MENTORS IN ORTHOPEDICS

CLINICAL RESULTS TWO YEARS AFTER TOTAL HIP ARTHROPLASTY WITH A DUAL-MOBILITY HEMISPHERICAL CUP

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SUMMARY

Background: Dislocation remains a significant complication following primary total hip arthroplasty (THA). While dual-mobility (DM) acetabular components effectively mitigate instability through an increased jumping distance and head-to-neck ratio, traditional designs featuring protruding cylindrical-spherical rims are associated with a risk of iliopsoas impingement due to anterior acetabular overhang.

Objective: This study aimed to evaluate the clinical outcomes, dislocation rates, and revision frequencies of a specific hemispherical DM cup designed without a protruding rim after a minimum follow-up of two years.

Key Points: A retrospective analysis was conducted on 332 consecutive primary THAs performed via a posterolateral approach using a cementless hemispherical DM component. Clinical assessment utilized the modified Harris Hip Score (mHHS) and Oxford Hip Score (OHS). At a mean follow-up of 2.8 years, no dislocations were recorded. The cumulative revision rate for the acetabular component was 0.6%, with an overall revision rate of 1.5%. Postoperative complications included symptomatic iliopsoas impingement in 0.9% of cases (n=3), which is lower than reported rates for traditional DM and unipolar designs. Mean functional scores were high, with an mHHS of 92 ± 12 and an OHS of 57 ± 5. Multivariate analysis indicated that functional outcomes were inversely correlated with patient age, while mHHS showed a positive correlation with acetabular cup diameter.

Conclusion: The use of a hemispherical DM cup without a protruding rim provides effective stability against dislocation while maintaining favorable functional outcomes. The observed low incidence of iliopsoas impingement suggests this design modification may address soft tissue irritation concerns associated with conventional DM components, though long-term radiographic and clinical surveillance is required.

KEYWORDS

Arthroplasty, Replacement, Hip; Hip Prosthesis; Prosthesis Design; Hip Dislocation; Postoperative Complications

INTRODUCTION

Dislocation is a costly and feared complication of total hip arthroplasty (THA), reported in up to 7% of primary THA. [1],[2]. Over the past decade, dual-mobility (DM) cups have been demonstrated to be effective at reducing subluxations and dislocations, due to their greater jumping distance and higher ratio of head to neck diameter [3]. Contemporary DM cups have been proven to effectively prevent intraprosthetic dislocation, and have shown low rates of complications and revision [3],[4]. Iliopsoas impingement remains a potential worry with DM cups, as they are more likely to overhang at the anterior margin of the acetabulum given that they are designed with a protruding cylindrical-spherical rim to increase the jumping distance [5].

Since 2014, the authors have been using a new DM hemispherical cup that does not have a protruding cylindrical-spherical rim (figure 1) in order to reduce the risk of iliopsoas impingement without any need to change the conventional positioning of the cup perioperatively, like unipolar cups

