TREATMENT OF RECURRENT THR DISLOCATION USING OF A CEMENTLESS DUAL-MOBILITY CUP: A 59 CASES SERIES WITH A MEAN 8 YEARS’ FOLLOW-UP

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KEYWORDS
Dislocation; Recurrence; Total hip replacement; Dual-mobility; Revision

SUMMARY
Introduction: Instability is one of the most feared complications following total hip replacement (THR). In France, dual-mobility cups are widely used in acetabular revision for instability; few studies, however, have focused on this type of implant.

Hypothesis: The gain in stability provided by the dual-mobility implant allows the risk of dislocation to decrease by the sole revision of the acetabular component in case of recurrent instability.

Objectives: This hypothesis was tested over medium-term follow-up of a series of cementless dual-mobility cups implanted during isolated acetabular revision for recurrent dislocation.

Patients and methods: A series of THR revision for instability was analyzed retrospectively. Inclusion criteria were: recurrent THR dislocation treated by cementless dual-mobility cup, between 1995 and 2001. Radiological analysis used Imagika™ software. Fifty-nine patients were included; nine died before radioclinical follow-up could be performed; none of the survivors were lost to follow-up. Mean follow-up was 8 years (range, 6–11 years).

Results: There was one early dislocation without recurrence; the dislocation rate was 1.7%. At follow-up, mean PMA score was 16.5 (12–18) and mean Harris score 86.7 (49–99). Radiologically, there was no loosening or migration, but 19% of X-ray views showed less than 1 mm wide peri-acetabular radiolucency. With dislocation as censoring criterion, 8-year survivorship was 98% (95% CI: 95–100%).

Discussion: The dislocation rate (1.7%) and clinical results were better than in most series of revision by constrained cup for recurrent dislocation. The high rate of peri-acetabular radiolucency would seem to relate to the external coating of the cup: aluminum oxide in the Novae-1 implant and aluminum oxide/hydroxyapatite in the Novae-E.
Conclusion: The use of dual-mobility cups to treat THR instability gave satisfactory results. We recommend dual-mobility cups with hydroxyapatite surface treatment over a porous metallic substrate, rather than with an aluminum oxide or an aluminum oxide/hydroxyapatite bilayer coating.

Level of evidence: Level IV. Retrospective Study.

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Introduction

Dislocation is one of the most feared complications following total hip replacement (THR). Huten estimated the frequency at 2% on the basis of a large-scale review of the literature [1]. In France, acetabular component replacement by dual-mobility cup to treat recurrent dislocation is frequent, but little described in the literature [2,3]. The dual-mobility concept (a polyethylene component, non-constrained with respect to the cup and constrained with respect to the femoral head) proved effective in preventing instability in recent series [4–6]. Lautridou et al. [4] reported 1.1% dislocation at 15 years in a series of 437 dual-mobility cups used in primary THR; Leclercq et al. [5] in a series of 200 THRs at 10 years’ follow-up (FU) and Philippot et al. [6] in a series of 384 at 15 years’ FU, found no cases of dislocation. The literature contains only two studies using of dual-mobility cups to manage implant instability: Leclercq et al. [2] with a series of 13 and Guyen et al. [3] with a series of 54, at respectively 2 and 4 years’ FU. The present study analyzed results over a longer term (minimum FU = 6 years) for revision using a dual-mobility cup for instability.

Patients and methods

Patients

This was a single-center retrospective study, including all cases of acetabular revision prior to 2001 for recurrent THR dislocation using a dual-mobility implant. During the same period, other treatments for recurrent dislocation were also used in our department, such as revision for wedge augmentation or for liner exchange. The series comprised 59 patients operated on between 1995 and 2001 using a Novae cup: 44 Novae-1TM cups (Figs. 1 and 2) and 15 Novae-E (Figs. 3 and 4). The Novae-E model introduces two major changes to the Novae-1 cup: no posterolateral cap, and an aluminum oxide/hydroxyapatite bilayer coating.

The series comprised 27 males and 32 females, with 30 right and 29 left hips. Patients’ mean height was 168 cm (range, 153—187 cm), mean weight 76 kg (52—120), and mean BMI 27.9 (18.4—59.1) with 31 patients overweight (BMI > 25). Mean age at revision by dual-mobility cup was 68 years (47—88). On the Charnley classification [7], 21 patients were grade A, six grade B1, one grade B2 and 22 grade C. The initial acetabular component was cemented in 16 cases and non-cemented in 43. The initial approach was systematically posterolateral. The friction couple was always metal/polyethylene. The femoral stem was systematically cemented. All femoral heads were 28 mm diameter.

Method of assessment

Clinical and X-ray data were analyzed by a single observer, who had not been involved in the surgery. Clinical analysis was based on Postel-Merle d’Aubigné [8], Harris [9] and normalized WOMAC scores [10].

