



Revision total hip arthroplasty with a Kerboul plate: comparative outcomes using standard versus dual mobility cups

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Abstract

Introduction Instability is a major complication in revision total hip arthroplasty (THA). Dual mobility (DM) cups were shown to reduce the risk of post-operative implant dislocation. Few case-series studies assessed the outcomes of cemented DM cups when associated to acetabular reconstruction antiprotrusio cages. No published comparative studies were found to look for outcome differences between standard cups (SC) and DM cups in first revision THA associated with a Kerboul plate (KP) and acetabular bone grafting.

Materials and methods This is a retrospective comparative study of two groups of patients in two institutions. All cases were first revision THA with KP reconstruction; a cemented standard cup (SC) was used in one institution (THA-SC group) while a cemented DM cup was used in the second institution (THA-DM group). The posterolateral approach and the same technique for KP placement, the cross technique, were performed in both groups. Primary outcomes were dislocation and revision rates. Survivorship and clinical and radiological results were set to be secondary outcomes. There were ten patients (13 hips) in the first group and 16 patients (16 hips) in the second with a mean follow-up clinical and radiological evaluation of 74.2 ± 47.9 months.

Results Besides age, no significant demographic differences were present between both groups. There were three dislocations (23%) in the first group treated with close reduction compared to none in the second ($p = 0.04$). No further episode of dislocation or revision surgery occurred until the last follow-up in both groups. The mean Harris Hip Scores for the THA-SC and THA-DM groups were 87.5 ± 10.9 and 87.4 ± 12.1 , respectively. When present, radiolucent lines were less than 1 mm thick and were non-progressive in both groups. In all patients, complete trabeculation remodeling or cortical repair of the graft was observed.

Conclusion The cup type was the single variable which could account for the observed dislocation rate difference. The mid-term results of using DM cups with KP in first revision THA seem very encouraging. Our findings add to the previously published results on the excellent outcomes in terms of stability in revision THA when using DM cups.

Keywords Total hip arthroplasty · Revision total hip arthroplasty · Dislocation · Dual mobility

Introduction

Loosening and instability are the two major causes of THA revision [1, 2]. These two complications, dislocation in

particular, were also the most prevalent causes of first revision THA when using standard cemented cups [3, 4]. The use of constrained acetabular liners or augments has been advocated in order to treat persistent THA instability; however, the rate of aseptic loosening of such devices was found to be high in the long term [5, 6]. The dual mobility socket was introduced by Gilles Bousquet to overcome prosthesis instability [7]. Dual mobility (DM) cups were shown to reduce the risk of post-operative implant instability in primary [8–11] and revision THA [12, 13].

The reinforcement (antiprotrusio) cages associated with bone grafting were found to be reliable in acetabular reconstructions owing to their excellent primary fixation and secondary osteointegration [14–18]. Few reports [19–22]

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assessed the outcomes of cemented DM cups when associated to acetabular reconstruction antiprotrusio cages (Table 1). All these reports were case-series studies. To the best of our knowledge, there are no published studies with comparative design exploring outcome differences between cemented polyethylene cups (SC) and DM cups in first revision THA using a Kerboul plate (KP) and grafting.

The aim of this study is to compare the outcomes of first revision THA with a KP between SC and DM cups.

Methods

We reviewed the charts of patients who underwent a first revision total hip arthroplasty with KP, in two institutions from January 2006 to December 2017. One institution used systematically a standard cup for revision cases (THA-SC group) while the other used a DM cup (THA-DM group). The two groups were continuous series in both institutions. We retrospectively analyzed and compared basic demographics and the results of the two groups. This study was approved by the ethical boards of both institutions.

The inclusion criteria were (a) a first revision case, (b) the use of KP reinforcement with bone graft, (c) the use of a posterolateral approach, (d) the use of the same surgical technique of KP placement, the cross technique (Fig. 1), and (e) the use of morcellized bone graft. The cross technique has been described in detail in an earlier report [23]. For patients with two or more revisions, an anterior or anterolateral approach and non-Kerboul cages, were excluded from the study. Figures 2 and 3 show a case of revision THA with a standard cup. Figures 4 and 5 show a case of revision THA using dual mobility cup (DMC).