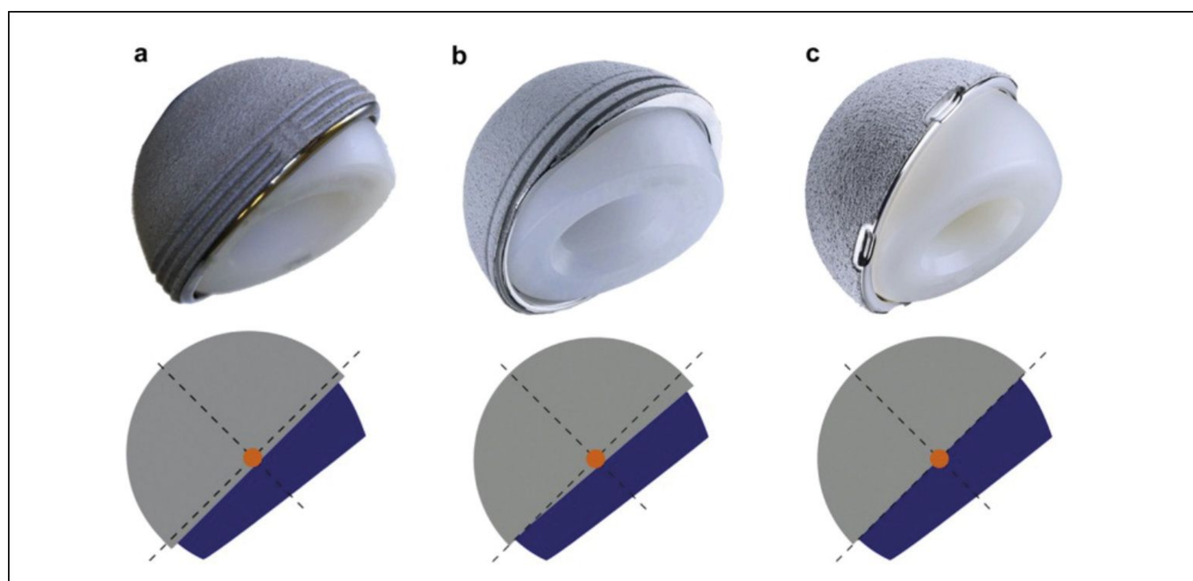

Figure 1: (a) Original dual-mobility (DM) cup design with a full cylindrical-spherical rim, (b) second generation DM cup with a partial cylindrical-spherical rim, and (c) the Symbol hemispherical DM cup without a cylindrical-spherical rim.

The purpose of this study was to determine the dislocation, complication and revision rate as well as the clinical rating of this DM hemispherical cup after a minimum of two years of follow-up.

MATERIALS AND METHODS

The authors looked at a consecutive case series of 332 primary hip arthroplasties (323 patients), carried out over two consecutive years by three surgeons (L.S., G.E. and F.C.) using the same uncemented DM hemispherical cup (Symbol cup DM HA, Dedienne Sante, Mauguio, France) for all primary hip arthroplasties, with no specific inclusion or exclusion criteria applied (all ages, indications, activity levels, all types of spinal-pelvic alignment).

The procedures were performed using the posterolateral approach, with the same technique applied for acetabular reaming and positioning of the cup in all 332 hips. The operative data are summarised in Table 1.

Intraoperative data.

Variable	Original cohort (n = 332 hips)
	N (%)
Surgical approach	
Posterolateral	332 (100)
Head diameter	
22	138 (42)
28	194 (58)
Neck length	
Short	119 (36)
Medium	181 (55)
Long	32 (10)
Cup diameter	
44	6 (2)
46	37 (11)
48	68 (20)
50	64 (19)
52	58 (17)
54	63 (19)
56	25 (8)
58	9 (3)
60	2 (1)
Stem type	
Symbol	135 (41)
Hype	85 (26)
Libra	78 (23)
Integrale	34 (10)

Table 1: Intraoperative data

Demographic and preoperative morphological data

The cohort consisted of 147 men (147 hips) and 185 women (194 hips), aged 72.3 ± 9.8 years (range, 45 to 96) with a body mass index of 26.5 ± 4.5 (range, 17 to 50). The aetiologies are summarised in table 2.

Variable	Univariable			Multivariable (n = 304)		
	β	95% C.I.	*P* value	β	95% C.I.	*P* value
Age at index operation (y)	−0.16	(−0.21 to 0.10)	**<.001**	−0.15	(−0.21 to −0.09)	**<.001**
BMI	0.03	(−0.10 to 0.16)	.663	−0.05	(−0.18 to 0.08)	.446
Male sex	1.46	(−0.35– 2.58)	**.010**	−0.26	(−1.78 to 1.27)	.741
Head diameter						
22	REF					
28	0.68	(−0.45 to 1.81)	.238	−0.61	(−1.88 to 0.66)	.343
Neck length						
Short	−1.21	(−2.40 to 0.03)	**.045**	−0.84	(−2.05 to 0.36)	.169
Medium	REF					
Long	2.14	(−0.48 to 3.27)	**.031**	1.60	(−0.33 to 3.52)	.104
Cup diameter (mm)	0.48	(0.15 to 0.81)	**.004**	0.39	(0.09 to 0.86)	.113

BMI, body mass index; C.I., confidence interval.
Bold values present statistically significant differences.

