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Original article

Dual mobility cup in revision total hip arthroplasty: Dislocation rate and survival after 5 years

E. Simian[a,b], R. Chatellard[a,b], J. Druon[a,b], J. Berhouet[a,b], P. Rosset[a,b,*]

[a] Services d'orthopédie 1 et 2, CHU de Tours, avenue de la République, 37044 Tours cedex 09, France
[b] Université François-Rabelais de Tours, PRES Centre-Val de Loire Université, 37020 Tours, France

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ABSTRACT

Background: Dislocation is a common complication of total hip arthroplasty (THA), particularly when performed as revision surgery. Dual mobility cups (DMCs) minimize the risk of instability when implanted during primary THA. However, their usefulness and survival in revision THA remain unclear. We therefore conducted a retrospective study to assess DMC stability and survival at a minimal follow-up period of 5 years after revision THA.
Hypothesis: The dislocation rate associated with DMCs for revision THA is similar to that seen after primary THA.
Materials and methods: Cup exchange with implantation of a DMC was performed in 71 patients (74 hips) between 2000 and 2007, for the following reasons: recurrent dislocation ($n = 22$), aseptic loosening ($n = 38$), and infection ($n = 14$). The DMCs were cemented in 47 cases and cementless in 27 cases. The clinical variables (Merle d'Aubigné-Postel score and Harris Hip Score) and radiological findings were collected retrospectively from the medical records and compared with those obtained at the last follow-up visit.
Results: Of the 74 cases, 2 were lost to follow-up. At last follow-up, the mean Merle d'Aubigné-Postel score was 15.2 (11–18) and the mean Harris Hip Score was 80.4 (51–98). Of the 8 failures, 2 (2/72, 2.7%) were related to mechanical factors (1 case each of aseptic loosening and dislocation) and 6 were changed because of infection (recurrent infection, $n = 4$). Mechanical failure was not linked to a specific reason for revision THA. A radiolucent line was visible in 4 cases but this finding was not associated with clinical manifestations. When failure was defined as cup revision for any non-infectious complication, 5-year implant survival was 99% (95% confidence interval, 93–100%).
Discussion: Use of a DMC in revision THA was associated with a slightly higher dislocation rate (1/72, 1.4%) than in primary THA, whereas 5-year survival was comparable. Cemented DMCs were not associated with a greater risk of loosening.
Conclusion: DMCs are useful to decrease the risk of dislocation in revision THA performed for any reason. The low rate of loosening indicates that DMCs do not result in high stresses at the bone-implant interface.
Level of evidence: IV, retrospective study.

1. Introduction

The dual mobility cups (DMC) designed by Gilles Bousquet are used in an expanding range of indications. This implant has been demonstrated to improve hip stability in primary total hip arthroplasty (THA) [1–7] and recurrent hip dislocation after THA [8–12].

Less is known about DMC outcomes in revision THAs performed for reasons other than recurrent dislocation [13–17], although these procedures carry a high risk of postoperative hip instability [18,19]. Other implant designs, such as the retentive cup and the large-diameter femoral head, decrease the risk of hip instability but are often associated with high rates of wear and loosening [20,21].

We therefore conducted a retrospective study to determine whether:

- DMCs used for revision surgery were associated with similar dislocation rates to those seen with DMCs for primary THA;
- DMC survival after revision surgery.

* Corresponding author. Services d'orthopédie 1 et 2, CHU de Tours, avenue de la République, 37044 Tours cedex 09, France. Tel.: +33 2 47 47 59 15.
E-mail address: philippe.rosset@univ-tours.fr (P. Rosset).

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We hypothesised that dislocation rates with DMCs were similar after primary and revision THA.

