



Research article

The association of dual-mobility total hip arthroplasty with dislocation compared to conventional hip arthroplasty for neck of femur fracture

Matthew C.A. Arnold*, John W. Kennedy, Evan Wright, Madeleine Reece and R.M. Dominic Meek

Department of Trauma and Orthopaedics, Queen Elizabeth University Hospital, 1345 Govan Road, Glasgow G51 4TF, UK

* **Correspondence:** Email: matthew.arnold@doctors.org.uk.

Abstract: Introduction: Neck of femur fractures are extremely common worldwide and have a mortality rate of 15% at 1 year. Dual-mobility cups (DMCs) have demonstrated a reduction in dislocation and revision rates for elective total hip arthroplasty (THA) but the benefits of DMC use in neck of femur fractures are less clear. The aim of this study was to compare the rate of dislocation between conventional and DMC THA following neck of femur fracture. **Materials and methods:** Data was retrospectively collected for patients who received either DMCs or standard acetabular components for neck of femur fractures at our institution. Patients were excluded if they had less than 2 years follow-up. Dislocation and revision rates were collected for all patients in addition to radiographic analysis to assess for loosening. **Results:** Data was collected for 39 patients with DMCs and 95 patients with conventional THA. Two patients with DMCs suffered a dislocation (5.1%) compared to 7 patients (7.3%) who underwent a conventional THA ($p = 0.49$). Both patients in the DMC group had additional risk factors for dislocation. One DMC patient required revision surgery for dislocation and one conventional THA patient underwent a revision for aseptic loosening. There were no cases of radiographic loosening in the DMC group. **Conclusions:** Our study showed a trend towards lower dislocation rates in patients treated with a DMC compared to conventional THA. Although there are potential issues associated with DMC implants and cost implications, this study suggests they may be advantageous in patients at high risk for dislocation.

Keywords: total hip arthroplasty; dual-mobility cup; dislocation; neck of femur fracture

1. Introduction

Neck of femur fractures are one of the commonest orthopaedic injuries worldwide, with the incidence expected to rise due to the ageing population [1]. These injuries are significant, with a mortality rate of 15% at 1 year according to the National Hip Fracture Database in 2020 [2]. Treatment modality is based on both fracture and patient specific factors, which include fracture fixation or total/partial replacement of the joint. Although total hip arthroplasty (THA) has been found to provide improved functional outcomes compared to hemiarthroplasty, it comes at the cost of an increased dislocation rate [3].

Dual-mobility cups (DMCs) are designed with two mobile interfaces; a prosthetic head that moves freely within a polyethylene liner that is also mobile within a metal acetabular cup. The concept was introduced in the 1970s by Gilles Bousquet and aimed to combine Charnley's low friction principle and the theory of increased femoral head-neck ratio to improve stability and lower dislocation rate [4–6]. Several studies agree that lower dislocation and revision rates occur in primary hip arthroplasty and revision surgery when using DMCs [7]. However, the evidence for DMC use in neck of femur fractures is comparatively limited. The aim of this study was to compare the rate of dislocation for patients who received a conventional THA to those that received a DMC for neck of femur fracture at our institution.

2. Materials and methods

Institutional Ethical Committee Approval was received from Queen Elizabeth University Hospital Department of Trauma and Orthopaedics. A prospectively collated database was reviewed to identify all patients undergoing THA for neck of femur fracture in which a DMC was utilised between the years 2013–2019. This enabled a minimum of 2 years follow-up. Details of their operation, follow up and outcomes were collected from historical hospital records. A comparative group of 100 patients who underwent THA with standard acetabular components was also established using the same database. Surgeon preference dictated which patients received a DMC during this period, and all operations were performed by a surgeon specialising in hip arthroplasty. Patients who were lost to follow-up prior to 2 years post-operative were excluded. Dislocation and revision rate were determined, and radiographs analysed for evidence of aseptic loosening performed. Results were analysed using a paired student T test with SPSS, with a p value of <0.05 considered significant.