Table 2: preoperative demographics and morphological data

All patients were contacted after a minimum of two years of follow-up for a clinical evaluation using the modified Harris Hip Score (mHHS) [6] and the Oxford Hip Score (OHS) [7]. Their cases files were used to document the implant materials, model and diameter, and any postoperative complications or revisions. If any patients presented with pain at the clinical evaluation, more extensive imaging investigations were performed to look for fractures, implant overhang, infection, loosening, etc.

Statistical analysis

The Shapiro-Wilk test was used to evaluate whether the distribution was normal. Univariate and multivariate analyses were performed once the relevant variables had been determined (age at the time of operation, sex, body mass index, cup size, head diameter, neck length and stem type) in order to identify any associations with the mHHS and OHS ratings. The P value for statistical significance was considered to be < 0.05. The statistical analyses were carried out using R version 3.5.3 (R Foundation for Statistical Computing, Vienna, Austria).

Results

In our cohort of 323 patients (332 hips), there were six perioperative complications, none of which was caused by the cup: four partial femoral fractures (1%) treated with cerclage wiring and two fractured greater trochanters (0.5%, in patients aged between 81 and 85 years) treated with trochanteric plate fixation.

In addition, two patients (2 hips, 0.6%) required stem and cup revision due to persistent hip pain that was unrelated to the cup: one was due to an excessive overall mediolateral offset, and the other was due to stem loosening with suspected sepsis. Three patients (1%) needed stem-only revisions due to a traumatic periprosthetic femoral fracture of both hips and a leg length discrepancy exceeding 20 mm caused by the stem being progressively pushed into one hip.

There were ten postoperative complications (3%) that did not result in removal of the implant: three (0.9%) cases of impingement between the cup and psoas (treated by steroid injection), one (0.3%) deep surgical site infection successfully treated with irrigation and replacement of the moving parts (PE liner), and one (0.3%) leg length discrepancy exceeding 10 mm managed with a shoe-lift. Finally, there were two (0.6%) periprosthetic femoral fractures caused by a trauma, one (0.3%) case of traumatic fascia lata inflammation, one (0.3%) case of trochanteric bursitis and one (0.3%) oedema with blistering, all of which were treated conservatively. Thirteen patients (13 hips, 4%) had died and none were lost to follow-up. No dislocations were recorded during the follow-up phase.

Clinical results

For the final cohort of 305 living patients (314 hips) with their original cup and stem, assessed after 2.8 ± 0.5 years (range 2–5 years), the mHHS was 92 ± 12 (range 46–100), and the OHS was 57 ± 5 (range 34–60). The multivariate analyses showed that the mHHS and OHS values fell significantly with age, while only the mHHS increased with the acetabular cup diameter (tables 3 and 4).

Preoperative demographics and morphological data.

Variable	Original cohort (n = 332 hips)	
	Mean ± SD N (%)	Range
Age	72.3 ± 9.8	(45-96)
BMI	26.5 ± 4.5	(17-50)
Male gender	147 (44%)	
Etiology		
Primary OA	298 (90%)	
Avascular necrosis	17 (5%)	
Femoral neck fracture	12 (4%)	
Dysplasia	3 (1%)	
Posttraumatic OA	1 (0%)	
RA	1 (0%)	

BMI, body mass index; SD, standard deviation; OA, osteoarthritis; RA, rheumatoid arthritis.

Table 3: Univariable and multivariable regression analysis of the modified Harris hip score.