2. Materials and methods

2.1. Patients

The inclusion criteria were implantation of a DMC during cup exchange surgery and a follow-up of at least 5 years. Starting in the 2000s, growing interest in DMCs prompted us to use this cup design for revision THA. Between 2000 and 2007, 74 DMCs were implanted for cup exchange in 71 patients. During the same period, cup exchange was performed with other cup designs in 114 patients. The reasons for choosing a DMC were older age and risk factors for hip instability (i.e., multiple revisions or revision for hip instability or infection). The reasons for cup exchange were recurrent dislocation ($n = 22$), aseptic dislocation ($n = 38$), and infection ($n = 14$, with one-stage procedure in 11 cases and two-stage procedure in 3 cases).

The 44 females and 27 males had a mean age of 67.9 ± 9.3 years (range, 38–90) at revision surgery. In 2 females, aseptic loosening required bilateral cup exchange. Another female underwent bilateral cup exchange, for recurrent dislocation on the right side and aseptic loosening on the left side.

2.2. Methods

Three DMC designs were used: DMS™ (cobalt-chromium, cemented; SEM, Paris, France) in 47 cases, Evora™ (cobalt-chromium coated with hydroxyapatite coating, cementless; SEM) in 23 cases, and revision Mobilité™ (coated with hydroxyapatite, cementless; Tornier, Saint-Ismier, France) in 4 cases. In patients with good-quality bone after reaming and without bony defects, a cementless implant was used ($n = 27$). Poor bone quality required a cemented implant in 47 cases, including 23 in which the presence of a bony defect prompted the use of a Ganz™ Reinforcement Ring (Zimmer, Warsaw, IN, USA) and defect filling with allogeneic bone. The postero-lateral approach was used in all 74 cases.

2.3. Outcome assessment methods

The clinical data (Postel-Merle d'Aubigné [PMA] [22] score and Harris Hip Score [23]) and radiological findings were collected retrospectively from the medical records and compared with those obtained at last follow-up visit. The set of radiographs consisted of an antero-posterior view of the pelvis and antero-posterior and lateral views of the operated hip. Granuloma-related osteolysis and radiolucent lines in the acetabulum were evaluated on serial radiographs in the DeLee and Charnley zones [24]. Loosening was defined as more than 3° of change in the cup inclination angle or more than 3 mm of cup migration [9].

2.4. Statistical methods

Kaplan–Meier survival curves were plotted with the 95% confidence intervals (95% CIs), using StatView 3.0 (Abacus Concepts, Berkeley, CA, USA) and R 2.10.1 (R Foundation for Statistical Computing, Vienna, Austria). The Kaplan–Meier method was applied to analyse survival, using two definitions of failure, i.e., surgical cup revision for any reason and surgical cup revision for non-infectious reasons. The survival analysis included computation of the 95% CIs, until the interval including at least 30 study cases.

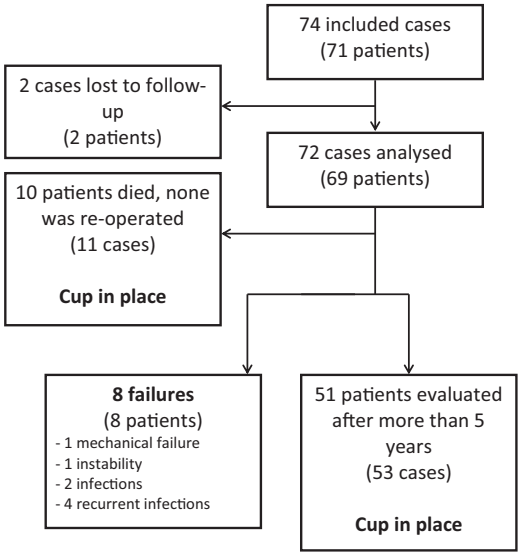

Fig. 1. Patient flow chart.

3. Results

Of the 71 patients (74 hips), 51 (53 hips) were re-evaluated. Mean follow-up in these 53 cases was 87.6 months (range, 60–137 months). Only 2 patients (2.7%) were lost to follow-up; both still had their DMC at last follow-up after 15 and 41.5 months, respectively. In addition, 10 patients (11 hips) died, at a mean of 38 months (range, 6–80 months) after revision surgery, without any instances of re-operation or dislocation.