Data extraction targeted demographics, etiologies of revision, surgical approach, prosthesis type, follow-up duration, clinical and radiological evaluation, and complications (Table 2). The modified Harris Hip Score (mHHS) was used to assess the functional status, pre-operatively and at follow-up. For the radiological evaluation, an anteroposterior (AP) view of the pelvis and an AP view of the hip with lateral views in standing position were made. Radiolucent lines and osteolyses on the AP views were assessed using the classification of DeLee and Charnley [24]. The American Academy of Orthopedic Surgeons (AAOS) classification was used to evaluate the acetabular defect. Heterotopic ossifications were graded according to the Brooker classification [25]. Graft osteointegration was evaluated using the Grodet et al. classification [26]; the graft is considered integrated when the score is at least equal to 6 out of a maximum of 9.

Table 1 Studies reporting DMC and reinforcement cage

Studies	Country	No. of cases	Reinforcement ring	No. dislocation	No. of re-dislocation	Revision for dislocation	Radiolucent lines	Radiological loosening of the cage	No. aseptic cage failure of 1st rTHA	Revision cage failure
Schneider et al. 2011	France	96 (62 1st, 24 2nd, 10 3rd rTHA)	Kerboul = 70 Burch-Schneider = 6, ARM = 20	4 (+ 6 with a missing GT: 2nd or 3rd rTHA)	1	0 (3 surgical reduction)	6	2	1	1
Pattyn and Audenaert 2012	Belgium	37 (1st revision?)	Ganz = 35 Burch-Schneider = 2	2	0	0	NA	NA	1	1
Vasukutty et al. 2012	UK	33 (1st revision?)	Gap	0	0	0	NA	3	1	1
Węgrzyn et al. 2014	France	61 (57 1st rTHA)	All Kerboul	0	0	0	3	0	0	0
Total		255		7 (2.7%)	1	?	9 (5.7%)	5 (3.8%)	4 (1.5%)	4 (1.5%)

rTHA, revision total hip arthroplasty; NA, not available

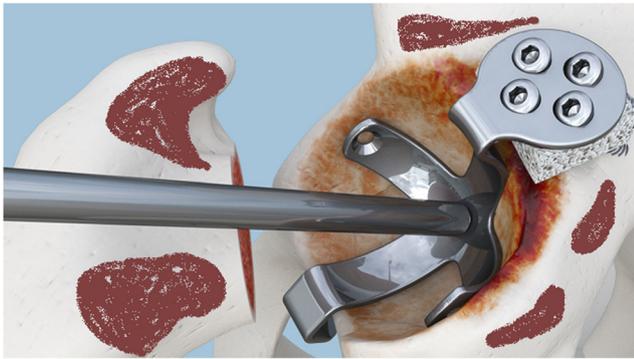


Fig. 1 Positioning of Kerboul plate using the cross technique

Statistical analysis

The StatsDirect software has been used to conduct statistical analyses. Statistical analysis was performed using non-parametric tests. Independent proportion *t* test was conducted to compare both groups. Significance was defined when *p* value is < 0.05 .

Results

The mean age of the whole sample (26 patients; 29 THA) was 72.8 ± 11.3 years, including 20 females and 6 males. Nineteen THA were performed on the right side and 10 on the left side. The mean follow-up for the whole sample was 74.2 ± 47.9 months. The AAOS classification of the whole sample was 3.33 ± 0.66 . The femoral head size was 22.2 mm for the THA-SC group and for those with acetabular cup size ≤ 48 mm in the THA-DM group. Basic characteristics of both groups are shown in Table 2.

All surgery was performed through a posterolateral approach, the same approach of the first primary surgery. There was a single complication (6.25%) in the THA-DM group, transient sciatic nerve palsy with complete recovery. The three complications of the THA-SC group were all early dislocations (23%). All were treated with closed reduction. No further dislocation episodes were encountered at the last follow-up for



Fig. 2 Patient 1 pre-operative x-ray of cup loosening



Fig. 3 Patient 1 post-operative x-ray of revision surgery with a Kerboul plate and standard cup

both groups. The mean pre-operative mHHS was similar in both groups (Table 2). The mean post-operative mHHS of the whole sample was 87.4 ± 11.4 ; the scores for THA-DM and THA-SC groups were of 87.4 ± 12.1 and 87.5 ± 10.9 , respectively. No infection was encountered in both groups.

