Dislocation After Revision Total Hip Arthroplasty

An Analysis of Risk Factors and Treatment Options

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Background: Dislocation is a leading and underemphasized cause of failure in revision total hip arthroplasty. Although this fact is generally well recognized, we are aware of no detailed assessments of this problem to date. Our purpose therefore was to evaluate the risk factors leading to instability after revision as well as the expected outcome of various treatment strategies.

Methods: Data were obtained from 1548 revision arthroplasties in 1405 patients who were followed for a minimum of two years (range, 2.0 to 16.4 years; mean, 8.1 years) or until dislocation occurred. Revisions specifically performed because of instability were excluded from the analysis. Risk factors were recorded along with treatment strategies and their success. The statistical relevance of both sets of variables was calculated.

Results: A dislocation occurred after 115 (7.4%) of 1548 revision hip arthroplasties. The use of an elevated rim liner was associated with significant decreases ($p < 0.05$) in dislocation following revision of femoral and acetabular components. The presence of trochanteric nonunion was a significant risk factor for subsequent dislocation ($p < 0.001$). Revisions with 32-mm and 28-mm-diameter femoral heads were both more stable than was revision with a 22-mm-diameter head ($p < 0.05$ for each). Surgery was the initial treatment for twelve of the 115 dislocations. Six of the twelve hips had no further instability. Of the 103 postoperative dislocations initially managed nonoperatively, only thirty-six did not redislocate. Thirty-eight of the sixty-seven hips that had an additional dislocation after closed treatment had repeat surgery for treatment of the instability. Only eleven of the thirty-eight hips were stable at one year after surgery. Overall, at the time of the final assessment, sixty-five (57%) of the 115 hips were stable, forty-one (36%) remained unstable, and the status of nine (8%) was unknown.

Conclusions: The risk factors for instability after a total hip revision are not the same as those after a primary procedure. The extent of the soft-tissue dissection is probably the most important variable since head size and trochanteric nonunion are related to "soft-tissue tension." Modular acetabular components with an elevated rim help to stabilize a hip undergoing a revision procedure.

Dislocation is a leading and underemphasized cause of failure in revision hip arthroplasty[1-6]. This complication is usually reported in the context of addressing other issues. Previously described risk factors for dislocation include the number of prior hip operations, avulsion of the greater trochanter after osteotomy, malposition of the components, impingement, insufficient abductor musculature, and the surgical approach[3,4,7-10]. We are aware of no report dealing specifically with the management of instability after revision hip arthroplasty. Many variables may influence the stability of a hip arthroplasty either directly or indirectly[6]. The purposes of the present study were to determine and to evaluate the potential risk factors for dislocation after revision arthroplasty, to contrast dislocation after revision arthroplasty with that after primary arthroplasty, and to assess the results of management to better document the expected outcomes of various treatment options.

Materials and Methods

Between January 1981 and December 1990, 1654 aseptic revision total hip arthroplasties were performed in 1497 patients who had a diagnosis of aseptic loosening, fracture of the prosthesis, or periprosthetic fracture. Revisions that were specifically performed because of instability were excluded from this study. Of the 1654 revisions, 1548 in 1405 patients were followed at least two years (range, 2.0 to 16.4 years; mean, 8.1 years) or until dislocation occurred. The remaining 106 revision arthroplasties (6%) in ninety-two patients were lost to follow-up and had no record of dislocation. At five years after revision arthroplasty, follow-up data were not available for 332 of 1497 patients, including 137 patients (9%) who were known to be deceased.

The indication for the revision was aseptic loosening in 1355 hips, fracture of the prosthesis in 133, and periprosthetic fracture in sixty. In the sample of 1548 revision arthroplasties, 652 had a femoral revision, 234 had an acetabular revision, and 662 had revision of both components. Bipolar replace-

ments and revisions because of instability, infection, or tumor were excluded in this study. A dislocation occurred after 115 (7.4%) of the 1548 revision arthroplasties. The medical records of the patients who had a dislocation were reviewed to determine the treatment modalities and outcomes.

Factors directly or indirectly influencing the risk of dislocation after revision hip arthroplasty were divided into preoperative, perioperative, and postoperative variables. All factors were then evaluated statistically to determine if they were a significant risk for dislocation in the setting of revision surgery.

Preoperative variables included age, gender, side, and preoperative diagnosis. Perioperative variables included the component revised, type of acetabular liner (an elevated or nonelevated rim), surgical approach, use of bone graft, and position of the acetabular component.

