Total hip arthroplasty dislocation rate following isolated cup revision using Hueter’s direct anterior approach on a fracture table

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KEYWORDS
Total hip arthroplasty; Dislocation rate; Revision; Anterior approach

Summary
Introduction: Instability is a major complication after revision total hip arthroplasty. Studies in the literature have shown that the dislocation rate after primary arthroplasties by anterior approach on a fracture table is satisfactory, but the rate of instability following revision surgery is not known.

Hypothesis and aims: We hypothesized that the Hueter direct anterior approach would result in a lower rate of postoperative dislocation following revision surgery. This hypothesis was tested in a series of isolated acetabular component replacements.

Patients and methods: Seventy-three consecutive isolated acetabular component replacements were performed between January 2000 and December 2007. Twelve revisions using constrained liners or dual mobility cups were excluded, thus 61 revisions in 59 patients, mean age 65.8-year-old (range 27–86) were included. The indications for revision arthroplasty were: 51 (83.6%) cases of aseptic loosening, five (8.2%) non-integration of cementless cups, three (4.9%) cases of instability, one (1.6%) case of impingement with the psoas and one (1.6%) case of excessive (3 cm) lengthening. Acetabular bone defects were moderate, with 12 stage I, 26 stage II, 19 stage III, and only four stage IV defects on the SOFCOT bone stock deficiency score. There was no acetabular reconstruction in 18 cases, while there were four isolated reconstruction cages and 39 cages with a graft. The replacement cup was cemented in 52 cases and cementless in nine. Inclination and anteversion were measured by the Pradhan method on standard X-rays.

Results: Results were evaluated after a mean follow-up of 2.4 years ± 1.7 years (1–7 years). Four dislocations were observed (6.6%) all anterior and early in the postoperative period (less than 2 months): three patients had a single episode of dislocation and one patient again
underwent revision cup replacement by Hueter anterior approach for recurrent anterior dislocation. The only factor associated with a risk of dislocation was a high body mass index: 29.7 ± 0.8 in the group with dislocation compared to 25.6 ± 3.2 in the group without (P = 0.008). A high number of prior interventions was also a significant risk factor (P = 0.045). On the other hand, there was no difference in cup inclination or femoral offset between the group with dislocation and that without.

Discussion: Although the rate of dislocation is higher than after primary THA by anterior approach, it remains acceptable for revision THA and is similar to rates observed with other approaches. The literature does not clearly establish that one surgical approach is better than another in terms of instability. This study was limited by the absence of CT-scan measurements of component orientation both preoperatively to evaluate the femoral component which is preserved, as well as during follow-up to evaluate cup angle and compare the groups with and without dislocation.

Conclusion: The Hueter direct anterior approach is a viable option for isolated cup revision, as long as femoral loosening has been excluded, and the orientation of the preserved femoral component is known.

Level of evidence: Level IV; retrospective study.

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Introduction

Dislocation is a serious complication [1,2] of primary total hip arthroplasty (THA). The postoperative incidence is approximately 1%, both by Moore’s posterolateral approach (1% in the series by Ogonda et al. [1]) and by the Hueter direct anterior approach (1.5% in the series by Sariali et al. [3]). The dislocation rate is three to five times higher after revision THA (RTHA), than after primary THA. [4,5]. The most frequent surgical approach for RTHA is posterolateral because both the acetabulum and the proximal and diaphyseal femur are accessible. The rate of dislocation following primary THA by the Hueter direct anterior approach is known to be low. We therefore hypothesized that the rate of postoperative dislocation following RTHA by this same approach would be low. However, there are limitations to this approach, in particular for femoral exposure, which is less satisfactory than by a posterior approach, especially if reconstruction is necessary. We therefore limited the indication for this approach to cases of isolated acetabular component replacement. The aim of this study was to confirm this hypothesis in a series of isolated cup replacements.