At the time of the follow-up examination, complete trabeculation remodeling or cortical repair of the graft was observed in each of the three acetabular zones defined by DeLee and Charnley. In most cases, the aspect of the graft appeared to match that of the surrounding native bone, a sign of mature woven bone formation within the region of the graft. Radiolucent lines on the acetabular side between the bone and the graft were found in one patient in the THA-SC group and in two patients in the THA-DM group. The observed radiolucent lines were less than 1 mm thick and were non-progressive during the period of follow-up. The summary of comparative results is shown in Table 3.

Survival rates of surgical re-revision as an endpoint were 100% for both groups. If the endpoint dislocation is used, the survival rate gives 77% for the THA-SC group and 100% for the THA-DM group ($p = 0.04$).

Discussion

The results of this retrospective comparative study are in line with those reporting excellent outcomes of DM cups, be it in primary [8–11] or in revision THA [12, 13]. Our selected population of patients who underwent first revision THA using KP showed a significant difference in instability outcomes in favor of those with DM cups. Current literature reveals a tendency to increase the indications of contemporary DMC when managing instability following primary and revision [27, 28]. In fact, it has been demonstrated that when compared to other surgical constructs such as constrained acetabular cups, conventional cups, femoral head exchanges, stem exchanges, or anti-luxation rings, DMC alone yielded significantly less re-revision due to dislocation: 9% vs 2% [29].

Besides the dislocation outcome, acetabular reconstruction via KP was found to yield excellent functional results and that in both groups. We believe that such results are due to an automatic location of the hip centre. Additionally, the use of a reinforcement ring is thought to increase success rate because it protects the graft from excessive forces; it gives a better support of the cup and a better restoration of length of the lower limb [30, 31]. In order to recreate the anatomical position of the acetabular implant, the cross technique [23] has the advantage to offer a systematic approach for assessing acetabular defects and placing the KP.

Bone graft demonstrated excellent osteointegration in both groups with no osteolysis or acetabular failure. Most of the operated hips (90%) presented severe bone defects (AAOS stages 3 and 4), suggesting that this technique is highly reliable in acetabular reconstruction (Table 2).

Pieringer et al. [31] report a 17.2% rate of dislocation using the Burch-Schneider™ cage with standard cups for revision THA. Winter et al. [32] reported one dislocation in 38 THA revisions (2.6%) using the same cage and cups. On the other

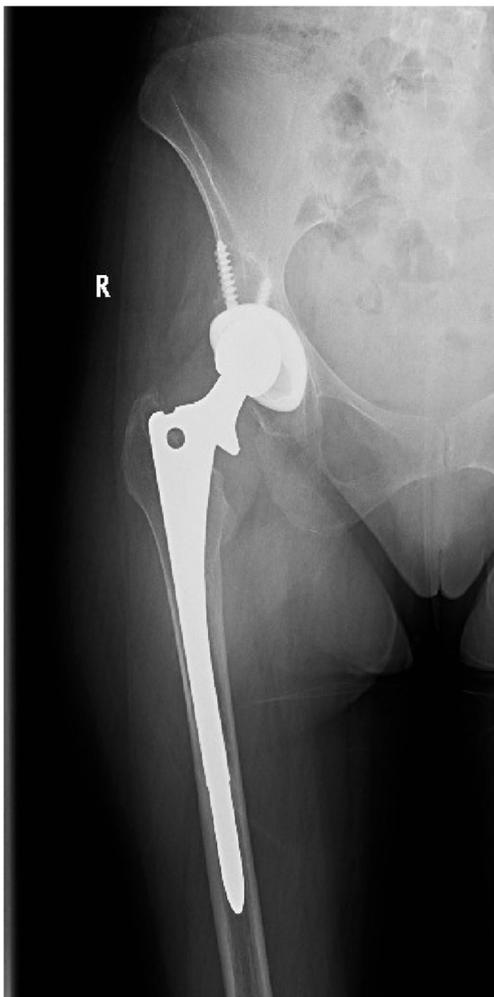


Fig. 4 Patient 2 pre-operative x-ray of cup loosening



Fig. 5 Patient 2 post-operative x-ray of revision surgery with Kerboul plate and dual mobility cup

hand, with the use of DM cups, Schneider et al. [19] reported 10.4% dislocations using different cage types; one patient out of two who presented a dislocation no longer had the greater trochanter. Wegrzyn et al. [22] and our series showed no dislocation when using KP with DM cups in first revision THA. A single DM cup failure necessitating revision has been reported in each of the three studies using different cage types (Table 1). No cup failure was encountered in our series and neither in that of Wegrzyn et al. [22] where KP was used. A possible explanation of the observed difference between Burch-Schneider™ and KP is that the former presents less depth when compared to the KP. Thus, the DM cup is better embedded in the KP.