The De Lee and Charnley classification [11] was used for topographic analysis of osteolysis and peri-acetabular radiolucency. Cup fixation defect was defined by complete (3-zone) radioluency of 2 mm. Radiological analysis used...
Imagika software (View Tech®) (Fig. 5), the reproductibility and precision of which is reported by Girard et al. [12]. Views not meeting Massin et al.’s [13] rotation and tilt criteria were excluded from analysis. Radiological enlargement was calculated from real diameter and measured cup diameter. Cup migration was defined as greater than 3 mm change in rotation center or greater than 8° change in inclination angle between postoperative and follow-up.

Statistical analysis used NCSS® software. Quantitative variable distributions were compared by Chi² test, and matched series by t-test. The significance threshold was set at 0.05. The survivorship curve was analyzed following Kaplan-Meier, with recurrence of dislocation as censoring criterion and the confidence interval set at 95%.

Results

Nine of the 59 patients died, but no others were lost to follow-up. Thus, 50 patients were included in the radioclinical assessment, at a mean 8 years’ follow-up (range, 6–11 years).

Complications

One true dislocation of the great joint (between the polyethylene liner and the cup) occurred at 35 days postoperatively in a patient with multiple sclerosis, but without any other dislocation risk factors. Reduction by external
Revision of recurrent THR dislocation by dual mobility cup

Table 1

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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Lowest</td>
</tr>
<tr>
<td>Mean Harris</td>
<td>86.7</td>
<td>49</td>
</tr>
<tr>
<td>Harris pain</td>
<td>40.9</td>
<td>20</td>
</tr>
<tr>
<td>Harris function</td>
<td>41.1</td>
<td>17</td>
</tr>
<tr>
<td>Harris mobility</td>
<td>4.4</td>
<td>3</td>
</tr>
<tr>
<td>Mean PMA</td>
<td>16.5</td>
<td>12</td>
</tr>
<tr>
<td>PMA pain</td>
<td>5.5</td>
<td>4</td>
</tr>
<tr>
<td>PMA mobility</td>
<td>5.9</td>
<td>5</td>
</tr>
<tr>
<td>PMA function</td>
<td>5.1</td>
<td>1</td>
</tr>
<tr>
<td>Normalized WOMAC</td>
<td>26.6</td>
<td>21.4</td>
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maneuver under general anesthesia was performed without difficulty. There was no recurrence at 74 months’ follow-up, and no intraprosthesis dislocation (of the small joint between the polyethylene liner and the femoral head) was observed.

Four patients showed symptomaticology of iliopsoas irritation during short-term follow-up after revision, in the form of pain on impeded active flexion of the thigh. They were managed medically, with per os non-steroid anti-inflammatory drugs. All were followed up, and none showed any signs of tendinitis at last follow-up. One patient developed a hematoma requiring surgical evacuation. One sustained a femoral fracture under the stem, without loosening, which was managed by a screwed plate. One patient showed early infection, managed by lavage and debridement and antibiotherapy. No components explantations were required.

**Clinical results**

At 8 years’ FU, the mean Postel-Merle d’Aubigné (PMA) score was 16.5 (range, 12—18), 5.5 mean pain score, 5.9 mean mobility score, and 5.1 mean function score. There were thus 2% excellent, 30% very good, 24% good, 14% acceptable and no poor results. Mean Harris score was 86.7 (range, 49—100), with 32% very good, 30% good, 24% fairly good and 8% acceptable or poor results (Table 1). Only 34 WOMAC questionnaires were analyzable, and showed a mean score of 26.6 (range, 21.4—30). At last follow-up, 18 patients (36%) had pain (14 mild, four moderate), and 38 (76%) could walk without a cane. Mean mobility was 98° (range, 85—130°) in flexion, 2° (0—10°) in extension, 33° (10—50°) in abduction, 19° (10—45°) in adduction, 27° (10—50°) in external rotation and 17° (0—30°) in internal rotation. Only 13 patients (26%) showed a limp, and 11 (22%) used at least one cane to walk.

**Radiologic results**

Postoperative X-ray found gaps (of less than 1 mm in thickness) in 27% of cases (16/59); all had disappeared by last follow-up. On the other hand, last follow-up X-rays showed peri-acetabular radiolucency in 18% of cases (9/50): three complete, three in zone 1, two in zone 2 and one in zone 3; all were less than 1 mm thick. Peri-acetabular radiolucency correlated significantly with presence of pain (P = 0.02, matched t-test). No osteolysis or failure of fixation was observed in the 50 last follow-up X-rays. Migration analysis was feasible in 43 cases of revision, and no migration was found.

**Survivorship analysis**

A single case of post-revision dislocation occurred, giving an 8-year survivorship of 98% (95% CI: 95—100%).

**Discussion**

**Study limitations**

The main limitation of this study lies in its retrospective design. Another is a possible recruitment bias: other forms of treatment of recurrent THR dislocation, notably revision for wedge augmentation and liner exchange, were used concomitantly in the department.