Patients and methods

Patients

Between January 1 and December 31, 2007, 447 revision total hip arthroplasties were performed in our unit, including 209 bipolar revisions, 42 isolated femoral component replacements, and 196 isolated cup replacements. Seventy-three of these isolated cup replacements were performed by anterior approach in 70 patients. To prevent a bias in the analysis of the instability rate, we excluded 12 of these hips which were revised with a dual mobility cup (10 hips) or a constrained liner (two hips).

The retrospective series of the 61 remaining hips in 59 patients included 14 men (23.7%) and 45 women (76.3%), mean age 65.8-year-old (range 27 to 86) with a mean body mass index (BMI) of 25.9 (range 20.1 to 35.2).

The indications for acetabular revision with a standard cup in the 61 remaining cups were: aseptic loosening in 51 cases (83.6%), non-integration of a cementless cup in five cases (8.2%), instability in three cases (4.9%), impingement with the posas in one case (1.6%) and excessive lengthening (3 cm) in one case (1.6%). The number of prior operations was one in 54 hips, two in five hips, three in one hip and four in one hip. The prior surgical approach was a direct anterior approach in 58 hips (Hueter in 54 cases and Smith-Petersen in four cases) and anterolateral in three hips (Watson-Jones). Patients were treated by five experienced surgeons.

Surgical method

All procedures were performed under general anesthesia. The patient was placed in the supine position on an orthopedic traction table so the limb could be manipulated for traction, rotation, adduction and hyperextension. During the approach the rectus femoris flexor tendon was not split. After dislocation, traction was released to prevent femoral interference from above and acetabular exposure was completed by placing a Hohman retractor on the posterior rim of acetabulum to prevent femoral obstruction from behind. Acetabular defects were evaluated based on the SOFCOT score [6], and were usually limited, including 12 stage I and 26 stage II, with only 19 stage III and four stage IV defects. There were no associated surgical procedures in 18 operations, a simple reinforcement device in four others and an acetabular graft with internal fixation in 39 hips. The cup was cemented in 52 cases and cementless in nine cases. The diameter of the femoral head was 22.2 mm in 25 cases, 28 mm in 35 cases and 32 mm in one case.

Method of evaluation

All patients were followed up for a minimum of 1 year and a maximum of 7 years (mean 2.4 years ± 1.7) with a clinical (Merle Aubigné PMA score [7]) and radiological evaluation including AP and profile standing views of the pelvis and hip. Cup inclination and anteverision were calculated for each patient on standard AP X-rays of the pelvis. The inclination was calculated according to the angle between the main axis of the ellipse and the teardrop line. Anteverision was calcu-
Dislocation rate after cup revision by anterior approach

The BMI was significantly higher in the patients with dislocation than in those without (29.7 ± 0.8 vs 25.6 ± 3.2 respectively, \( P = 0.008 \)). There were also a greater number of hips that had undergone several operations in the group with dislocations (\( P = 0.045 \)). On the other hand, there was no significant difference between the two groups for the factors: (age, sex, preoperative range of motion and diameter of the femoral head) (Table 1). The mean PMA score at the final follow-up was 17.75 ± 0.5 in the group with dislocation versus 17.3 ± 1.5 in the group without (NS).

There was no significant difference in inclination (dislocated 39.5° ± 4° and non-dislocated 44.5° ± 5.5° \( [P = 0.07] \)) or cup anteversion (dislocated 25.6° ± 11° and non-dislocated 18.9° ± 9° \( [P = 0.415] \)) between the two groups.

Mean femoral offset was 5.5 cm ± 1.7 cm in the group with dislocation and 4.7 cm ± 0.9 cm in the group without. This difference was not significant (\( P = 0.15 \)). Moreover, there was no significant difference in the proportion of short femoral necks between the two groups (\( P = 0.14 \)).

Two of the dislocated hips (50%) presented with shortening of more than 5 mm (including one with more than 1 cm) and none of these patients presented with lengthening of more than 5 mm. Ten of the non-dislocated hips (17.5%) presented with more than 5 mm of shortening (including four with more than 1 cm) and 17 (29.8%) presented with lengthening of more than 5 mm (including 12 with more than 1 cm). There were no differences between the groups with and without dislocation for any of these variables.

Table 1 Comparative statistical analysis between the group with dislocation and without.

