Anterior dislocation of a total hip replacement. Radiographic and CT-scan assessment. Behavior following conservative management

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Summary

\textit{Background:} Hip dislocation is one of the most frequent complications of total hip replacement. The direction of dislocation matters. Most dislocations are posterior; anterior dislocation remains rare and its treatment is controversial.

\textit{Study objectives:} To clinically and radiologically evaluate the outcomes of the conservative (orthopaedic without revision surgery) treatment of anterior hip dislocations after total hip replacement by immobilisation of the hip in 45° flexion, 10 to 20° abduction and neutral rotation (deck chair position).

\textit{Materials and methods:} Between 1997 and 2007, 19 patients (11 women, 7 men), aged between 36 and 89 years old (average age 64.6 years), operated on for hip osteoarthritis using a posterolateral approach, presented with anterior dislocation of their cemented total hip arthroplasty. Instability during extension associated with external rotation was noted at surgery in eight cases. Ten dislocations occurred in the immediate postoperative period (within 48 hours) and nine within an average postoperative delay of 39 days (6—82). After reduction of the dislocation by closed manipulation, the patients were treated by immobilisation in the deck chair position for an average of 2 weeks (10—21 days). Radiological and functional assessment (based on the Merle d’Aubigné score [PMA]) was performed on average at 4 years after surgery. The inclination of the cup in the frontal plane and any lengthening of the operated extremity were measured on an AP pelvic plain film with the patient in the standing position. Cup and femoral stem anteverision were calculated by CT-scan in 16 cases.

\textit{Results:} At the last follow-up, four patients had had recurrent anterior dislocations (one patient had had two dislocations). They were again treated with immobilisation in the deck chair position for two weeks without further recurrence. None of the patients underwent revision surgery on the temporarily unstable operated hip. Thirteen patients had no pain and eleven had an
unlimited walking perimeter. The final average PMA score was 16 (12-18). The patients who presented with one or two recurrences had a PMA of 18 in the final follow-up. Six patients presented with at least 5 mm of shortening (average: 10 mm, maximum 25 mm) with one case of 10 mm of lengthening. The average cup inclination angle in frontal plane views was 48° (40–57°). It was more than 50° in seven cases. The average cup anteversion in CT-scan was 30° (14-60°). The average femoral anteversion in CT-scan was 24° (3–52°). A total of 12 implants (eight cups and four femoral stems) had at least 25° excessive anteversion on CT-scan assessment.

Discussion, conclusion: Anterior dislocation after total hip replacement is associated with approximately 10° of excessive femoral and acetabular anteversion respectively. Nevertheless, correction of these architectural anomalies is not necessary because immobilisation in the deck chair position for 2 weeks effectively prevents recurrence and results in satisfactory medium-term functional results.

Level of evidence: Level IV retrospective study.

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Introduction

The average rate of dislocation after total hip arthroplasty reported in the literature is 2% [1]. Most of these dislocations are posterior [1]. Anterior dislocations are therefore rare, and their treatment has not been clearly defined. Our goal was to analyse a group of patients with anterior dislocations after total hip arthroplasty operated on by a posterolateral approach to determine the risk factors and evaluate the results after orthopaedic treatment by immobilisation with approximately 45° hip flexion associated with 10 to 20° hip abduction and neutral rotation (the deck chair position).

Patients and methods

Patients

We retrospectively studied 19 cases of anterior dislocation after total hip arthroplasty (14 right and 5 left) that occurred between 1997 and 2007. The frequency of anterior dislocations was estimated to be between 0.5—1% in an evaluation of 10 years of surgical activity in our department (with approximately 2000 total hip replacements performed during that time). This frequency was much higher than that in the literature [1]. The series included seven men and 11 women (one bilateral case) with an average of 64.6 years old (36—89). The average Body Mass Index (BMI) was 28.5 (19—39). We excluded dislocations that occurred after revision total hip replacements so that only cases of primary hip arthroplasty were included. The main clinical histories were four congenital hip dysplasias (22%), treated by varus (1 case) or valgus (1 case) femoral osteotomy or Chiari pelvic osteotomy (1 case), 1 acetabular fracture, one ipsilateral hemiplegia, one case of epilepsy and four alcohol intoxications.