Of the 72 assessable cases, 8 underwent removal of the DMC. In 6 (8.3%) cases, DMC removal was required because of infection (recurrent infection, $n = 4$) after a mean follow-up of 15.7 months (1–55 months). In the 2 (2.7%) remaining cases, the reason for DMC removal was mechanical: aseptic loosening in 1 (1.4%) case, after 117 months; and dislocation of the large joint in 1 (1.4%) case, requiring reduction by external manoeuvres under general anaesthesia 10.5 months after cup exchange for hip instability. No links were obvious between these failures and any of the three cup designs used. No patients experienced intra-prosthetic dislocation.

Of the 51 patients (53 hips) with no cup exchange during a follow-up of at least 5 years, 8 (8 hips) were not re-evaluated clinically and had no follow-up radiographs after at least 5 years (Fig. 1). Thus, 43 patients (45 hips) were evaluated. The mean PMA score was 15.2 ± 2 (11–18) and the mean HHS was 80.4 ± 12.9 (51–98) (Table 1). Mean cup inclination in the coronal plane was 44.6° (38°–54°). There were no radiolucent lines in 40 cases, including all 23 cases managed with a Ganz™ Reinforcement Ring (which consistently produced strong fixation). A continuous 2-mm radiolucent line was visible in each of 4 asymptomatic patients. In 2 of these cases (Mobilité™ and DMS™ in 1 case each), the line remained stable over time and was associated with osteolysis in zones 1 and 3 or in zones 1, 2, and 3, respectively. Progression of the line was documented in the other 2 cases (DMS™ in both), which were associated with osteolysis in zones 1 and 2 or in zones 2 and 3, respectively. In a 60-year-old woman who was asymptomatic (PMA = 18; and HHS = 98), migration over more than 3 mm was noted 123 months after Evora™ cup implantation, as well as polyethylene wear and acetabular osteolysis in zones 1, 2, and 3.

When failure was defined as revision surgery for any reason, the 5-year implant survival rate was 90% (95% CI, 84–95%) (Fig. 2). A major reason for failure was infection ($n = 6$, 8.3%), a complication not directly related to the implant. When failure was defined as revision for non-infectious reasons, 5-year implant survival was

Table 1
Outcomes according to implant design and reason for revision surgery.

Indication	Aseptic loosening		Dislocation		Infection	
Cup	Cemented	Cementless	Cemented	Cementless	Cemented	Cementless
Number of cases	18	8	8	6	3	2
PMA score [22]	14.5 (11–18)	15.0 (12–18)	14.5 (12–16)	16.8 (15–18)	16.7 (16–17)	17.0 (16–18)
Harris Hip Score [23]	76.0 (51–96)	81.1 (67–98)	75.4 (59–92)	91.0 (84–94)	88.3 (83–96)	89.0 (87–91)
Progressive radiolucency	2 cases					
Stable radiolucency	1 case					1 case
Asymptomatic loosening				1 case		

PMA: Postel-Merle d'Aubigné.

