the study were included 390 patients with a mean follow-up period of 31.2 months. No cases of dislocation or intraprosthetic dislocation were encountered. Displaced FNF can successfully be treated with THA using DMAC, as it provides excellent stability and function, as well as low risk of revision surgery.

Keywords—total hip arthroplasty, dual-mobility acetabular cup, femoral neck fracture, geriatric patients

1 Introduction

The geriatric population is the fastest growing demographic in the world, and with it the incidence of femoral neck fracture (FNF) increases exponentially. These fractures are associated with high levels of functional deficiency and mortality in geriatric patients, and in most of them they occur as a result of low-energy fall from their own height. Also, often times they are a main cause of chronic pain and disability, and additionally a psychological burden to these patients. Aside from the standard risk factors for FNF, such as female sex, family history for osteoporosis, unhealthy lifestyle with increased BMI, smoking and bad nutrition, there are specific ones in geriatric patients which are age-related. Examples are loss in balance, disturbance in eyesight and coordination, as well as muscle weakness and side effects from medication.

A main goal of treating these fractures is early mobilisation. Surgical options for this are reduction and internal fixation, hemiarthroplasty or total hip arthroplasty (THA).
The choice for treatment is complex, depending not only on the type of fracture, but also on the general functional status of the patient and his expectations, as well as on the surgeon’s experience. The latest guideline of the American Academy of Orthopaedic Surgeons (AAOS) strongly recommends hip arthroplasty (hemiarthroplasty or THA) for displaced FNF, and in well-selected patients it is the preferred choice\(^5\). Several studies point out that displaced FNF in geriatric patients have better outcomes after hip arthroplasty than internal fixation\(^6\)-\(^9\). Meanwhile these patients have a higher tendency for post-operative complications, such as dislocation, compared to patients that undergo elective hip replacement, because of the more common muscle weakness, cognitive and neurological deficiency, as well as falls from own height.

The principle of the dual-mobility acetabular cup (DMAC) is developed in 1974, France by prof. Gilles Bousquet. It is comprised of a small head (22.2/28mm), attached in a moveable way to a larger polyethylene liner, which on the other hand articulates with a metal acetabular capsule. This way the functional range of motion is increased and the risk of dislocation decreases\(^11, 12\).

The aim of our study is to assess the functional outcome in geriatric patients with FNF who underwent THA with DMAC, to evaluate the stability of the joint and the rate of complications- dislocation, infection, loosening and periprosthetic fractures.

### 2. Materials and methods

For the period June 2018- October 2022, in UMHAT “St. Anna”- Sofia, in total 450 operations for THA with DMAC were performed, on 441 patients, aged ≥70 years who experienced a FNF. Regarding sex 328 (74.4%) of them are female and 113 (25.6%) male with mean age 79.24±5.71 SD years. For fixation methods 225 (45.6%) of them are cemented, 78 (17.3%) cementless, 158 (35.1%) reverse-hybrid (cemented acetabular cup and cementless stem) and 9 (2%) hybrid (cementless acetabular cup and cemented stem) (tabl.1). In this retrospective study the mean follow-up period is 31.2 months, with a minimal of 12 months and a maximum of 64 months. In total 51 (11.6%) of the patients were lost to the minimal follow-up period. The surgical approach which was used is a lateral modified “Hardinge”. The rehabilitation programme included breathing exercises, analytical exercises for the musculature of lower limbs, staged verticalisation and tuition on walking with or without walking aid (WA), depending on the manual muscle testing (MMT) of the lower limbs. The exercises were performed at least once daily, with given recommendations to be performed as often as possible, more continuosly and more intensely. For radiographic evaluation patients were brought to a checkup on the 30th day of surgery, on the 6th and 12th month, and after that once a year. Functional status was examined using the “Harris Hip Score” system (HHS). The patients underwent a mean hospital stay of 7 days. Low molecular weight heparin was applied to all patients for DVT prophylaxis.
3. Results

For a medium-term follow-up period of 31.2 months we did not encounter any cases of dislocation or intraprosthetic dislocation. Aseptic loosening of a cemented DMAC occurred in two patients (0.5%), at the 7th and 12th month. Eventually they were subjected to a single-stage revision with implementing a cementless DMAC (fig.1).