Surgical method

Total hip replacement was performed by posterolateral approach. All the polyethylene cups were cemented. The titanium femoral stems (Osteal™, Ceraver, France) were also cemented, and the heads were aluminium (16 32 mm diameter heads and three 28 mm diameter heads). The indications for arthroplasty included five stage 4 osteonecroses (with one bilateral case), four arthroses secondary to hip dysplasia, one arthrosis after an acetabular fracture and nine primary arthroses of the hip.

The pre-operative results showed an average of 25 mm (8–72 mm) of shortening in the operated side in three cases, and an average of 9 mm of lengthening in two cases.

The dislocation was diagnosed clinically based on functional incapacity (although this was less marked than in posterior dislocations), occasional shortening, and especially a large external rotation of the hip, then diagnosed radiologically by a plain frontal view X-ray of the pelvis with the patient lying supine (Fig. 1).

The dislocation was reduced during in emergency under general anesthesia in the operating room with external manipulations. The patients were then immobilised in bed in the deck chair position with the hip in approximately 45° flexion, neutral rotation and 10 to 20° hip abduction, theoretically for two weeks.

Evaluation methods

We analysed the delay to dislocation after surgery, the possible presence of instability of the reconstructed hip noticed during surgery, how long immobilisation actually lasted, the occurrence of one or several recurrences and the necessity of revision surgery. The functional Merle D’Aubigné score [2] (PMA) was evaluated at the last follow-up.

Figure 1 Frontal X-ray of the pelvis: anterior dislocation of a left total hip replacement.
Figure 2  Inclination measurement (verticality) of the cup on the pelvis in relation to the bi-ischiatric line.

The radiological evaluation was based on the measurement of components orientation by means of plain X-ray views in 19 cases and in 16 cases on tomodensitometry (CT-scan). On a frontal plain X-ray view of the pelvis during weight bearing with the knees and hips in extension we measured: (a) the inclination of the cup by measuring the angle that passed by the line connecting the bi-ischiatric line to the tangent of the acetabular component; (b) the pre- and postoperative lengths by the comparative distance of the ischium/lesser trochanter along the vertical axis (Fig. 2).

The technique used to measure anteversion of hip components by CT-scan (right/left comparison) was that described by Goutallier et al. [3]: the patient is in the supine position with the knees extended and both lower limbs parallel and immobilised with wooden blocks and straps. Reference spots are marked on each knee to make sure that the patient has not moved at the end of the examination. The CT-scan slices are referenced with a frontal topogram (scout view). The superior femoral axis is evaluated on two 8 to 10 mm thick slices, one which passes through the center of the head of the femur and the other through the middle of the base of the neck of the femur. The inferior femoral axis corresponds to the tangent of the posterior of the two femoral condyles drawn on a 5 mm thick slice where the intercondylar notch has the inverted U shape of a roman arch. Femoral anteversion is obtained by a simple reading, drawn directly on the television screen and corresponding to the angle between the superior and inferior femoral axes (Fig. 3).

Cup anteversion is determined by the value of the angle formed between the line joining the posterior edges of the two iliac bones on the image passing through the center of the cup (corresponding to the area of the ischiatic spine) and the image passing through the anterior and posterior ends of the metallic ring located on the periphery of the acetabular component. (Figs. 4 et 5).

Figure 3  CT-Scan to measure anteversion of the femoral component (right/left comparison).

Figure 4  Identification of the center of the cup passing by the ischiatic spine.

Figure 5  Measurement of cup anteversion: angle formed by the line joining the posterior edges of the iliac bones on the image passing through the center of the cup (corresponding to the zone of the ischiatic spine) and that through the anterior and posterior ends of the metal ring on the periphery of the acetabular component.
Results

Clinical results

The results were evaluated after an average follow-up of 4 years. Eight cases of instability (42%) in extension associated with external rotation were described in the surgical report. Dislocation occurred within 48 hours after surgery in 10 cases (53%), including seven in whom anterior instability was noted during surgery. Secondary dislocation occurred within an average of 33 days (3–82) in nine cases (47%). Dislocation occurred with the patient in the supine position in 14 cases (73%), while going from a reclining position to standing in four cases (21%) and was post traumatic in one case.

All patients were immobilised in the deck chair position. The average real duration of immobilisation was 13 days (7 to 21 days). No cutaneous, thromboembolic or infection complications occurred.