<table>
<thead>
<tr>
<th></th>
<th>Dislocated (4/61)</th>
<th>Non-dislocated (57/61)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>66.5 ± 12.5</td>
<td>65.6 ± 13.1</td>
<td>0.9 (NS)</td>
</tr>
<tr>
<td>Sex</td>
<td>1H/3F</td>
<td>14H/43F</td>
<td>1 (NS)</td>
</tr>
<tr>
<td>BMI</td>
<td>29.7 ± 0.8</td>
<td>25.6 ± 3.2</td>
<td>0.008 (S)</td>
</tr>
<tr>
<td>Preoperative ROM* (degrees)</td>
<td>217 ± 29</td>
<td>197.4 ± 36.7</td>
<td>0.522 (NS)</td>
</tr>
<tr>
<td>Several operations (≥ 2 interventions)</td>
<td>2/4 (50%)</td>
<td>4/57 (7%)</td>
<td>0.045 (S)</td>
</tr>
<tr>
<td>Head diameter ≥ 28 mm</td>
<td>3/4 (75%)</td>
<td>34/57 (59.6%)</td>
<td>1 (NS)</td>
</tr>
<tr>
<td>Cup anteversion (degrees)</td>
<td>25.6 ± 11.5</td>
<td>18.9 ± 9</td>
<td>0.415 (NS)</td>
</tr>
<tr>
<td>Cup inclination (degrees)</td>
<td>39.5 ± 4</td>
<td>44.5 ± 5.5</td>
<td>0.07 (NS)</td>
</tr>
<tr>
<td>Femoral offset (cm)</td>
<td>5.5 ± 1.7</td>
<td>4.7 ± 0.9</td>
<td>0.167 (NS)</td>
</tr>
<tr>
<td>PMA score at final follow-up</td>
<td>17.75 ± 0.5</td>
<td>17.3 ± 1.5</td>
<td>0.22 (NS)</td>
</tr>
</tbody>
</table>

*Preoperative range of motion is obtained by adding all sectors of motion.

**Statistical analysis**

The differences were analyzed with non-parametric tests, in particular the Mann-Whitney test for continuous variables and the Fisher exact test for non-continuous variables. A P value of less than 0.05 was considered to be statistically significant.

**Results**

Moreover, one patient presented with a hematoma requiring surgical removal 14 days after surgery. No septic or thromboembolic complications occurred.

**Discussion**

This series shows that the rate of dislocation for revision THA by anterior approach was higher, but still acceptable than when this approach was used for primary THA, and that our results were similar to those in published series. Indeed, in series reporting isolated cup revisions whatever the approach used, the dislocation rate was between 0 and 10%: 0% for Manning et al. [2] (posterolateral approach with posterior repair), 0% for O’Brien et al. [9] (direct lateral approach), 0% for Paratte et al. [10] (anterolateral approach), 3.4% for Raut et al. [11] (trochanterotomy), 4.7% for Thomasson et al. [12] (mostly anterior approaches), 8% for Poon and Lachiewicz [13] (posterolateral approach and trochanterotomy), 10.8% for Bidar et al. [14]

\[ \text{Anteversion} = \arcsin \left( \frac{p}{0.4D} \right) \]

\[ \text{D: large diameter of the cup} \]

\[ \text{M: point at 1/5th of D} \]

\[ \text{P: right angle between M the arc of the ellipse} \]

\[ \text{Anteversion} = \arcsin \left( \frac{p}{0.4D} \right) \]

\[ \text{Figure 1 Elements to calculate cup anteversion on an AP X-ray.} \]

