

## ARTHROPLASTY

# Low dislocation rates achieved when using dual mobility cup hip implants for femur neck fractures

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### Abstract

**Background:** Total hip replacements done for intracapsular neck of femur fractures (NOF) have a dislocation rate of up to 14%. This is seven times higher than in total hip arthroplasty (THA) done for osteoarthritis. Using a dual mobility cup (DMC) has been shown to be effective in addressing dislocation in elective THA. Our hypothesis is that the use of DMC in NOF will do the same. This study aims to determine the incidence proportion of dislocation of DMCs one year after surgery in patients who received THA for NOF and to compare it to dislocation rates as documented in existing studies.

**Methods:** A retrospective study was done on 86 patients treated with DMC THA for an intracapsular NOF fracture from 2012 until 2016. A minimum one-year follow-up period was required for inclusion into the study. The number of dislocations at one year after surgery was noted.

**Results:** Forty-one patients with a mean age of 60.7 years were included (26 females and 15 males). All patients were operated via the posterior approach. None of the patients had dislocated after one year.

**Conclusion:** Low dislocation rates can be achieved using DMC THA in the management of intracapsular NOF fractures. Our one-year dislocation rate of 0% compares favourably to conventional THA and is comparable to similar DMC studies done outside of South Africa.

**Level of evidence:** Level 4

**Keywords:** dual mobility cup, neck of femur fracture, dislocation, total hip arthroplasty, intracapsular

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## Introduction

The total hip replacement may have been rated as the best operation of the 20th century, but it is not without its complications.<sup>1</sup> Dislocation of the hip prosthesis post-operatively remains one of the most common complications encountered after total hip arthroplasty (THA). Rates of 1.9% at one year and increasing up to 7% over 25 years have been reported in primary THA.<sup>2</sup> Post-operative dislocations are the indication for surgery in 22.5% of revision cases and, even after revision surgery, 30% of patients will have persistent instability of their hip.<sup>3,4</sup>

The dislocation rate of THA done for fractures is much higher still, and thus of even more concern than in primary THA.

When using the posterior approach for THA done for femur neck fractures, Enocsen found a dislocation rate of 12–14%.<sup>5</sup> This is seven times higher than in primary hip arthroplasty. Hummel reported a dislocation rate of 2–8% when using the anterolateral approach for similar indications.<sup>6</sup> If done for a failed open reduction and internal fixation of a femur neck fracture, 22% of hips dislocated post-operatively.<sup>7</sup> When the patient was also demented, dislocation rates shot up to 32%.<sup>7</sup> As a local comparison, a study done at the University of Cape Town and published in 2018 found a 4.3% risk for early dislocation after total hip arthroplasty for neck of femur (NOF) fractures.<sup>8</sup>

There are several patient risk factors that increase the risk for dislocation after THA. These include dementia, psychiatric disorders, alcohol abuse, age higher than 80 years old, neuromuscular disorders and non-compliance with post-operative movement and rehabilitation instructions.<sup>9,10</sup>

Besides patient risk factors, there are also surgical risk factors that contribute to dislocation. Some of these are the surgical approach used, the positioning of the acetabular and femoral components, soft-tissue tension and the surgeon's experience.<sup>9</sup> Great emphasis was previously placed on putting the implant in the so-called 'safe zone' with the acetabular cup at  $40^{\circ} \pm 10^{\circ}$  inclination and  $15^{\circ} \pm 10^{\circ}$  anteversion.<sup>11</sup> This has recently been found not to be as much of a protective factor as previously thought, with 58% of all hip prosthesis dislocations being in the safe zone. Abdel, who headed the study, concluded that hip dislocations post THA are multifactorial in cause, and a holistic approach needs to be taken to minimise the risk of dislocation.<sup>12</sup>

A modern solution to the problem of dislocation after THA has been suggested, namely the dual mobility cup (DMC). Designed by Prof. Gilles Bousquet and André Rambert in France in 1974, it features two articulations: the acetabular cup with the polyethylene insert and the polyethylene insert with the head of the femoral component.<sup>13-15</sup> It is available in both cemented and uncemented options. This implant has been suggested as an option to reduce dislocation rates in very high-risk patients.

DMCs theoretically decrease dislocation risk for the same reasons a large effective femoral head does. It increases the head-to-neck ratio, allowing for a greater range of motion before impingement starts taking place.<sup>16,17</sup> It also increases jump distance, allowing

for a greater amount of lateral head movement before dislocation takes place.<sup>17</sup>

Some authors recommend caution when using it for standard primary THA and in young patients as there is some concern about increased wear rates and aseptic loosening. This concern is mainly because of the lack of long-term follow-up data and not because high rates of wear or aseptic loosening have actually been found.<sup>13</sup> There may in fact be decreased wear with DMCs as there are two articulating interfaces and thus less friction and sliding at each.<sup>18,19</sup> Regarding real-world outcomes measured thus far, medium-term follow-up of these prostheses has been done by Philippot, who found a very favourable 15-year socket survival rate of 96.3% ( $\pm 3.7\%$ ).<sup>20</sup> Several companies currently offer DMC options for THA. Some examples are shown in *Table 1*.