![Aseptic loosening](image1.jpg)

**Fig. 1.** Aseptic loosening

We encountered two cases (0.5%) of periprosthetic joint infections, treated by staged revision with an antibiotic spacer (gentamycin), followed by insertion of new components (fig.2).

![Periprosthetic joint infection](image2.jpg)

**Fig. 2.** Periprosthetic joint infection
In one of those patients augmentation with an anti-protrusion cage was required. One patient who had DMAC with cementless fixation (0.3%), experienced a periprosthetic femur fracture, type B3 Vancouver, after a fall from own height. Later on revision was performed using a modular cementless revision stem (fig.3).

At the latest radiographic checkup, none of the other patients had changes in implant positioning, compared to the 30th-day postoperative x-ray. There were no signs of progressive radiolucent lines. The functional result was excellent with a mean Harris Hip Score of 86.1 (tabl.2).

**Table 2. Results**

<table>
<thead>
<tr>
<th>Results</th>
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<tbody>
<tr>
<td>Harris Hip Score</td>
<td>86.1</td>
</tr>
<tr>
<td>Dislocation/ intraprosthetic dislocation</td>
<td>0</td>
</tr>
<tr>
<td>Aseptic loosening</td>
<td>2 (0.5%)</td>
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<tr>
<td>Periprosthetic joint infection</td>
<td>2 (0.5%)</td>
</tr>
<tr>
<td>Periprosthetic fracture</td>
<td>1 (0.3%)</td>
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4. Discussion

Randomised studies have compared the main methods of treatment of FNF, namely THA to hemiarthroplasty and internal fixation, and have found superior results in healthy geriatric patients who had undergone THA\textsuperscript{8,13-17}. Middleton et al. demonstrated excellent medium-term results of THA after FNF in geriatric patients\textsuperscript{18}. There is a small number of studies in the literature about treatment of displaced FNF using DMAC. Some of them show a very low dislocation rate\textsuperscript{19}, while others coincide with our result\textsuperscript{20}, namely no dislocations.

Instability continues to be a serious complication of THA, as studies have found that it is the main reason for revision in the US (22.5\%)\textsuperscript{21}. The cumulative risk of dislocation after THA increases in age >70 years. In the current study the mean age at time of surgery is 79.24±5.71 SD years. The DMAC is showing to be an excellent choice in primary THA where the dislocation risk is high (comorbidity with neurological illnesses, muscle weakness, cognitive deficiency, etc.), especially in this specific group of patients\textsuperscript{22}. It is proven that DMAC effectively lowers the risk of dislocation, increases range of motion and overall stability\textsuperscript{23}. Because of its specific design, postoperative restrictions in range of motion, typical for standard-cup THA, dropped out in our patients. On day one postoperatively they could flex the affected limb over 90° in the hip joint, be verticalised without any WA, or using one WA, depending on the pain syndrome, muscle status in the lower limbs and their mental condition. In this case our results correlated with similar other studies\textsuperscript{23,24,25}.

In the past, premature wear of the polyethylene liner was thought to be a specific disadvantage of DMAC. The consequences of such wear could lead to the so-called intraprosthetic dislocation (separation of the small head from the liner), a complication typical only for DMAC\textsuperscript{26}. These fears were based on the results of the first generation dual-mobility acetabular cups, observed in the long-term. Studies show that contemporary versions of DMAC provide a new coating of the metal capsule, with an optimised surface for osseointegration, as well as loosening resistance, comparable to standard acetabular cups. Furthermore, the quality of the polyethylene is significantly improved, being highly cross-linked, which prevents premature wear\textsuperscript{23,27}.

5. Conclusion

Femoral neck fractures in geriatric patients are a main problem, since they are associated with functional deficiency, disability and high mortality rate. They can successfully be treated with THA using DMAC, as it provides excellent stability and function. Our study also found that the risk of revision surgery using this treatment method is low.
6. References


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