Primary total hip arthroplasty revision due to dislocation: Prospective French multicenter study

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Summary
Introduction: Dislocation following total hip arthroplasty (THA) may require surgical revision, and is one of the most frequent causes for revision in national registers. The goals of this study were to determine the characteristics of revision THA for dislocation and identify the typical features of hips revised due to dislocation.
Materials and methods: A prospective multicenter study (30 centers) was performed in first revision THA performed between January 1, 2010 and December 31, 2011 (multiple revisions were excluded).
Results: Two hundred nineteen (10.4%) of all first revisions (2153 cases in 2107 patients) were for dislocation, which was the fifth cause of revision. There were 135 men and 84 women, mean age 65.9 years old (24.3–92.4) at primary THA and 72.9 years old (31.9–98.8) at revision. Revision surgery was performed a mean 7.1 years (±7.1) after primary THA. The predictive risk factors for dislocation were: a 22.2 mm diameter femoral head (risk × 2.4), a posterolateral approach (risk × 1.7), older age (risk × 1.1), an elevated rim liner for primary THA (risk × 6.6). The use of a dual mobility cup did not influence the rate of revision for dislocation (8.8%) compared to the use of a flat rim liner (9.1%).

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Discussion: The 10.4% rate of revision of THA for dislocation seems markedly lower than the results in the literature both for frequency and ranking. The use of elevated rim or constrained liners designed to decrease the risk of dislocation does not improve results compared to standard liners.

Level of evidence: Level IV, prospective prognostic study without a control group.

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Introduction

The frequency of dislocation in total hip arthroplasties (THA) varies from 2–5% [1–3] in the literature. Huten [2] reported a mean frequency of 2–3% in a large review of the literature. An estimated 2800–4200 patients may develop this complication out of the 140,000 THA performed in France annually. Although the use of dual mobility cups seems to reduce the risk of dislocation in France [4–7], these cups cannot be systematically recommended to patients under the age of 75 and/or in more active patients [8].

Treatment of the first episode of dislocation is often conservative and non-surgical and does not present a problem. On the other hand, the prevention and treatment of recurrent dislocation is more complicated, especially since it occurs in one or two cases out of three [1]. For example, in the Swedish national register, 8.7% of the cases of surgical revision of THA are for recurrent dislocation [9] which is the second cause of surgical revision, well behind aseptic loosening (73.1%), but just before deep infection (7.8%). The distribution in the USA between 2005 and 2006 was different, with dislocation as the primary cause of revision in 22% [10], compared to 20% for aseptic loosening and 15% for infection. However, this study included all revision THA and not just the first revision of primary THA.

The main goal of this study was to determine the characteristics of the group that underwent surgical revision of primary THA for dislocation in a cohort of patients who underwent surgical revision of primary THA¹ and to compare these results with those of reference national registers. The secondary goal was to identify the typical features of hip arthroplasties requiring revision for dislocation compared to those for other causes of revision.

Materials and methods

Materials

A prospective multicenter study (30 centers) was performed by the French Society of Orthopedics and Traumatology (SOFCOT) on first revisions of THA performed between January 1, 2010 and December 31, 2011 (multiple revisions were excluded). Two hundred and nineteen THA revisions for dislocation were identified out of 2107 first revisions (10.4%).

Evaluation methods

The SOFCOT evaluation form was used to gather demographic, anthropometric and clinical data (Oxford-12 hip classification [11], Postel Merle d’Aubigné [PMA] score [12] and Harris [13] score) as well as the details of surgery and the implants used for revision surgery. The surgical approaches for primary and revision THA, the types of implants used, the delay between primary THA and revision and the number of previous interventions on the hip were noted.

The different surgical techniques were described: change of one or more components, revision of the bearing couple, insertion of a dual mobility cup, of a large diameter or a constrained acetabular cup, associated procedures of the soft tissues and/or the greater trochanter.

Statistical methods

Statistical analyses were performed at the Biostatistics unit of the CHRU Lille using SAS version 9.2 and SPSS version 15.0 software. Descriptive statistics were performed by analysis of continuous, ordinal, qualitative and/or nominal variables. Bi-variate comparisons between groups were performed by the Student t-test or analysis of variance if there were more than 30 in the group. The Mann-Whitney test or the Kruskal-Wallis test was used if there were fewer than 30 in the group. Group comparisons were analyzed by the Chi² or Fischer exact test. Multivariate analysis was performed by logistic regression. The predictive risk factors were evaluated by stepwise logistic regression analysis (Odds Ratio) comparing the group that underwent revision for dislocation to the other groups.

