

Double Mobility Cup in Primary Total Hip Arthroplasty: Dislocation Rate and Survivorship in Single Institution Cohort Analysis

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Abstract

The dual mobility cup was introduced in France in the 1970s by Gilles Bousquet to decrease dislocation rates in high-risk patients. The system acts as a large prosthetic femoral head, allowing greater range of motion within the socket and low dislocation risk. Concerns about intra-prosthetic dislocation and accelerated wear have been emphasized.

Methods

From March 2004 to February 2019 we implanted 1651 DMCs in 1509 patients. Follow up was from 1 month to 160 months. Average age of patients was 75.6 years (from 29 to 98). 1032 were females and 477 males. In 402 cases operation was due to fracture of the femoral neck, in 1103 due to osteoarthritis. Operations were performed by 7 different surgeons using 3 different approaches. We used six different types of femoral stem. Post-operatively patients were mobilized next day after surgery or when the general health condition allowed it. We did not restrict any activities, that are usually forbidden in the early post-operative time after total hip arthroplasty. In all patients,

excluding those with acute fracture, Harris Hip Score was measured pre-operatively and post-operatively.

Results

Average Harris Hip Score pre-operatively was 45.72 and 87.20 post-operatively. We diagnosed infection of prosthesis in 16 cases and in 15 cases infection of subcutaneous tissue above the fascia, femoral nerve palsy in 1 case, periprosthetic fracture in 15 cases and 1 case of acute AFS thrombosis. So far we had only 1 dislocation of prosthesis and no revision due to aseptic loosening.

Conclusion

Based on experience from our clinical outcome and patient assessment, we conclude that double mobility cup system is a safe in reliable option for every patient with a goal to decrease dislocation risk without increasing polyethylene wear.

Introduction

Total hip arthroplasty (THA) is considered one of the most successful surgical procedures with high patient satisfaction rates and great clinical results for treating various conditions predominant end-stage osteoarthritis. Despite great results, a failed THA can result in catastrophic event.

Reducing postoperative complication, especially early and late THA instability, is important for patient outcome and quality of life. Risk factors for instability can be patient-specific (gender, age, comorbidities, abductor status...) or related to operative variables (surgical approach, component positioning, femoral head diameter). Modifications in surgical technique (anterior, antero-lateral approach, increased offset and correct restoration of abductor tension) and the incorporation of dual mobility acetabular components can provide better stability and functional outcome of patients [1].

The principle of a dual mobility cup (DMC), often called "tripolar", was developed in France in 1974 by Gilles Bousquet. His system is based on large, fixed, acetabular component and a bipolar, mobile, femoral component that provides stability against bone and 2 articular surfaces. A large polyethylene surface directly facing acetabular metal implant and a standard-sized femoral head interfacing with mobile polyethylene.

Significant complications have been noticed after first generation cups, which were mainly caused by accelerated wear of the polyethylene and early intra-prosthetic dislocation [2,3].

More recent studies appear to be safer due to new polyethylene manufacturing techniques and improvements in prosthesis fixation [4].

The purpose of our study was to determine our clinical outcome and survivorship of this THA system.

Methods

The study objective was to evaluate dislocation rate and polyethylene wear in a cohort of 1509 patients all operated in our institution. All enrolled hips were primary total hip replacement and only a double mobility cup was implanted. From March 2004 to February 2019 we have operated on 1651 hips using DMC.

There were 477 males and 1509 females with a mean age of 75.6 years (from 29-98). No exclusion or inclusion factors were identified. All patients had different conditions requiring THA (fracture of femoral neck, primary osteoarthritis, avascular necrosis, post-traumatic arthrosis).

Mean follow-up was 99 months (1-164 months).

Operations were performed by 7 different surgeons using 3 different approaches- classic anterolateral, minimally invasive anterolateral and minimal invasive direct anterior approach. Three different acetabular cups were inserted, with cemented or cement-less fixation. No post-operative restrictions were applied to patients and all were allowed to mobilize on first postoperative day with no movement restrictions.