Variable	Univariable			Multivariable (n = 304)		
	β	95% C.I.	*P* value	β	95% C.I.	*P* value
Age at index operation (y)	−0.37	(−0.51 to −0.24)	**<.001**	−0.35	(−0.50 to −0.21)	**<.001**
BMI	0.07	(−0.24 to 0.39)	.658	−0.12	(−0.43 to 0.19)	.448
Male sex	3.20	(0.43 to 5.96)	**.023**	−1.63	(−5.35 to 2.09)	.389
Head diameter						
22	REF					
28	1.78	(−1.00 to 4.57)	.209	−1.50	(−4.60 to 1.61)	.344
Neck length						
Short	−2.72	(−5.55 to 0.11)	.060	−2.18	(−5.13 to 0.76)	.146
Medium	REF					
Long	2.19	(−2.42 to 6.81)	.351	3.48	(−1.23 to 8.18)	.147
Cup diameter (mm)	1.27	(0.46 to 2.07)	**.002**	1.25	(0.08 to 2.41)	**.037**

BMI, body mass index; C.I., confidence interval.
Bold values present statistically significant differences.

Table 4: Univariable and multivariable regression analysis of the Oxford Hip Score.

DISCUSSION

The popularity of DM cups has been growing recently because they deliver an acceptable range of motion while preventing instability [1],[2]. In view of the absence of dislocations and our satisfactory short-term clinical scores, this important cohort offers confirmation that the new DM hemispherical cup that we studied is effective in the prevention of dislocation, although longer term follow-up is still needed to check the longevity of the clinical results and stability of radiography [2],[4],[10].

This study suggests that DM hemispherical cups could be as effective in the prevention of dislocation as other contemporary DM cups with protruding cylindrical-spherical rims [1],[3],[10]. In addition, the short-term data showing an absence of intraprosthetic instability where the cup meets the liner or where the liner meets the head indicates that 22 mm and 28 mm heads are compatible with this cup design. However, it remains unclear whether larger femoral heads are advantageous: while on the one hand they can reduce dislocation rates, on the other, they can cause increased wear of the liner [11],[12].

This study produced satisfactory clinical results for an uncemented THA using a new DM hemispherical acetabular cup without a protruding cylindrical-spherical rim, with a cumulative revision rate for the cup of 0.6% and an overall cumulative revision rate of 1.5%, after a mean follow-up period of 2.8 years. While the overall cumulative revision rate may seem high for such a short follow-up period, it should be noted that some of these were due to traumatic periprosthetic fractures and that the rate is within the range reported with other contemporary DM acetabular cups [4],[8],[9].

For this case series, the means of the mHHS and OHS after 2 to 5 years were 92 and 57 points, respectively, which are favourable compared to the scores reported for contemporary DM cups [2]. Our multivariate regressions

showed significant associations between age and the mHHS and OHS, which is to be expected since function declines in elderly patients.

In this study, a clinical diagnosis of iliopsoas impingement was given if a patient presented with anterior groin pain. Radiographs were then taken in these patients to exclude other possible causes of pain, and if no other cause of pain was found, CT scans were performed to quantify the overhang and anteversion of the cup. Psoas impingement caused by an excessive overhang and inadequate anteversion was identified in 3 hips (0.9%) even though DM hemispherical cups were used, probably due to insufficient anteversion of the cup or oversizing. Vandenbussche et al. [5] had in fact cautioned that implant overhang would be more likely to occur with DM cups in view of their more prominent rims. Nonetheless, the incidence of iliopsoas impingement in our case series is considerably lower than the rates seen in previous cases series (4.3%) [13], and in other recent case series with unipolar cups (3.9%) [14].

The limitations of this study included its retrospective design and absence of radiographic evaluation. The minimum duration of follow-up of two years was insufficient for a robust survival analysis, but it was long enough to detect common early complications related to the cup, such as instability, dislocation or iliopsoas impingement. The main strength of this study was the sample size of 332 hips, which consisted of patients subject to hip instability, with a DM hemispherical cup. Although four types of stem were used, the same DM cup implant was used in all patients.

CONCLUSION

In view of the absence of dislocations and our satisfactory clinical scores, this important cohort offers confirmation that the new DM hemispherical cup that we studied is effective in the prevention of dislocation, although longer term follow-up is still needed to check the longevity of the clinical results and stability of radiography.

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