The components that were revised were assessed as follows: femoral component only, acetabular component only, and both femoral and acetabular components. The revised acetabular components were divided into those with and those without elevated rims. The diameter of the femoral head was recorded, and the groups with and without subsequent dislocation were compared with respect to the size of the femoral head.

The surgical approach was classified into one of three categories: (1) anterolateral or lateral without a trochanteric osteotomy (the anterior one-third to one-half of the abductors was detached from the greater trochanter and later repaired with suture); (2) lateral with a trochanteric osteotomy (the trochanter was replaced and secured usually by means of a single-wire figure-of-eight technique, as described by Coventry[11], with the trochanter routinely advanced distally 5 to 10 mm); or (3) posterior (at closure, only the piriformis tendon was regularly reattached).

The position of the acetabular component was determined according to the method of Woo and Morrey[6]. The radiographs were made from a standard distance and with use of standard positioning of the patient. Anteversion and retroversion were measured on the lateral radiograph as the angle formed by a line drawn tangential to the face of the acetabular component and a line drawn perpendicular to the horizontal plane. Tilt was measured on the anteroposterior radiograph as the angle formed by a line drawn tangential to the acetabular component and a line drawn tangential to the inferior margin of the ischial tuberosities. Anteversion of the femoral component was not measured. Measurements were made on the radiographs of the 115 hips that had a dislocation (anteroposterior radiographs were available for all 115 hips and lateral radiographs were available for 107) as well as on those of a group of 115 controls that were matched with respect to the component that was revised, the diagnosis, the age of the patient, and the year of surgery.

The only postoperative variable that could be documented with certainty was trochanteric nonunion.

Once the dislocation had occurred, the type of treatment and its outcome were documented. The initial treatment was categorized as surgical or nonsurgical. The surgical records of the patients undergoing additional surgery were reviewed, and the findings (the cause of the dislocation) as well as the treatment were recorded.

Statistical Assessment

Statistical analysis was performed with use of the relative risk analysis, as defined by Cohen[12], and with the help of a statistician. The paired t test was used to compare differences between groups with normal distributions of continuous variables[12]. The chi-square test was used to compare differences between discrete variables. A p value of <0.05 was considered significant.

Results

During the ten years from 1980 to 1989, the yearly incidence of dislocation after revision hip arthroplasty did not change appreciably and ranged from 5.2% to 9.8% (average, 7.4%).

The mean age at the time of revision was sixty-three years (range, twenty-six to eighty-six years) for the ninety-nine patients (115 hips) who had a dislocation compared with sixty-five years (range, seventeen to ninety-three years) for the control group of 1313 patients (1433 hips) who had not had a dislocation after the revision procedure. The difference was not significant ($p = 0.12$)[12].

Fifty-eight (8.6%) of the 678 hips in the female patients and fifty-seven (6.6%) of the 870 hips in the male patients had a dislocation after the revision; the difference was not significant ($p = 0.14$).

Forty-seven (6.4%) of the 730 left hips and sixty-eight (8.3%) of the 818 right hips had a dislocation after the revision; the difference was not significant ($p = 0.16$).

TABLE I Stability of the Hips After Revision According to the Diameter of the Femoral Head

Diameter of the Femoral Head	Stable *(No. of Hips)*	Unstable *(No. of Hips)*	Total No. of Hips
22 mm*	343	41	384
26 mm	102	11	113
28 mm	395	23	418
32 mm	593	40	633
Total *(no. of hips)*	1433	115	1548

*The difference between the 22-mm and 28-mm-diameter femoral heads and between the 22-mm and 32-mm-diameter femoral heads was significant ($p < 0.05$, chi square).

The rate of dislocation according to the diagnosis for the revision was 7.1% (ninety-six) of 1355 hips that had aseptic loosening, 9.8% (thirteen) of 133 that had fracture of the prosthesis, and 10.0% (six) of sixty that had a periprosthetic fracture. No significant difference was detected between any of these groups ($p = 0.39$).

According to the specific component involved, a dislocation occurred after forty-six (7.1%) of 652 femoral revisions, twenty-one (9.0%) of 234 acetabular revisions, and forty-eight (7.3%) of 662 revisions of both components. No significant difference between the rates of dislocation among these three groups was detected ($p = 0.61$). Of the 713 hips that required bone-grafting at the time of revision surgery, fifty-four (7.6%) had a dislocation. Of the 835 hips that did not require bone-grafting, sixty-one (7.3%) had a dislocation.