Although we would expect a higher dislocation and revision rates with the DM group, due to the younger population [33], the results proved the opposite. The SC group showed a significantly higher dislocation rate. Several studies demonstrated that even in high-risk patients, significantly fewer dislocations following DMC, in both primary and revision THA

Table 2 Basic characteristics of the two groups

Group	THA-SC	THA-DMC	<i>p</i> value
Number of patients	10	16	–
Number of operated hips	13	16	–
Reason for revision	Aseptic loosening = 10	Aseptic loosening = 13 Infection = 3	–
Gender	4 M, 6 F	3 M, 13 F	0.4
Side	9 R, 4 L	10 R, 6 L	0.05
Mean age	78.5 ± 17.8	69.2 ± 14.8	0.01
AAOS acetabular defect classification	3.18 ± 0.75	3.46 ± 0.5	0.25
Femoral head size	22.2 mm	22.2 mm for cups ≤ 48 mm, 28 for cups > 48 mm	–
Acetabular cup size	50–54 mm	46–52 mm	–
Mean follow-up period	97.9 ± 46.8 months	72.9 ± 40.5 months	0.1
Pre-operative mHHS	28.1	26.2	0.8

THA, total hip arthroplasty; DMC, dual mobility cup; SC, standard cup

[34, 35]. Additionally, knowing that most dislocations usually occur within the first two years after revision [36], it is unlikely that a high number of new dislocation episodes would happen after more than six years of follow-up.

Besides the dislocation rate, all outcomes were similar in both groups. Such similarity is likely to be the consequence of using systematically the posterolateral approach, the KP for acetabular reconstruction, and the same cross technique for KP placement and grafting. That would add substantial homogeneity between groups in terms of the operative technique and thus would give more credit to the “cup type” variable. These results would suggest that DM cups could be a better option for prosthesis stability when compared to the SC for acetabular reconstruction using KP in first revision THA. These findings and in addition to those already reported [37–39] would confer DM cups the status of the gold standard cups in relation to the stability outcome.

No intra-prosthetic dislocation was encountered among our patients during a mean follow-up of 6.2 years. This is in line with the fact that new DMC generation showed a quasi-disappearance of this complication [40–42].

The major limitations of this study are the small number of included patients and its retrospective non-randomized design. The limited number of the patients is due to the multiple restrictive criteria required for inclusion. The

samples were limited to first revision THA, posterolateral approach, the use of KP as an antiprotrusion device, and the use of the same technique for KP placement. Where all other reports were cohort studies, our study is the first comparative series between both cup types in first revision THA with KP. Future randomized study with larger samples is already planned by the same investigators. On the other hand, the two groups were quite similar in terms of pre-operative and post-operative variables. One would argue that the age difference between the two groups would have affected the outcomes. But the fact that the mean age in both groups falls within a senior population counters that argument. The femoral head size difference could not be considered as a limitation since the DMC concept is based on increasing the size of the prosthetic head: the effective diameter of the femoral head is the outer diameter of the polyethylene mobile component [43]. Another potential limitation might be that comparison was done between two different teams. However, since the same technique, the cross technique, has been used in placing the KP, the cup type is believed to be the only variable which has yielded the difference in the dislocation rate between the two studied groups.

In conclusion, the mid-term results of using DM cups with KP in first revision THA are encouraging. Such findings would add to the published body of data which demonstrates higher prosthesis stability when using DM cups. This study would incite surgeons to use the association of DM cups with KP in acetabular reconstruction via the cross technique guidelines.

Compliance with ethical standards

Conflict of interest Assi and Caton declare royalties from Lepine Group. Fawaz, Samaha, and Yammine have no financial statement to declare.

Table 3 Comparative outcomes

Group	THA-SC	THA-DMC	<i>p</i> value
Dislocation rate	3/13 (23%)	0/16	0.04
Revision rate	0	0	–
Infection rate	0	0	–
Graft osteointegration score	7.7 ± 0.48	7.8 ± 0.54	0.8
Postoperative mHHS	87.5 ± 10.9	87.4 ± 12.1	0.9

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent For this type of study, formal consent is not required.

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