Results

The population

Revisions for dislocation represented 10.4% of the cases of first revision THA and was the fifth cause of revision. The causes of revision ranked by frequency were aseptic loosening (891 cases), peri-prosthetic fractures (249 cases), infection (240 cases), wear (230 cases), dislocation (219 cases), technical errors (119 cases), implant fractures (67 cases) and unexplained pain (51 cases). There were 135 men and 84 women with a mean age of 65.9 years old (24.3–92.4) at primary THA and 72.9 years old (31.9–92.8) at revision. The mean Body Mass Index (BMI) was 26.2 (17.3–45.4) with 20% of obese patients (44 cases) (BMI > 30). The mean height was 164 cm (142–187) and weight was 72.7 kg (40–110).

Etiologies for the indication of primary arthroplasty were: primary osteoarthritis in 150 cases (68.4%), necrosis in 20 cases (9.1%), dysplasia in 13 cases (5.9%), inflammatory coxitis in six cases (2.7%), post-traumatic in 22 cases (9.9%) and other causes in eight cases (9.6%).

Prior to revision for dislocation, patients presented with a mean PMA score of 13.4 (2–18). There was very little pain

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¹ Study presented at the Symposium on revision of primary THA at the SoFCOT meeting in Paris, November 2012.
in most of the hips because the pain score was greater or equal to 5 points for 119 hips (54%). Hip mobility was still very good because the score was greater or equal to 5 points in 178 hips (81.3%) with flexion range of motion of more than 90° in 149 cases (70.3% of cases). Moreover, the effect on walking was limited with a score of greater or equal to 5 in 107 patients (48.8%). On the other hand, the patients had significant medical problems because only 13.9% of the patients were ASA 1, 54.5% ASA 2 and 31.6% ASA 3 and 4 (respectively 28.7% and 2.9%). Like the PMA score, preoperative functional changes were relatively slight, with a mean Oxford score of 33.8 (13–60). The patients were not particularly active because the Devane score was category I, II and III for 10.3%, 42.2% and 34.7% of patients respectively, while only 12.7% were very active with scores of IV and V (9.4% and 3.3% respectively). A single hip was involved in most patients as shown by the Charnley score which was class A in 62.1% of cases, and classes B and C in only 26.5% and 11.4% of cases respectively.

**Primary arthroplasty**

The characteristics of the implants for primary THA are found in Table 1. The diameter of the femoral head component for primary THA was 28 mm in most (107, 49%) cases and the mean diameter of the cup was 51.8 mm (42–64).

The surgical approach was posterior in most (155, 70.7%) cases, the cup was cementless in 139 (63.8%) and the femoral stem was cemented in 114 (53%). Bearing couples were hard on soft in most (180, 82%) cases and hard on hard in 39 (18%). Dislocations involved a cup or a standard (flat rim) liner in 180 cases (83.3%), a cup with an elevated rim liner in 22 cases (10.2%), a dual mobility cup in 12 cases (5.6%), a constrained liner in two cases (0.9%) and was not described in three cases.

Besides dislocation, which was the indication for additional surgery, 15 postoperative complications occurred following primary THA (6.9%) including nine misdirections or fractures, one re-cementing of the femoral stem component, four suspected femoral stem component instabilities and one gluteal avulsion.

**Revision surgery**

Revision THA was performed a mean 7.1 years (±7.1) after primary THA and lasted a mean 88 min (28–298). The characteristics of the techniques and the implants used for these revisions are described in Table 1. The distribution of the surgical approaches was comparable to that of primary THA with a posterior approach in most (152, 69.4%) cases. Most revisions involved the acetabular component (165 cases, 75.3%), both components in 45 cases (21%) and a femoral revision alone in six cases (2.7%). Head-neck resection was performed in two cases (0.9%).

As in primary THA, fixation of most cups was cementless (128 hips, 63.3%). A reinforcement ring was used in 12.7% of the cases. An acetabular graft was performed in 42 cases (15 allografts, 7 autografts, 10 mixed and 10 bone substitutes). Like primary THA, fixation of the revision stem was cemented in most (36, 62.3%) cases. Grafts were only necessary in three femurs (2 autografts and 1 bone substitute). The revision bearing couple was hard on soft even more frequently than for primary THA (204 cases, 96.7%) including 35 high cross-linked polyethylene liners. Most (173) revisions were performed with dual mobility cups (79.7%).