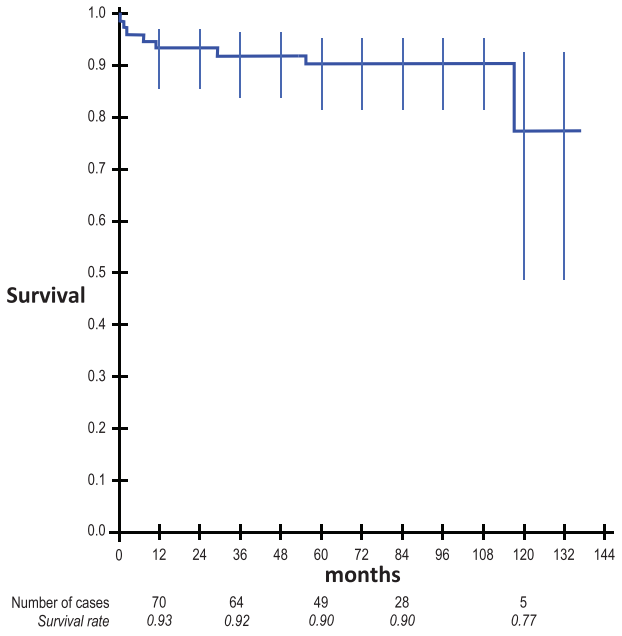

Fig. 2. Implant survival curve obtained when failure was defined as cup revision for any reason.

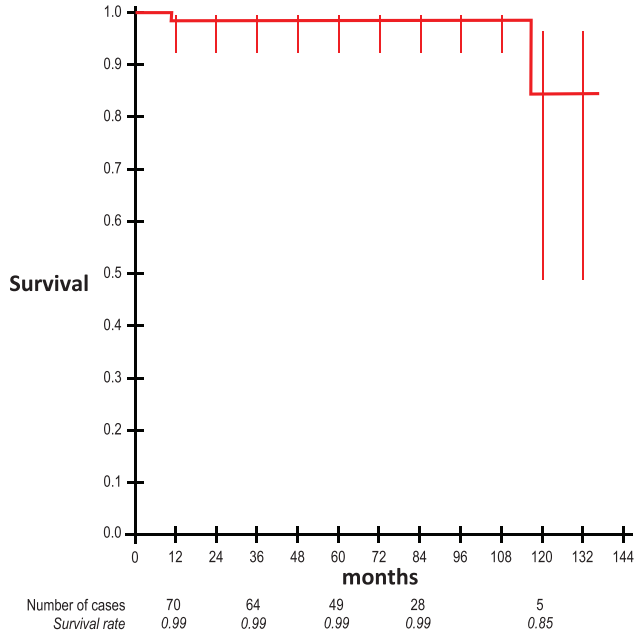

Fig. 3. Implant survival curve obtained when failure was defined as cup revision for non-infectious complications.

99% (95% CI, 93–100%) (Fig. 3). The marked decrease in numbers of exposed patients over time precluded a meaningful analysis of survival rates after longer follow-up (only 28 cases with data after 7 years).

4. Discussion

The outcomes were satisfactory, with a single case of dislocation, producing a rate of 1.4%. This value is similar to rates reported after DMC use for revision THA [8–17], but higher than those reported with DMCs for primary THA [1–7]. When failure was defined as revision for non-infectious complications, 5-year survival was 99% (95% CI, 93–100%), i.e., comparable to previously reported rates of DMC survival in primary and revision THA (Table 2).

This study has several limitations. First, the patient population was heterogeneous. However, our goal was to assess DMC dislocation rates after revision surgery for any reason and with any implant design, since the underlying principles are always the same. Second, the age of the patients and occurrence of infectious complications explain that only 71% of patients were re-evaluated after more than 5 years, whereas outcome data were available for 97.3% of the implants. Third, the 5-year follow-up may seem insufficient, although it should be kept in mind that a substantial proportion of complications develop within the first 3 years [2]. Fourth, interpretation of the standard radiographs was often difficult, particularly in patients with cemented DMCs in a reinforcement ring. Therefore, our data on cup fixation should be interpreted with caution.