This study aims to determine whether DMCs used in NOF fractures are a possible solution to the high dislocation rates mentioned above. It intends to do so by retrospectively determining the cumulative incidence of dislocation in our study group at one year post-surgery and then comparing the numbers found to existing studies of dislocations in conventional total hip replacements as well as DMC studies done in other countries.

## Methods

We did a retrospective cohort study at a single tertiary level hospital in Bloemfontein (Universitas Academic Hospital). We identified all the patients who had received DMC hip arthroplasty for intracapsular NOF fractures from July 2012 until December 2016. A total of 86 patients were identified. Electronic records (Meditech) and admission data, clinic files, radiological records and telephonic follow-up were then used to determine whether these patients had dislocated their hips post-operatively. Surgeon experience and the method of implant fixation were also documented.

A minimum follow-up time of one year (at our clinic or telephonic) was required to be included in the study. Patients who did not complete a full year of follow-up at our clinic were phoned to find out whether they had dislocated or not. Patients with incomplete records were excluded from the study. Those who had less than one year of follow-up time and were untraceable telephonically or otherwise were excluded. The Department of Home Affairs assisted in identifying patients who passed away within the first year of surgery. These patients were also excluded. Those who had arthroplasty done for failed open reduction and internal fixation of intracapsular NOF fractures were also excluded. Age was not an exclusion criterion. Some younger patients received DMC hip arthroplasty because of a high risk for dislocation. This decision was at the discretion of the attending consultant.

After determining the cumulative incidence of dislocations in our study group, we planned to compare our numbers to those of existing studies on hip dislocation in standard and DMC hip arthroplasty done for intracapsular NOF fractures.

All patients had a primary hip arthroplasty with a Polarcup<sup>®</sup> prosthesis. This product is manufactured by Smith & Nephew

**Table 1:** Dual mobility cups available

Company	Trade name	HXPE*	Cemented	Head sizes (mm)
Smith & Nephew	Polarcup	Yes	Yes	22, 28
Tornier	Dual Mobility Cup	Yes	Yes	22, 28
Stryker	Mobile Hip System	Yes	Yes	22, 28
Zimmer-Biomet	Avantage Active Articulation	Yes Yes	Yes No	22, 28 28
DePuy	Gyros	Yes	No	22.5, 28

\*HXPE: highly cross-linked polyethylene

Orthopaedics AG of Rotkreuz, Switzerland. Several other companies also manufacture similar prostheses and the choice of this specific implant was based on departmental protocol. Both cemented and uncemented techniques were used for acetabular cups and femoral components, depending on patient indications. All the patients were operated via the posterior approach (Kocher-Langenbeck approach). This is departmental protocol and makes comparison with other DMC studies much easier and more accurate, as the vast majority (>95%) of similar studies done previously also utilised the posterior approach.

## Results

Forty-one of the 86 patients identified were included in the study. A total of 45 patients were excluded. Eight had incomplete files, four passed away during the first year after surgery and the rest did not complete a full year of follow-up and could not be contacted telephonically. Thirty-four of these patients followed up at our clinic for one year or more. Seven patients did not complete a full year of follow-up at the clinic but were reached telephonically more than one year after surgery was performed and were confirmed not to have dislocated.

The mean age of the patients included was 60.7 years (SD 8.6). Twenty-six (63.4%) of the patients were females, with the youngest being 42 years, the oldest 81 years and with a mean age of 62 years (SD 9.5). There were 15 (36.6%) males among the patients included, with the youngest being 49, the oldest 67 and with a mean age of 58.4 years (SD 6.3). Patient demographics are shown in *Table II*.

The risk factors for dislocation common to all the patients in the cohort were that they received THA for a NOF fracture via the posterior approach. Surgeon experience could not be controlled for and prostheses fixation was variable (according to patient indications). Regarding the experience of the surgeon, 24 cases (58.5%) were performed by a registrar, 12 cases (29.3%) by a registrar with consultant supervision and five (12.2%) by a consultant. Both cemented and uncemented prostheses were used in different combinations depending on specific patient indications. A cemented cup and stem was used in 29 of the cases (70.7%). An uncemented cup and cemented stem (hybrid implant) was used in six patients (14.6%). A cemented cup and uncemented stem

(reverse hybrid implant) was used in four of the cases (9.8%) and an uncemented cup and stem was used in two patients (4.9%). Details of the surgeries performed are summarised in *Table III*. Some complications other than dislocation were encountered. Two of the patients developed deep wound infections. One of these patients ended up having a Girdlestone excisional arthroplasty and the other had to undergo two-stage revision surgery.