3. Results

Forty-three patients were identified who received a DMC implant (Modular Dual Mobility, Stryker, Newbury, UK) and 100 who received a standard THA. Four patients from the DMC group and five from the conventional THA group died prior to two years follow-up and so were excluded. One additional patient in the DMC group was lost to follow up due to moving to another country. This resulted in 39 patients in the DMC group and 95 in the conventional THA group included in the study. None of the excluded patients suffered a dislocation. All patients were operated on by surgeons who specialised in hip arthroplasty.

The median age for DMC cups was 64 and 69 for conventional THA. 15 patients who received a DMC were male, compared to 30 for conventional THA. All implants were manufactured by Stryker

(Newbury, UK) and patient demographics are shown in Table 1. All patients were followed up for a minimum of 2 years. Mean follow up time was 43 months.

There was a non-significant trend towards a lower dislocation rate in the DMC group, with two dislocations (5.1%) in the DMC group compared to seven patients (7.3%) in the conventional THA cohort ($p = 0.49$). Of the two DMC patients who suffered dislocation, one had a background of a right hemiparesis and the other suffered from balance issues which resulted in a fall and dislocation. Both dislocations occurred within one month of surgery. Regarding the conventional THR patients who suffered a dislocation, three were a result of a fall and two occurred on standing from a seated position. All dislocations occurred within the first year post-operatively. One patient in the DMC group was revised for dislocation, and one from the conventional THA group was revised for aseptic loosening. No patients in the conventional THA group required revision for dislocation. No other cases in either group demonstrated radiographic features of loosening.

Table 1. Patient demographics and implants used.

Demographic	DMC patients	Conventional THR patients	Total
Number of patients included in study	39	95	134
Male gender (%)	15 (38)	30 (32)	45 (33.6)
Median age	64	69	66.5
Stem (%)	Exeter V40 (92)	Exeter v40 (100)	N/A
	Restoration stem (8)		
Head (%)	MDM liner cementless (100)	V40 (77) BioloX Delta (20) LFIT anatomic (3)	N/A
Cup (%)	Trident (100)	Trident (98) XLFit (2)	N/A

4. Discussion

DMCs have shown promising results compared to conventional THA with regard to dislocation rate due to greater inherent stability [7,8]. This characteristic may be particularly desirable in fractured neck of femur patients, for whom dislocation remains significantly higher than elective THA. Reasons for this include older age and increased ligament laxity in patients with a neck of femur fracture [9,10].

We have demonstrated an insignificantly reduced rate of dislocation in DMCs compared to conventional THA in patients with neck of femur fractures. These findings are comparable with other papers. The most recent study demonstrated no incidence of dislocation in 53 patients [11]. A larger study of 241 patients showed a 1.4% incidence of dislocation [8] whilst other authors reported no incidences of dislocation [4] and favourable outcomes when compared with conventional THA [12] and bipolar hemiarthroplasty [13,14]. Nich et al. found a dislocation rate of 6.7% ($n = 45$) [15] and two systematic reviews demonstrated a maximum dislocation rate of 4.6% [16] and 4% [17]; lower than that of conventional THA. In our study, it is also worth noting that both patients in the DMC group who suffered a dislocation had a medical history that pre-disposed them to falling. This contrasts

with the conventional THA group who had no patients with similar predisposing factors. We also found a low incidence of revision rate following DMC THA; however, a large multi-centre study found no reduction in revision risk when a DMC is used compared to THA [18].

Despite encouraging clinical results, concerns have been raised over the increase in polyethylene wear with DMC compared to conventional implants due to the additional articulation surface [19,20]. Additionally, there is the unique complication of intraprosthetic dissociation (IPD), initially demonstrated by Lecuire et al. [19]. This occurs when the mobile insert that holds the femoral prosthetic head is worn, which leads the head to separate from the mobile insert. This complication arising from long-term wear requires revision surgery in almost all cases [21]. Although a serious complication, the incidence is low with reports of large-scale studies ranging from 0.3 to 1.3% [22]. Factors contributing to IPD are thought to be BMI, femoral stem type and the diameter of the acetabular cup used [21].