In 175 cases (84.1%), there were no complications after revision. Postoperative complications included 12 infections (5.3%), nine recurrent dislocations (4.3%), three evacuated hematomas (1.3%) and five sciatic nerve palsy (2.4%). Six patients (2.7%) died within 3 months after revision surgery.

**Statistical correlations**

Several significant differences were observed between the revision for dislocation group and the group with revision for other causes in the symposium cohort: the presence of a history of medical treatment and local surgery at primary THA ($P = 0.001$), a small diameter femoral head at primary THA ($P = 0.0025$), a well-preserved flexion (greater than 90°, $P = 0.0001$), and the type of acetabular component at primary THA (cups or liners with elevated rims had a higher risk of revision for dislocation, $P = 0.004$). Dual mobility cups did not prevent the risk of revision due to dislocation since 5.6% of these revisions included this type of component. However, when cases of intraprothetic dislocation were included, (12) 8.8% of dual mobility cups were revised for dislocation compared to 9.1% with standard liners, 15.8% with elevated

### Table 1: Characteristics of revised primary total hip arthroplasty (THA) and the implants used for revision.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Primary THA (%)</th>
<th>Revision THA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of the femoral head component</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.2</td>
<td>35</td>
<td>29</td>
</tr>
<tr>
<td>28</td>
<td>49</td>
<td>70</td>
</tr>
<tr>
<td>32</td>
<td>11</td>
<td>0.7</td>
</tr>
<tr>
<td>36 or more</td>
<td>5</td>
<td>0.3</td>
</tr>
<tr>
<td>Surgical approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>5.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Lateral</td>
<td>17.8</td>
<td>19</td>
</tr>
<tr>
<td>Trochanterotomy</td>
<td>5.4</td>
<td>7</td>
</tr>
<tr>
<td>Posterolateral</td>
<td>70.7</td>
<td>69.4</td>
</tr>
<tr>
<td>Acetabular fixation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cemented</td>
<td>36.2</td>
<td>36.7</td>
</tr>
<tr>
<td>Cementless</td>
<td>63.8</td>
<td>63.3</td>
</tr>
<tr>
<td>Femoral fixation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cemented</td>
<td>53</td>
<td>62.3</td>
</tr>
<tr>
<td>Cementless</td>
<td>47</td>
<td>37.7</td>
</tr>
<tr>
<td>Bearing couple</td>
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<tr>
<td>Hard on soft</td>
<td>82</td>
<td>96.7</td>
</tr>
<tr>
<td>Ceramic-ceramic</td>
<td>10</td>
<td>2.9</td>
</tr>
<tr>
<td>Metal-metal</td>
<td>8</td>
<td>0.4</td>
</tr>
<tr>
<td>Type of cup or insert</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>83.3</td>
<td>9.6</td>
</tr>
<tr>
<td>Elevated rim</td>
<td>10.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Dual mobility</td>
<td>5.6</td>
<td>79.7</td>
</tr>
<tr>
<td>Constrained</td>
<td>0.9</td>
<td>6.5</td>
</tr>
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</table>
rim liners and 11.2% with constrained liners. The anterior approach, which is associated with a lower risk of dislocation, also did not prevent revision for this cause because 5.4% of the primary THA revised for dislocation were performed by this approach. Compared to the rest of the symposium cohort, perioperative complications on the femoral side were more frequent in the group that underwent revision for dislocation ($P = 0.009$) as well as the development of postoperative complications ($P = 0.001$).

Fifty-seven of the 219 cases of revision for dislocation (26%) were performed within 3 months after surgery, 93 (42.5%) within 5 years and 69 (31.5%) later, after more than 5 years. Certain factors were significantly correlated with the delay until dislocation. In the early dislocation group (less than 3 months): the experience of the surgeon (junior, $P = 0.009$), the type of cup (dual mobility, $P = 0.04$) and an older patient at primary THA ($P = 0.001$); in the late dislocation group (after 5 years): a diameter of 22 mm ($P = 0.01$) and an ASA score of 1 or 2 ($P = 0.04$); in the group with recurrent dislocations: a high Devane score ($P = 0.02$).

No correlation was found between the dislocation revision group and the rest of the symposium cohort for: experience of the surgeon (senior or junior, $P = 0.1$), modular or standard stem ($P = 0.7$), modular or standard cup ($P = 0.96$), the type of bearing couple of primary THA ($P = 0.53$), or, finally, the size ($P = 0.7$) or weight ($P = 0.6$), BMI ($P = 0.3$) of patients during revision.