The main aim of this study was to determine the cumulative incidence of dislocation of DMC hip prostheses used for intracapsular NOF fractures one year after surgery was performed. We found that none (n=0) of the patients included in our study had dislocated one year after surgery.

## Discussion

By using DMC THA in the management of intracapsular NOF fractures we achieved a 0% dislocation rate at one-year follow-up. This is significantly better than the rates reported with conventional THA for this indication.<sup>5,7,8</sup> (This is compared to total hip replacements for NOF fractures in general, and not for specific prostheses like big femoral head components that might compare more favourably with DMC implants.)<sup>21</sup> The dislocation rates for DMCs found in this study are similar to the results found by other authors in recent years. *Table IV* shows a comparison of the results of similar studies done. All the studies shown in *Table IV* used the posterior approach, except for the study done by Adam *et al.* in which 20% of cases were performed via the anterolateral approach.<sup>22</sup>

A limiting factor to this study is the large number of patients lost to follow-up. Universitas Academic Hospital has a catchment area that includes the Free State, Northern Cape, Lesotho and parts of the Eastern Cape. Many of these areas are very remote and

**Table II:** Patient demographics

Characteristics (n=41)	
Age in years (mean; SD)	60.7; 8.6
Females	62; 9.5
Males	58.4; 6.3
Sex (n; %)	
Females	26; 63.4%
Males	15; 36.6%

**Table III:** Details of surgeries performed

Surgeries performed (n=41)	
Prosthesis	n (%)
Smith & Nephew Polarcup	41 (100%)
Approach	
Posterior (Kocher-Langenbeck)	41 (100%)
Surgeon experience	
Registrar	27 (58.5%)
Registrar with consultant supervision	12 (29.3%)
Consultant	5 (12.2%)
Fixation method	
Cemented cup and stem	29 (70.7%)
Uncemented cup and cemented stem	6 (14.6%)
Cemented cup and uncemented stem	4 (9.8%)
Uncemented cup and stem	2 (4.9%)

**Table IV:** Dislocation rates of dual mobility cups used for neck of femur fractures

Authors	Year	Country	Follow-up	Number of patients (n)	Dislocations (n)	Dislocation rate (%)
Current study	2019	South Africa	12 months	41	0	0%
Tarasevicius <i>et al.</i> <sup>23</sup>	2010	Lithuania	12 months	42	0	0%
Adam <i>et al.</i> <sup>22</sup>	2012	France	9 months	214	3	1.4%
Bensen <i>et al.</i> <sup>24</sup>	2014	Denmark	21 months	175	8	4.6%
Nich <i>et al.</i> <sup>25</sup>	2016	France	36 months	45	3	6.7%
Boukebous <i>et al.</i> <sup>26</sup>	2018	France	24 months	98	3	3.1%
Zagorov <i>et al.</i> <sup>27</sup>	2018	Bulgaria	29 months	49	0	0%
Rashed <i>et al.</i> <sup>28</sup>	2018	Egypt	12 months	31	0	0%

rural which makes it difficult for patients to follow up in the long term. This is coupled with inadequate record-keeping, with many patients being admitted to hospital without having their telephone numbers or identity numbers captured. Despite excluding these patients from the study, we believe it is unlikely that many, or even any, of them dislocated. The structure of the health system in the Free State is such that patients who dislocated would have to be referred to Universitas Academic Hospital for reduction and would likely have been picked up in this manner.

Future researchers may consider doing a prospective study in which they can better control data capture and possibly attain a higher level of long-term follow-up. A prospective study could also look at whether patients have other risk factors for dislocation besides the ones that the patients in our cohort shared, namely THA done via the posterior approach for NOF fractures.

## Conclusion

The results obtained in this study were comparable to similar studies done abroad and show promise for the use of DMCs to achieve low dislocation rates in this high-risk group of patients.

### Ethics statement

The author/s declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, 2010.

Ethical clearance for the study was received from the University of the Free State Ethics Committee (HSREC 165/2016). Permission to use medical records was obtained from the Free State Department of Health. Formal consent was not required for this study.

### Declaration

The authors declare authorship of this article and that they have followed sound scientific research practice. This research is original and does not transgress plagiarism policies.

### Author contributions

LJE collected and analysed the data, and wrote and edited the manuscript. FF contributed to the protocol and management of patients. FJvdM proposed the study concept, supervised the study and managed patients.

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