

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

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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^{1, 2}. 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 patients³. 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 medication⁴.

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 choice⁵. Several studies point out that displaced FNF in geriatric patients have better outcomes after hip arthroplasty than internal fixation⁶⁻¹⁰. 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 continuously 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.

Operations for TTA with DMAC: 450 (441 patients)		
Parameter	N	%
Mean age	79.24±5.71 SD	
Sex	Male 113	25.6
	Female 328	74.4
Fixation method	Cemented 225	45.6
	Cementless 78	17.3
	Hybrid 9	2
	Reverse-hybrid 158	35.1
Follow-up (months)	31.2 (12-64)	

Table 1. Materials and methods

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).



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).

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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).



Fig.3. Periprosthetic fracture

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

Results	
Harris Hip Score	86.1
Dislocation/ intraprosthetic dislocation	0
Aseptic loosening	2 (0.5%)
Periprosthetic joint infection	2 (0.5%)
Periprosthetic fracture	1 (0.3%)

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^{8, 13-17}. Middleton et al. demonstrated excellent medium-term results of THA after FNF in geriatric patients¹⁸. 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 rate¹⁹, while others coincide with our result²⁰, 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%)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 patients²². It is proven that DMAC effectively lowers the risk of dislocation, increases range of motion and overall stability²³. 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^{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 DMAC²⁶. 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^{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

1. A Kannus P, Niemi S, Parkkari J, Palvanen M, Vuori I, [Järvinen](#) M. Nationwide decline in incidence of hip fracture. *J Bone Miner Res*. 2006. PMID: 17002578
2. Ju DG, Rajae SS, Mirocha J, Lin CA, Moon CN. Nationwide Analysis of Femoral Neck Fractures in Elderly Patients: A Receding Tide. *J Bone Joint Surg Am*. 2017 Nov 15;99(22):1932-1940. doi: 10.2106/JBJS.16.01247
3. Salkeld G, Cameron ID, Cumming RG, Easter S, Seymour J, Kurrle SE, Quine S. Quality of life related to fear of falling and hip fracture in older women: a time trade off study. *BMJ*. 2000 Feb 5;320(7231):341-6. doi: 10.1136/bmj.320.7231.341
4. Hippisley-Cox J, Coupland C. Derivation and validation of updated QFracture algorithm to predict risk of osteoporotic fracture in primary care in the United Kingdom: prospective open cohort study. *BMJ*. 2012 May 22;344:e3427. doi: 10.1136/bmj.e3427
5. American Academy of Orthopaedic Surgeons. Management of Hip Fractures in Older Adults, Evidence-Based Clinical Practice Guideline, Adopted by: The American Academy of Orthopaedic Surgeons Board of Directors. December 3, 2021
6. Bhandari M, Devereaux PJ, Swiontkowski MF, Tornetta P 3rd, Obremskey W, Koval KJ, Nork S, Sprague S, Schemitsch EH, Guyatt GH. Internal fixation compared with arthroplasty for displaced fractures of the femoral neck. A meta-analysis. *J Bone Joint Surg Am*. 2003 Sep;85(9):1673-81. doi: 10.2106/00004623-200309000-00004
7. Bhandari M, et al. Operative management of displaced femoral neck fractures in elderly patients. An international survey. *J Bone Joint Surg Am*. 2005 Sep;87(9):2122-30. doi: 10.2106/JBJS.E.00535
8. Blomfeldt R, Törnkvist H, Ponzer S, Söderqvist A, Tidermark J. Comparison of internal fixation with total hip replacement for displaced femoral neck fractures. Randomized, controlled trial performed at four years. *J Bone Joint Surg Am*. 2005. Aug;87(8):1680-8. doi: 10.2106/JBJS.D.02655
9. Healy W, Iorio R. Total hip arthroplasty: optimal treatment for displaced femoral neck fractures in elderly patients. *Clin Orthop Relat Res*. 2004 Dec;(429):43-8
10. Rogmark C, et al. A prospective randomised trial of internal fixation versus arthroplasty for displaced fractures of the neck of the femur. Functional outcome for 450 patients at two years. *J Bone Joint Surg Br*. 2002 Mar;84(2):183-8. doi: 10.1302/0301-620x.84b2.11923
11. Grazioli A, Ek ET, Rüdiger HA. Biomechanical concept and clinical outcome of dual mobility cups. *Int Orthop*. 2012 Dec;36(12):2411-8. doi: 10.1007/s00264-012-1678-3
12. Stroh A, Naziri Q, Johnson AJ, Mont MA. Dual-mobility bearings: a review of the literature. *Expert Rev Med Devices*. 2012 Jan;9(1):23-31. doi: 10.1586/erd.11.57
13. Keating JF, Grant A, Masson M, Scott NW, Forbes JF. Randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty. Treatment of displaced intracapsular hip fractures in healthy older patients. *J Bone Joint Surg Am*. 2006 Feb;88(2):249-60. doi: 10.2106/JBJS.E.00215.
14. Hopley C, Stengel D, Ekkernkamp A, Wich M. Primary total hip arthroplasty versus hemiarthroplasty for displaced intracapsular hip fractures in older patients: systematic review. *BMJ*. 2010 Jun 11;340:c2332. doi: 10.1136/bmj.c2332.
15. Macaulay W, Nellans KW, Garvin KL, Iorio R, Healy WL, Rosenwasser MP. Prospective randomized clinical trial comparing hemiarthroplasty to total hip arthroplasty in the treatment of displaced femoral neck fractures: winner of the Dorr Award. *J Arthroplasty*. 2008 Sep;23(6 Suppl 1):2-8. doi: 10.1016/j.arth.2008.05.013