It is also important to consider the economic implications when choosing an implant, with DMCs costing almost three times more than a conventional THA cup. A cost analysis by Khoshbin et al. suggested that DMCs are cost effective, particularly in younger patients, however, for patients >75 it is not conclusive [23]. A more recent study suggested DMCs were not cost-effective in any patients for the first two years or in patients over 80 years old. However, DMCs become cost-effective for those aged under 80 years between 5 and 15 years [24]. In the most recent systematic review, the average age of patients receiving a DMC was 77.8 years [24] and was 64 in this study.

There are several limitations to this study. First, the sample size was not large. Although comparable to other similar studies in the literature [4,8,11,12] this is likely responsible for the absence of statistical significance in our results. Additionally, although our database is prospectively collated the study design was retrospective and there was no implant randomisation which could lead to bias in the results. In addition, operations were chosen by each individual surgeon which introduces selection bias, however, with comparable demographics, surgical approach and femoral implants, this may have mitigated some of these potential issues.

5. Conclusions

DMCs have demonstrated promising outcomes when utilised for degenerative disease. However, fewer studies have investigated their use in neck of femur fractures. In this study, we showed a non-significant trend towards lower dislocation rates with DMC compared to conventional THA in neck of femur fracture; however, this was statistically insignificant. Whilst there are potential issues associated with DMC implants, such as increased wear, as well as cost implications, our results suggest they may be advantageous in patients at high risk for dislocation.

Use of AI tools declaration

The authors declare that they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

All authors declare no conflicts of interest in this paper.

References

1. Morri M, Ambrosi E, Chiari P, et al. (2019) one-year mortality after hip fracture surgery and prognostic factors: A prospective cohort study. *Sci Rep* 9: 18718. <https://doi.org/10.1038/s41598-019-55196-6>
2. Royal College of Physicians, Facing new challenges—The National Hip Fracture Database report on 2020. London Royal College of Physicians, 2021. Available from: [https://www.nhfd.co.uk/FFFAP/Reports.nsf/0/220AC3A08F5AC22080258789007CCC92/\\$file/NHFD_2021_Report.pdf](https://www.nhfd.co.uk/FFFAP/Reports.nsf/0/220AC3A08F5AC22080258789007CCC92/$file/NHFD_2021_Report.pdf).
3. Iorio R, Healy WL, Lemos DW, et al. (2001) Displaced femoral neck fractures in the elderly: Outcomes and cost effectiveness. *Clin Orthop Relat Res* 383: 229–242. <https://doi.org/10.1097/00003086-200102000-00027>
4. Tarasevicius S, Busevicius M, Robertsson O, et al. (2010) Dual mobility cup reduces dislocation rate after arthroplasty for femoral neck fracture. *BMC Musculoskelet Disord* 11: 175 <https://doi.org/10.1186/1471-2474-11-175>
5. De Martino I, Triantafyllopoulos GK, Sculco PK, et al. (2014) Dual mobility cups in total hip arthroplasty. *World J Orthop* 5: 180–187. <https://doi.org/10.5312/wjo.v5.i3.180>
6. Yang S, Xie F, Cui W, et al. (2021) A review of the clinical and engineering performance of dual-mobility cups for total hip arthroplasty. *Am J Transl Res* 13: 9383–9394.
7. De Martino I, D’Apolito R, Soranoglou VG, et al. (2017) Dislocation following total hip arthroplasty using dual mobility acetabular components: A systematic review. *Bone Joint J* 99: 18–24. <https://doi.org/10.1302/0301-620X.99B1.BJJ-2016-0398.R1>
8. Adam P, Philippe R, Ehlinger M, et al. (2012) 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* 98: 296–300. <https://doi.org/10.1016/J.OTSR.2012.01.005>
9. Slover J, Hoffman MV, Malchau H, et al. (2009) A cost-effectiveness analysis of the arthroplasty options for displaced femoral neck fractures in the active, healthy, elderly population. *J Arthroplasty* 24: 854–860. <https://doi.org/10.1016/J.ARTH.2008.05.008>
10. Hudson JI, Kenzora JE, Hebel JR, et al. (1998) Eight-year outcome associated with clinical options in the management of femoral neck fractures. *Clin Orthop Relat Res* 348: 59–66. <https://doi.org/10.1097/00003086-199803000-00011>
11. Canton G, Moghnie A, Cleva M, et al. (2019) Dual mobility total hip arthroplasty in the treatment of femoral neck fractures: A retrospective evaluation at mid-term follow-up. *Acta Biomed* 90: 98–103. <https://doi.org/10.23750/abm.v90i1-S.8070>
12. Tarasevičius S, Robertsson O, Dobožinskas P, et al. (2013) A comparison of outcomes and dislocation rates using dual articulation cups and THA for intracapsular femoral neck fractures. *23: 22–26*. <https://doi.org/10.5301/HIP.2013.10632>
13. Bensen AS, Jakobsen T, Krarup N (2014) Dual mobility cup reduces dislocation and re-operation when used to treat displaced femoral neck fractures. *Int Orthop* 38: 1241–1245. <https://doi.org/10.1007/S00264-013-2276-8>
14. Mufarrih SH, Qureshi NQ, Masri B, et al. (2021) Outcomes of total hip arthroplasty using dual-mobility cups for femoral neck fractures: A systematic review and meta-analysis. *HIP Int* 31: 12–23. <https://doi.org/10.1177/1120700020926652>