\[ \text{D: large diameter of the cup; M: point at 1/5th of D; P: right angle between M the arc of the ellipse; Anteversion} = \arcsin \left( \frac{p}{0.4D} \right) \]
(posterolateral approach for isolated replacement of inserts with no cup reorientation). Moreover, these rates were similar to those following acetabular and femoral revisions: 1.7% for Marti et al. [14] (trochanterotomy), 1.8% for Hallstrom et al. [16] (posterolateral approach with trochanterotomy in 88% of the cases), 2.4% for Massin et al. [17] (posterolateral approach with trochanterotomies in 15%), 2.9% for Wroblewski et al. [18] (trochanterotomy), 7.4% for Alberton et al. [4] (direct lateral, transtrochanteric and posterolateral approaches), 8.2% for Callaghan et al. [19] (trochanterotomy), 8.4% for Mahomed et al. [20] (direct lateral, transtrochanteric and posterolateral approaches), 10% for Pascarel et al. [21] (posterolateral approach with trochanterotomies in 50%), 11.2% for Kershaw et al. [22] (anterolateral, posterolateral approaches and trochanterotomy), 11.9% for Woo et al. [5] (prospective series with direct lateral, transtrochanteric and posterolateral approaches). The small number of patients in certain series, [2,9,10], the retrospective design of most of these studies and the absence of randomized studies makes it impossible to confirm that one approach is more effective than another for revision THA, in particular in relation to the risk of dislocation.

Nevertheless, trochanterotomy has the disadvantage of increasing the risk of trochanteric nonunion [11,15,19,21,23,24], and there is an increased risk of cutaneous lateral femoral nerve injury with the direct anterior approach, although certain authors feel that this does not cause significant functional difficulties [25].

For primary THA the data on the advantages and disadvantages of the surgical approach are more systematic and the direct anterior approach has been found to be of interest because it preserves the soft tissues and because of the relatively limited risk of dislocation [26,27] due to preservation of the abductors and the posterior plane [28]. Several studies have shown that results with this approach are precise and reproducible for implant positioning as well as lower limb length equality, with satisfactory dislocation rates [3,29–33]. However, results of primary THA by other surgical approaches are equally satisfactory. The posterolateral approach is classically described as having a higher risk of dislocation because the posterior plane is not preserved, but a recent series does not confirm this and prevents this by capsular and pelvitrochanteric repair after placement of the implant [1,34,35]. Moreover, there are no long term functional differences with the different approaches, no matter how "invasive" they are for the periarticular muscles [36,37]. For although functional results are better with the direct anterior approach than with the direct lateral approach up to 1 year after surgery, results are similar at 2 years [38]. Moreover, a recent meta-analysis [39] does not confirm that one approach is optimal for primary THA, therefore we can assume that this is the same for revision arthroplasties, for which existing data are less rigorous. In fact, it is the individual needs of the patient and the technical preferences of the surgeon that count in these cases [36–39].

In our series, being overweight resulted in a statistically significant increase in the risk of postoperative dislocation which is logical considering the results in the literature on primary THA by Hueter direct anterior approach [3,5,20,40]. A greater number of surgical interventions before revision was also correlated with the risk of dislocation, which is comparable to results in the literature [3,5,12,14,20,40,41]. The limited number of cases makes it impossible to define other significant risk factors.

No instability was identified during surgery. This raises the question of the reliability of testing for stability on the orthopedic traction table compared to other approaches in which the limb is free.

This study was limited by the radiographic measurement of cup anteversion which is less precise than CT-scan. In particular, this study was limited by the absence of data on femoral stem anteversion:

1) first by preoperative CT-scan which would confirm the feasibility of isolated revision or the possibility of realigning the acetabular component to avoid postoperative dislocation by taking into account data on the non-revised component;

2) but also during surgery by anterior approach to confirm that a stable stem with insufficient anteversion or even retroversion can be left in place.

CT-scan measurements of femoral component orientation seem to be indispensable if a Hueter direct anterior approach is used for isolated revision of an acetabular component.

**Conclusion**

The Hueter anterior approach is a viable option for isolated cup revisions as long as the presence of femoral loosening has been excluded, and the orientation of the intact femoral component is known. With these limitations in mind, the Hueter direct anterior approach is an option for isolated cup revisions in particular following primary arthroplasties performed by anterior approach. The dislocation rate is acceptable and there is a low risk of complications as long as femoral problems which could require revision and especially reconstruction have been eliminated.

**Disclosure of interest**

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

**References**


Dislocation rate after cup revision by anterior approach