The predictive risk factors of revision for dislocation were: an elevated rim liner at primary THA (risk $\times 6.6$), 22 mm diameter femoral head (risk $\times 2.4$), a posterolateral approach (risk $\times 1.7$) and older age (risk $\times 1.1$).

Discussion

The estimated rate of dislocation of THA is between 2 and 5% [1–3,11,12]. An analysis of the literature shows that there are numerous risk factors for THA dislocation including age over 75, a BMI over 30, preoperative high range of motion, a high level of activity, certain etiologies such as avascular necrosis of the femoral head, a history of medical treatment, neurological injury, the surgical approach… [1–3,7,10,14–18]. However, a specific, reliable score cannot be obtained because there are too many of these factors [19].

There were very few lost to follow-up patients in our study. On the other hand, this study has the biases associated with a multicenter design, in relation to the different levels of experience of the numerous surgeons, the lack of homogeneity in the type of hip replacements, the surgical approach… Moreover, clinical follow-up of revision THA was too short to draw firm conclusions about the pertinence of the choice of revision components [20].

The rate of revision THA for dislocation in this study was 10.4%, fifth on the list of causes of revision. This rate is markedly lower than that in the literature for the incidence and ranking of this cause of revision. Indeed in the Swedish register, 73.1% of the 25,684 revisions performed between 1979 and 2009 were for aseptic loosening, with 8.7% for dislocation in second place [21]. In the Australian register, aseptic loosening was the first cause of revision (29.9%) of the 31,335 revisions analyzed, followed by dislocation (27.6%) [22]. In the New Zealand register of 2278 THA, the rate of revision for dislocation was 30.6% (second cause) [23]. The rate of 10.4% is therefore lower than that reported in the main registers. One hypothesis to explain this difference would be the more frequent use of dual mobility cups in France to reduce the risk of dislocation during primary arthroplasties in particular in high-dislocation-risk patients [24]. Our results suggest that the use of the dual mobility cup does in fact reduce the rate of revision for “classic” dislocation (5.6%) compared to the use of a standard flat liner (9.1%), but there is no difference (8.8%) if intraprosthetic dislocations, which specifically occur in dual mobility cups, are taken into account, tending to invalidate this hypothesis. Moreover, the use of dual mobility cups in young and/or active patients results in a high risk of wear, which associated with the problems of intraprosthetic dislocations and of the coating of the cup, suggests that their use should be limited [4–8]. Other technical elements might explain the fairly low rate of revision for dislocation in our study, such as the surgical approach or preservation of the soft tissues, which are impossible to evaluate in this type of study. Although the posterolateral approach was associated with a high rate of dislocation, it is also the most frequently used approach for primary arthroplasties and our study emphasizes that the anterior approach, which was used much more rarely during the study period in the centers investigated, is still associated with some risk of dislocation.

The use of anti-dislocation rims or constraining liners, which like dual mobility cups were designed to reduce the risk of dislocation, did not improve results compared to standard liners [11,25]. The use of cross-linked polyethylene liners should reduce the rate of late dislocation by reducing linear wear compared to conventional polyethylene liners. In any case, the bearing couple was not a risk factor for dislocation in our series, which is confirmed by the results in the literature [1,2]. The only results associated with the implants that seemed to be pertinent in our study was the size of the femoral head component. None of the large diameter components (diameter of component equal to the diameter of the native femoral head as in resurfacing) required revision for dislocation. The literature confirms these results with a risk of dislocation that is inversely proportional to the head diameter [17,26]. Nevertheless, based on our results and those of the literature, it is difficult to determine the diameter above which the risk of dislocation is significantly lower [8]. However, a diameter of 36 mm or more can be recommended to prevent this risk [27].

Conclusion

In 2012, THA dislocations were one of the main causes of surgical revision and were associated with major consequences (high cost, negative impact on functional results). The rate of revision for dislocation in our study was lower than that in the literature. Revision surgery for dislocation is generally performed in elderly patients in good general condition. It usually involves the acetabular component only, and the duration of surgery is generally short. The role of the soft tissues is difficult to determine clinically (capsule repair, muscular release/distension) but is probably important. Finally, the use of a dual mobility cup alone cannot
explain the relatively low rate of revision for dislocation in this large series.

Disclosure of interest

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