15. Nich C, Vandebussche E, Augereau B, et al. (2016) 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?. *J Arthroplasty* 31: 1256–1260. <https://doi.org/10.1016/j.arth.2015.11.041>
16. Canton G, Moghnie A, Ratti C, et al. (2018) Dual mobility total hip arthroplasty in the treatment of femoral neck fracture: A systematic review of the literature. *Recent Adv Arthroplast* 2: 32–38.
17. Cha YH, Yoo JI, Kim JT, et al. (2020) Dual mobility total hip arthroplasty in the treatment of femoral neck fractures. *Bone Joint J* 102: 1457–1466. <https://doi.org/10.1302/0301-620X.102B11.BJJ-2020-0610.R2>
18. Farey JE, Masters J, Cuthbert AR, et al. (2022) Do dual-mobility cups reduce revision risk in femoral neck fractures compared with conventional THA designs? An international meta-analysis of arthroplasty registries. *Clin Orthop Relat Res* 480: 1912–1925. <https://doi.org/10.1097/CORR.0000000000002275>
19. Lecuire F, Benareau I, Rubini J, et al. (2004) Intra-prosthetic dislocation of the Bousquet dual mobility socket. *Rev Chir Orthop Reparatrice Appar Mot* 90: 249–255. [https://doi.org/10.1016/S0035-1040\(04\)70101-4](https://doi.org/10.1016/S0035-1040(04)70101-4) (Article in French language)
20. Kobayashi S, Takaoka K, Tsukada A, et al. (1998) Polyethylene wear from femoral bipolar neck-cup impingement as a cause of femoral prosthetic loosening. *Arch Orthop Trauma Surg* 117: 390–391. <https://doi.org/10.1007/S004020050274>
21. Neri T, Boyer B, Geringer J, et al. (2019) Intraprosthetic dislocation of dual mobility total hip arthroplasty: Still occurring? *Int Orthop* 43: 1097–1105. <https://doi.org/10.1007/s00264-018-4054-0>
22. Massin P, Orain V, Philippot R, et al. (2012) Fixation failures of dual mobility cups: A mid-term study of 2601 hip replacements. *Clin Orthop Relat Res* 470: 1932–1940. <https://doi.org/10.1007/s11999-011-2213-3>
23. Khoshbin A, Haddad FS, Ward S, et al. (2020) A cost-effectiveness assessment of dual-mobility bearings in revision hip arthroplasty. *Bone Joint J* 102: 1128–1135. <https://doi.org/10.1302/0301-620X.102B9.BJJ-2019-1742.R1>
24. Montgomery S, Bourget-Murray J, You DZ, et al. (2021) Cost-effectiveness of dual-mobility components in patients with displaced femoral neck fractures. *Bone Joint J* 103: 1783–1790. <https://doi.org/10.1302/0301-620X.103B12.BJJ-2021-0495.R2>



AIMS Press

© 2023 the Author(s), licensee AIMS Press. This is an open access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>)