Instability is among the main complications of prosthetic revision surgery [18,19,25]. The dislocation rate in our study (1.4%, 1 case) is comparable to the rates found in other studies of DMC use for revision THA [8–17]. Garbuz et al. [26] reported benefits from using large-diameter heads (36 and 40 mm) to prevent instability in exchange THA, but they have the major drawback of inducing marked polyethylene wear [20]. The risk of wear is lower with DMCs, as reported by Adam et al. [27] and, more recently, by Prudhon et al. [28]. Several studies demonstrated lower loosening rates with DMCs than with retentive cups [9,10,15]. The low dislocation rate supports our policy of using DMCs almost routinely for exchange THA. However, the dislocation rate was higher than for primary THA [1–7], a situation in which dislocation rates after DMC implantation are consistently lower than 1% and sometimes nil. Numerous factors influence the stability of a total hip prosthesis, including implant positioning, the number of previous surgical procedures, whether synovectomy is performed, and the presence of muscle damage related to iterative dissection. These risk factors for dislocation are more common in patients undergoing revision compared to primary THA.

Cemented metal cups are associated with high rates of loosening and polyethylene wear [29,30]. In our study, no cases of loosening occurred in the subgroup managed with a cemented DMC and a Ganz™ reinforcement ring. On the other hand, in 2 hips a DMC cemented onto the bone was surrounded by a radiolucent line, indicating a need for close monitoring. Other studies found no cases of loosening of DMCs cemented onto bone [9,15]

Table 2
Previously reported outcomes of dual mobility cups.

	Indication	Type of cup	*n*	No of deaths	No of patients lost to follow-up	Mean follow-up	PMA score at revision	Dislocation of the large joint	Intra-prosthetic dislocation	Cup inclination	AL	Survival rate
Primary THA												
Philippot et al. [3]	Primary THA	Cementless	106	12	1 (0.9%)	10 years	15.8 ± 0.8	0	2	46.8°	2	94.6% (10 years)
Leclercq et al. [5]	Primary THA	Cementless	200	56	31 (15.5%)	11 years	16.3	0	0	46°	0	99% (10 years)
Combes et al. [7]	Primary THA	Cementless	3474	470	524 (15.1%)	7 years		15	7		31	93% (10 years)
Revision THA												
Hamadouche et al. [9]	Dislocation	Cemented	51	2	1 (1.9%)	51.4 months	15.8 ± 2.2	1	1	47°	1	95.7% (72 months)
Leiber-Wackenheim et al. [10]	Dislocation	Cementless	59	9	0	8 years	16.5	1	0		0	98% (8 years)
Mertl et al. [11]	Dislocation	Cemented or cementless	180	21	14 (7.7%)	7.7 years	15.7 ± 2.5	7	2		2	92.6% (8 years)
Langlais et al. [15]	AL	Cemented	88	3	0	3 years	16.1	0	1		2	94.6% (5 years)
Massin et al. [16]	AL and dislocation	Cementless	23	0	0	4.5 years	15	2	0		0	
Schneider et al. [17]	AL and dislocation with reconstruct-tion cage	Cemented	96	15	4 (4.2%)	41 months	15.5 ± 2.3	11	0		2	95.6% (8 years)
Our case-series	THA revision for any reason	Cemented or cementless	74	11	2 (2.7%)	7.3 years	15.2	1	0	44.6°	2	99% (5 years)

THA: Total hip arthroplasty; PMA: Postel-Merle d'Aubigné; AL: aseptic loosening.

or implanted in a Ganz™ Reinforcement Ring [17], a fact that may reflect decreased stresses at the cement-bone interface. Delayed mobilisation occurred for 2 cementless DMCs, of which 1 did not require re-operation. In this last case, polyethylene wear responsible for granuloma formation is a possibility. In case-series of cementless DMCs for primary THA, success rates were satisfactory (93% after 10 years according to Combes et al. [7] and 99% after 10 years according to Leclercq et al. [5]). Similarly, satisfactory outcomes were obtained with press-fit DMCs used for revision THA (98% after 8 years for Leiber-Wackenheim et al. [10]).

5. Conclusion

The results of this case-series study confirm the usefulness of DMCs for revision THA, in particular when the cup is maintained in a reinforcement ring.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Outside this work, Philippe Rosset is a consultant for, and receives royalties from Sciences et Médecine.

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