**Recurrent dislocation management**

The management of recurrent THR dislocation is not standardized, varying between surgeons, institutions and countries. Huten [1] stresses the need to explore for etiological factors (implant malorientation, insufficient soft-tissue tension, cam effect, and implant laxity [separation]), which should be corrected if found. Studies of revision for isolated etiological treatment without change of implant type, however, reported unsatisfactory results: 39% recurrence for Daly et Morrey [14] and 24% for Fraser et Wroblewski [15]. Revision by wedge augmentation or liner exchange also runs an elevated risk of recurrence: 24% for Madan et al. [16] in a series of 68 cases, and 17% for Nicholl et al. [17] in a series of 28. Moreover, according to Bidar et al. [18] these procedures should be restricted to non-loose and correctly oriented cups in patients who have not undergone iterative surgery. In the management of recurrent THR dislocation, revision to replace the acetabular component by an implant less subject to dislocation has the advantage of correcting certain etiological factors while increasing mechanical resistance to dislocation. The most frequently used acetabular implants are non-constrainedtripolar cups (such as dual-mobility cups) and constrained cups (whether tri- or not). Sikes et al. [19] and Amstutz et al. [20] also recommend large-diameter cups (metal/metal or metal/polyethylene), but only Amstutz et al.’s study [20] reported results, with a recurrence rate of 14%, which was rather high.

The present recurrence rate of 1.7% was close to that reported by Guyen et al. [5]: 1.9% at a mean 4 years’ FU. Recurrence rates with constrained cups varied: Knudsen et al. [21] reported 10%, Berend et al. [22] 8.3%, Levine et al. [23] 7%, Bremner et al. [24] 5.4%, Callaghan et al. [25] 7.1%, Goetz et al. [26] 3.7%, Khan et al. [27] 2.9%, Shapiro et al. [28] 2.4% and Shrader et al. [29] 0%. The present recurrence rate is thus identical to or lower than that of most series using constrained cups, confirming the suitability of dual-mobility cups in recurrent dislocation.
Clinical results

Table 2 compares the present results to those of series using constrained implants in the same indication. The rate of residual pain was equivalent to that reported for constrained cups, and the mean Harris score was higher. The populations studied in these various reports, however, were certainly not homogeneous, especially in terms of pre-operative clinical scores and degree of initial THR instability.

Implant-related complications

Intrapesthetic dislocation is a classical complication in dual-mobility implants, but did not occur in the present series. Two protective factors may be noted. The first is the relatively high age of the present population, intrapesthetic dislocation being more frequently found in young active patients. The second concerned the design of the femoral component, which was always a stem with an "unaggressive" cylindrical neck, without relief. There was a relatively high rate (36%) of residual pain in the present series. This is worrying, even if the pain was mild to moderate. A significant correlation was found between peri-acetabular radiolucency and presence of pain, so that a secondary stability (osteointegration) defect may be the underlying cause. Radiolucency implies an osteointegration defect with the Novae cups, which led us to abandon dual-mobility cups with aluminum oxide or aluminum oxide/hydroxyapatite coatings in favor of a hydroxyapatite bilayer on a porous metal substrate (titanium plasma spray).

Constrained cups also have their specific complications issues, with a risk of disassembly and acetabular loosening. There are several reports of high rates of early loosening: Khan et al. [27] found 14% at 36 months' FU, Bremner et al. [9] Harris hip scores [9] in constrained cup series.

Table 2

<table>
<thead>
<tr>
<th>Authors</th>
<th>Number of patients</th>
<th>Follow-up (months)</th>
<th>Mean Harris score</th>
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<tbody>
<tr>
<td>Anderson et al.</td>
<td>21</td>
<td>31</td>
<td>76</td>
</tr>
<tr>
<td>Berend et al.</td>
<td>128</td>
<td>120</td>
<td>64.6</td>
</tr>
<tr>
<td>Callaghan et al.</td>
<td>31</td>
<td>46</td>
<td>80.8</td>
</tr>
<tr>
<td>Khan et al.</td>
<td>34</td>
<td>36</td>
<td>69</td>
</tr>
<tr>
<td>Shrade et al.</td>
<td>79</td>
<td>36</td>
<td>76.4</td>
</tr>
<tr>
<td>Present series</td>
<td>59</td>
<td>96</td>
<td>86.7</td>
</tr>
</tbody>
</table>

et al. [39] found five particular types of disassembly with the Tripolar Omnifit™ retentive cup. It is thus because of both their complexity and their constrained design that constrained cups are liable to disassembly. Moreover, in case of disassembly, the implant loses its retentive capacity, entailing a risk of recurrence of dislocation, generally requiring surgical revision. In dual-mobility cup dislocation, reduction is always possible, in our experience; and once reduced, the dual-mobility implant recovers its original dislocation resistance, whereas constrained cups lose retentiveness following dislocation.

Conclusion

Dual-mobility cup revision for recurrent THR dislocation presently appears to be the most effective attitude, with 1.7% recurrence at 8 years. Peri-acetabular radiolucency and residual pain should be reduced by the use of dual-mobility implants with an adequate porous coating.

In implant instability, dual-mobility cups seem preferable to constrained cups, which show higher dislocation recurrence rates and involve specific mechanical complications.

In young patients, dual-mobility cups entail a risk of intraprosthesis, and other forms of treatment may be recommended, such as large-diameter implants as suggested by certain authors, although this attitude remains to be confirmed.

Conflict of interest statement

None.

References

Revision of recurrent THR dislocation by dual mobility cup