The clinical course of each patient was evaluated preoperatively, early postoperatively (2-4 weeks), at 4-6 months and 1-1.5 years and later on a 3-5 year basis. All patients visiting the outpatient clinic received clinical and radiographic review. All radiographic images were stored for analysis in a computer database. Any visible migration of the acetabular component was measured on sequential radiographs using DeLee and Charnley method and all complications were recorded.

Harris Hip Score and WOMAC score was obtained from every patient not suffering a femoral neck fracture preoperatively and on each clinical visit.

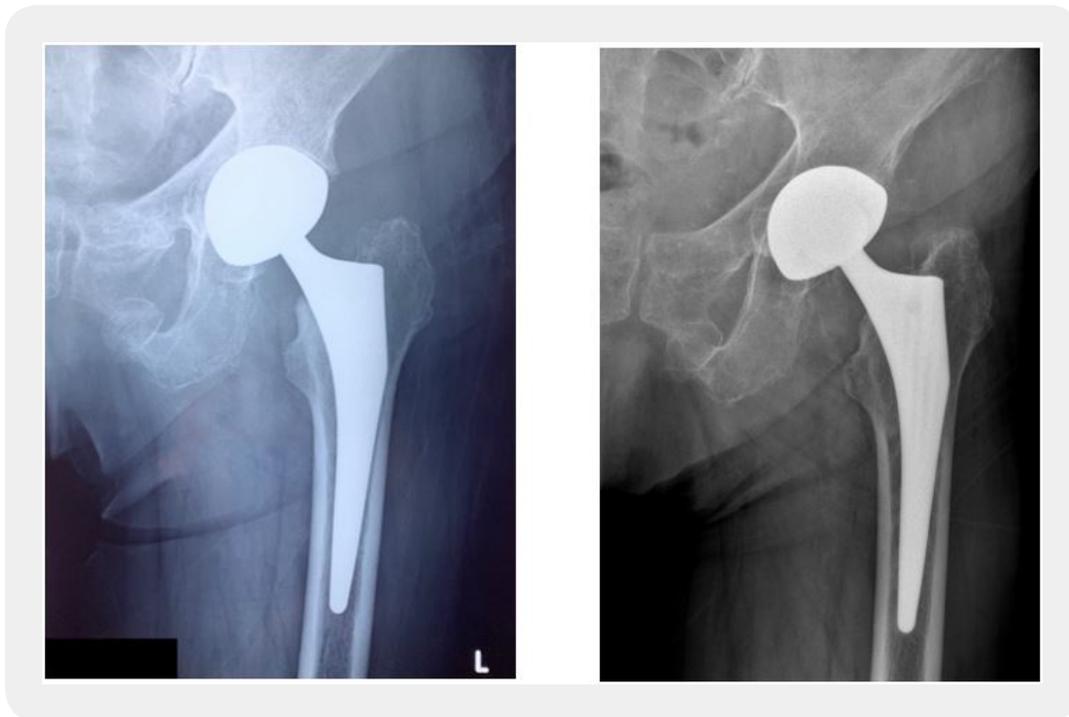
Results

Only 1 late dislocation and no early dislocations were recorded at the time of review within all of the studied cohort. Of the 1591 hips available for examination (68 died of unrelated causes), the number of complicated hips was 41. We recorded 16 cases of deep prosthetic joint infection, 15 cases surgical site infections, 1 case of femoral nerve palsy, 15 periprosthetic fractures with exchange of either acetabular or femoral component, or both.

The 36 reoperations consisted in 12 femoral shaft fractures treated by plates and wires; 5 one stage revision with poly exchange for early prosthetic joint infection and 13 explantations for late joint infections.

The average HHS score, which was recorded only for cases of osteoarthritis and avascular necrosis, has increased from the initial value of 45.72 to 87.20 at the last follow-up.

Radiographic results showed excellent implant fixation in all cases with lack of radiolucent line all around the outer surface of the cup. No cases of femoral head migration have been detected.