Four patients (five cases because of one bilateral case or 26%) presented with recurrent anterior dislocation including one bilateral case, and one patient with two recurrences on D7 and D14 when getting up (Table 1). In all these patients the diameter of the femoral head was used as 32 mm. They were again immobilised in the deck chair position for an average of 20 days without any additional recurrence. All recurrences occurred early within two weeks after the patients placed weight on the hip (D1, D1, D4, D7, D14). Four occurred when changing position from lying in bed to standing and one was post-traumatic immediately following a fall. Finally, one case of posterior dislocation occurred after weight was placed on the leg.

None of the patients presented with further recurrence. The PMA score at the final follow-up was 16 (12–18). The walking perimeter was unlimited in 11 patients (60%). Thirteen patients were without pain (72%), four had occasional pain and one reported permanent pain. The PMA score was judged to be good or very good in 77% of cases. The four patients were without pain (72%), four had occasional pain and one reported permanent pain. The PMA score was compared to 39 in seven cases including two with one recurrence each.

The average cup anteversion on the operated side was 30° (14–60°) compared to 19° (14–31°) on the contralateral side. The average difference in anteversion between the operated side and the contralateral side was 9.3° (−4°, 42°). Dislocation recurred in two of the eight patients with anteversion of more than 25° (42%). The five recurrences occurred in anteversions with differences between the prosthetic and opposite side of 1, −4, −4, 2 and 24° respectively (Table 1).

The femoral stem anteversion was an average of 24° (3–52°) compared to 16° (6–34°) in the contralateral side. The average difference in anteversion between the operated and contralateral sides was 9.1° (−7°, 30°). Dislocation did not recur in either of the two anteversions of 50°. The five cases of recurrence occurred because of excessive anteversion in the prosthetic side of 3°, 7°, 10°, 10° and 9° respectively (Table 1). The average sum of femoral and acetabular anteversions measured on CT was 58° (17°–110°) compared to 39° in the opposite side (17°, 57°) (Table 2). All of the characteristics of the five cases of recurrence are summarised in Table 1.

Discussion

Although there is very little in the literature about this complication, we believe that the rate of anterior

### Table 1 Characteristics of recurrence.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Age</th>
<th>BMI</th>
<th>History</th>
<th>Number of recurrences</th>
<th>Differential(^{a}) femoral anteversion</th>
<th>Differential(^{a}) acetabular anteversion</th>
<th>Difference preoperative length (mm)</th>
<th>Difference postoperative length (mm)</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>67</td>
<td>25.5</td>
<td>Acetabulum fracture</td>
<td>1</td>
<td>+3</td>
<td>−4</td>
<td>0</td>
<td>−5</td>
</tr>
<tr>
<td>2</td>
<td>76</td>
<td>24.7</td>
<td>Hip dysplasia</td>
<td>2</td>
<td>+7</td>
<td>+2</td>
<td>−72</td>
<td>−25</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>22</td>
<td>Bilateral osteonecrosis</td>
<td>1</td>
<td>+10</td>
<td>+24</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 left side</td>
<td>67</td>
<td>39.2</td>
<td>Alcohol. Bilateral osteonecrosis</td>
<td>1</td>
<td>+10</td>
<td>+1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 right side</td>
<td>67</td>
<td>39.2</td>
<td>Alcohol. Bilateral osteonecrosis</td>
<td>1</td>
<td>+9</td>
<td>−6</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

BMI: body mass index.

\(^{a}\) Difference between the implant side and the controlateral hip.
dislocations of total hip replacements operated by the posterolateral approach is underestimated. Some early dislocations, managed in emergency procedures and considered to be posterior are probably anterior. It is essential to distinguish between these two entities to adapt the therapeutic management.