16. Ravikumar KJ, Marsh G. Internal fixation versus hemiarthroplasty versus total hip arthroplasty for displaced subcapital fractures of femur--13 year results of a prospective randomised study. *Injury*. 2000 Dec;31(10):793-7. doi: 10.1016/s0020-1383(00)00125-x.
17. Mouzopoulos G, Stamatakis M, Arabatzi H. The four-year functional result after a displaced subcapital hip fracture treated with three different surgical options. *Int Orthop*. 2008 Jun;32(3):367-73. doi: 10.1007/s00264-007-0321-1. Epub 2007 Mar 13
18. Middleton SD, McNiven N, Anakwe RE, Jenkins PJ, Aitken SA, Keating JF, Moran M. Medium-term patient-reported outcomes after total hip replacement for displaced hip fractures. *Eur J Orthop Surg Traumatol*. 2017 Oct;27(7):917-921. doi: 10.1007/s00590-017-1907-y. Epub 2017 Jan 25.
19. Adam P, Philippe R, Ehlinger M, Roche O, Bonnomet F, Molé D, Fessy MH. Dual mobility cups hip arthroplasty as a treatment for displaced fracture of the femoral neck in the elderly. A prospective, systematic, multicenter study with specific focus on postoperative dislocation. *Orthop Traumatol Surg Res*. 2012 May;98(3):296-300. doi: 10.1016/j.otsr.2012.01.005. Epub 2012 Mar 29.
20. Tarasevicius S, Busevicius M, Robertsson O, Wingstrand H. Dual mobility cup reduces dislocation rate after arthroplasty for femoral neck fracture. *BMC Musculoskelet Disord*. 2010 Aug 6;11:175. doi: 10.1186/1471-2474-11-175.
21. De Martino I, D'Apolito R, Soranoglou VG, Poultsides LA, Sculco PK, Sculco PT. Dislocation following total hip arthroplasty using dual mobility acetabular components: a systematic review. *Bone Joint J*. 2017 Jan;99-B(ASuppl1):18-24. doi: 10.1302/0301-620X.99B1.BJJ-2016-0398.R1.
22. Bloemheuvel EM, Steenbergen LN, Swierstra BA. Dual mobility cups in primary total hip arthroplasties: trend over time in use, patient characteristics, and mid-term revision in 3,038 cases in the Dutch Arthroplasty Register (2007-2016). *Acta Orthop*. 2019 Feb;90(1):11-14. doi: 10.1080/17453674.2018.1542210. Epub 2018 Nov 19.
23. Blakeney WG, Epinette JA, Vendittoli PA. Dual mobility total hip arthroplasty: should everyone get one? *EFORT Open Rev*. 2019 Sep 3;4(9):541-547. doi: 10.1302/2058-5241.4.180045. eCollection 2019 Sep.
24. C. Assi, E. El-Najjar, C. Samaha, and K. Yammine, "Outcomes of dual mobility cups in a young Middle Eastern population and its influence on life style," *Int Orthop*, vol. 41, no. 3, pp. 619–624, Mar. 2017, doi: 10.1007/s00264-016-3390-1.
25. J. E. Farey et al., "Dual mobility versus conventional total hip arthroplasty in femoral neck fractures (DISTINCT): protocol for a registry-nested, open-label, cluster-randomised crossover trial," *BMJ Open*, vol. 12, no. 9, Sep. 2022, doi: 10.1136/bmjopen-2022-064478.
26. Fahad S, Nawaz Khan MZ, Aqueel T, Hashmi P. Comparison of bipolar hemiarthroplasty and total hip arthroplasty with dual mobility cup in the treatment of old active patients with displaced neck of femur fracture: A retrospective cohort study. *Ann Med Surg (Lond)*. 2019 Jul 13;45:62-65. doi: 10.1016/j.amsu.2019.07.025. eCollection 2019 Sep.
27. Gaillard R, Kenney R, Delalande JL, Batailler C, Lustig S. Ten- to 16-Year Results of a Modern Cementless Dual-Mobility Acetabular Implant in Primary Total Hip Arthroplasty. *J Arthroplasty*. 2019 Nov;34(11):2704-2710. doi: 10.1016/j.arth.2019.06.051. Epub 2019 Jun 28.

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