Picture 1: Radiographic analysis postoperatively on the left, 7 years after operation on the right

Table 1: Complication analysis of double mobility cups used in our institution

DEMOGRAPHICS	N HIPS
N HIPS	1651
PATIENTS	1509
Male	477
Female	1032
REOPERATIONS	36
Non-implant related	24
Implant related	12
DISLOCATIONS	1
PERIPROSTHETIC FRACTURE	15
SURGICAL SITE INFECTION	15
DEEP JOINT INFECTION	16
FEMORAL PALSY	1
SURVIVAL RATE	97.6%
HHS Scores	
Pre-OP HHS	45.72
Post-OP HHS	87.2

Discussion

The risk of hip instability following primary THA is a major cause of revision in hip arthroplasty [5,6]. DMCs had been assessed to successfully face this issue and we have adopted this system in 2004. As regarding patient factors, several studies have identified dislocation factors, such as gender, age, ASA Score, aetiology and comorbidities [7-9]. For that reason we perform a comprehensive preoperative evaluation of every patient. Taking into account their age, older patients were favourable due to potential risk of wear leading to intra-prosthetic dislocations [10].

This cohort study addressed 1509 patients in 1651 hips, who all received double mobility cup from 3 different implants using either a cemented or cement-less fixation. All cement-less acetabular cups were using press-fit fixation under hydroxyapatite coatings. Outcomes have been analysed for the entire cohort with demographics, complications and survivorship rates. Complete clinical and radiological assessment was available in 1415 patients with a mean follow-up 99 months (1-164). 68 patients were lost due to death for unrelated causes, meaning 93 percent of patients were available for clinical and radiological follow up (26 patients were lost during follow-up for unknown reasons).

Only 1 reported dislocations after 2 year after operation and 0 aseptic loosening at the latest follow up is confirming great results with post-primary THA stability and durability using DMCs in various patients. This rate is comparable to other reports of DMCs in primary THA. Vielpeau *et al.* reported 0 dislocations after 5.2 years while Philippot *et al.* reported 0 dislocations after 10 years of follow-up and Leclercq *et al.* reported 0 dislocations after minimum of 5 years of follow-up [11-14].

Bauchu *et al.* [15] recorded 0 dislocation and a survival rate of 97.4% at 7 years. Our survival rate after 5 years was 98.6%. We acknowledge the possibility of early aseptic loosening in dual mobility designs, even though we have not yet encountered this problem in our series. For that reason, we have modified our indications and we use it also in younger patients. The second published cause of failures was intraprosthetic dislocation following progressive polyethylene wear [12]. The DMCs used in this study may prevent these intra-prosthetic dislocations with the use of newly manufactured highly cross-linked polyethylenes (HXLPE). The duration on newly HXLPE material has been shown to lower the wear rate around 30% as compared to regular UHMPE [16]. Recent studies over 10 years upon fixed HXLPE bearings have clinically confirmed even in young patients excellent long term results previously demonstrated on Hip simulators and RSA studies [17]. Osteolysis and accelerated wear in DMCs was no higher than in conventional cup [14].

All-though this study has its limitations, mostly due to short examination period, we can conclude a 3 important features compared to first generation DMCs. The first improvement regards the enhanced fixation of the press-fit cup thanks to the hydroxyapatite-coated bone-metal interface, which has showed excellent long lasting fixation in uncemented cups [18,19]. The second critical concern is reduced wear of new HXLPE inserts, which prevents from complications such as intraprosthetic dislocations. The third major advantage of modern cups is its anatomical shape of the cup, which allows the prevention from painful ilio-psoas anterior conflicts with DMC which were reported at an incidence of approximately 5% of all THAs [20,21].

As a result of the present study, encouraging clinical results were recorded even in younger, more active patients and further, longer clinical studies will provide a definite answer about safety of DMC system use.

Conclusion

In conclusion, this study supports the use of DMC system in primary THA in all patients. This study also demonstrates that DMC can reduce dislocation rate comparable to rates seen in conventional hip articulations. With better cup design and material longevity we continue to indicate DMC in our patients at high risk for dislocation, even at younger age with reduced dislocation rate and no increased risk for accelerated wear or failure.

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