In order to identify factors favoring early anterior dislocations after total hip replacement, we compared the characteristics of our population and those of two series of total hip replacement [4,5] performed in our unit (same recruitment, same surgeons, same surgical technique, same implants) in 100 [4] and 156 cases [5]. Our population was an average of 6 years older than in the two other series. The average BMI was 28.5 compared to 25 corresponding to 10 kg of excess weight. The rate of congenital hip dysplasia in our study (22%) was higher than in the two other series (12 and 19%). The lack of anterosuperior acetabular coverage secondary to dysplasia can result in incorrect positioning of the implant components causing excessive anteversion and verticalisation of the cup as a result of the modification of the anatomical references and a natural tendency by the surgeon to increase cup anteversion to obtain good coverage of the bone by the implant. The rate of osteonecrosis of the head of the femur (26%) in our study supports the results by Nishii et al. [6] who reports that these patients have a higher risk of dislocation than patients with primary osteoarthritis of the hip. This is probably because these hips are much more mobile and thus potentially more unstable than in cases of arthrosis.

The reference examination for diagnosing errors in the positioning of implants is CT-scan [3,7,8] but the results must be interpreted with caution [9]. Pinoit et al. [10], Ala Eddine et al. [11] and De Thomasson et al. [12] have shown that pelvic retroversion occurs when going from the supine to the standing position in more than 90% of cases. As a result, acetabular anteversion is increased when standing (confirmed in our four dislocations when going from lying down to the standing position). In our study, the CT-Scan measurement of anteversion in the implants was performed with the patient in the supine position, which underestimates the actual orthostatic anteversion. This could explain why anterior dislocations occur in cases of slightly excessive acetabular anteversion measured with the patient lying down.

For certain authors, the best anatomical conditions are present when the sum of the anteversions is approximately 20° [13]. In our series, it was an average of 58°. Our results confirm those of Fontes et al. [13] and Lewinnek et al. [14], showing that anterior dislocations of total hip replacements are associated with excessive anteversion of the femoral and/or acetabular components. The dislocations occurred in our series in patients with an average excessive femoral and acetabular anteversion of 9.1° and 9.3° respectively compared to the healthy side.

The cases of recurrence were not those presenting with the greatest femoral or acetabular anteversion, however, these patients had less average anteversion than in the overall series. The lack of recurrent instability despite these anatomical anomalies (no recurrence requiring surgical revision in the four cases of femoral or acetabular excessive anteversion of 50° or more) confirms that, after healing, the excessive anteversion in the prosthesis is well tolerated, without any negative consequences to hip stability. The impact of postoperative length inequality or an excessive inclination of the cup is difficult to evaluate because the three patients without preoperative inequality had shortening of 5 mm or less with no clinical effects and the three patients who presented with preoperative shortening were equalised or not changed postoperatively.

The functional PMA score of good to excellent in 72% of cases seems disappointing compared to other series with the same procedure (89%) [4]. It is difficult to imagine that this difference is due to the anterior dislocation of the total hip replacement because there was no chronic hip instability in the final follow-up and revision surgery was not necessary in any of the cases. This result may be explained by the characteristics of our series, including older patients with a higher BMI.

The discovery of an anterior instability during surgical testing of a total hip replacement by external extension–rotation appears to be correlated with a risk of early anterior dislocation. In our series, it was found in eight cases (42%) including three recurrent cases, despite immobilisation in the deck chair position. Femoral anteversion should be reduced, if possible, if anterior instability is discovered during surgery or the postoperative rehabilitation protocol should be adapted accordingly, especially during the first 48 hours after surgery (seven out of eight early dislocations were considered unstable during surgical testing). Because the instability occurs mainly in bed when the person is lying in the supine position (14 cases), it might be logical to allow patients to begin normal walking and sitting while remaining in the deck chair position when in bed for approximately two weeks. This protocol could both prevent episodes of anterior instability of the hip replacement while limiting the strict protocol of complete bed rest in.
the deck chair position to proven cases of postoperative dislocation.

Conclusion

The occurrence of anterior dislocation of a total hip replacement operated by the posterolateral approach is not an unusual complication. It occurs in the early postoperative course. The population at risk includes older patients with a high BMI and patients with congenital dysplasia or osteonecrosis of the hip. This complication occurs in relation to malorientation of the implants associated with excessive anteversion of femoral and/or acetabular components. We treated these early postoperative anterior dislocations orthopedically by immobilization in the deck chair position for an average of 14 days. The treatment is well tolerated with no iatrogenic complications. Although recurrence occurred in 26% of patients, only one patient had two recurrences and none of the patients had developed chronic instability requiring revision surgery at 4 years of follow-up.

Conflicts of interest

No conflicts of interest.

References