The use of a 22-mm-diameter femoral head was shown to be associated with a significantly increased likelihood of instability compared with the 28 and 32-mm-diameter heads (Table I).

Elevated Rim Liner

Of the 896 acetabular revisions, 234 involved revision of the acetabular component alone and 662 involved revision of both the femoral and the acetabular component. One hundred and thirty of the acetabular components that were revised had an elevated rim liner. Five (3.8%) of the 130 acetabular components with an elevated rim liner dislocated compared with sixty-four (8.4%) of 766 with a nonelevated rim liner ($p = 0.07$). The relative risk for dislocation associated with the nonelevated inserts was twice (2.2 times) that associated with the elevated liners. When combined acetabular and femoral revisions were analyzed, the rate of dislocation was two (2.3%) of eighty-six hips with an elevated rim liner compared with forty-six (8%) of 576 hips without an elevated rim liner ($p < 0.05$). The relative risk was approximately four times less with the elevated liners.

Surgical Approach

Dislocations occurred, according to the surgical approach, in seventy-five (7.5%) of 1001 hips managed with the anterolateral and lateral approaches without trochanteric osteotomy, thirty-one (7.8%) of 399 hips managed with the lateral approach with trochanteric osteotomy, and nine (6.1%) of 148 hips managed with the posterior approach. No significant association was detected between a particular approach and postoperative dislocation ($p = 0.61$).

Position of the Acetabular Component

Postoperative anteroposterior radiographs were available for all 115 hips that subsequently had a dislocation after revision. The mean angle of inclination of the acetabular component, measured in the anteroposterior plane, was 45° (range, 22° to 61°; standard deviation, 8°) for the 115 hips that had a dislocation after revision and 44° (range, 21° to 62°; standard deviation, 8°) for the 115 matched controls. The difference was not significant ($p = 0.39$).

Lateral radiographs were available for 107 of the 115 hips that had had a dislocation and for ninety-eight of the matched controls. No difference was revealed between the groups with respect to the mean angle of anteversion, which was 10° (range, 18° of retroversion to 39° of anteversion; standard deviation, 11°) for the hips that had had a dislocation and 10° (range, 14° of retroversion to 30° of anteversion; standard deviation, 9°) for the matched controls ($p = 0.67$).

Trochanteric Nonunion

Trochanteric osteotomies were performed in 399 hips at the time of revision surgery. Nonunion developed in nine (2.3%) of them at the site of the trochanteric osteotomy. Seven of the nine patients with a nonunion had subsequent dislocations compared with twenty-four of 390 hips in which the trochanteric osteotomy healed. Therefore, trochanteric nonunion was a dominant risk factor for dislocation ($p < 0.001$).

Management of Dislocation After Revision Hip Arthroplasty (Figure 1)

The initial management of the dislocation was nonoperative in 103 of the 115 hips. Thirty-six (35%) of the 103 hips initially managed nonoperatively had no subsequent dislocations. Eight of these hips were managed with immobilization in a cast (a spica cast [seven] or a bilateral long leg cast with abduction bar [one]); twenty-two were treated with abduction braces; and, for six, the patient was instructed on precautions against dislocation only. The duration of immobilization in a cast or abduction brace ranged from six weeks to three months. Follow-up in this group of patients ranged from five to 214 months (average, 41.2 months).

Sixty-seven (65%) of the 103 hips that were initially managed nonoperatively had subsequent instability. Initial management included immobilization in a spica cast (eight hips), reiteration of the precautions against dislocation (eight), treatment elsewhere (eleven), and use of an abduction brace (forty). Thirty-eight of the sixty-seven hips in which closed treatment failed had repeat surgery because of instability (see Appendix). Stability was confirmed in only eleven of them at one year postoperatively. The outcome in eight hips was unknown. The remaining nineteen hips had at least one subsequent dislocation or recurrent subluxation. Eight of these hips had a second operation for the treatment of instability.

Twenty-nine of the sixty-seven unstable hips that were initially managed nonoperatively had not had surgical intervention at the time of the latest follow-up, which ranged from one to 170 months (average, 80.4 months) postoperatively. Seventeen of the twenty-nine had recurrent instability at the time of the final follow-up. Twelve of the twenty-nine hips had had two, three, or four (average, 2.6) dislocations, but the hips were stable at the time of the final follow-up.

Surgery was the initial form of management in twelve of the 115 dislocations (see Appendix). Six of the twelve hips had no recurrent instability, five had further instability, and one was lost to subsequent follow-up.

Overall, at the time of the final assessment, sixty-five (57%) of the 115 hips were stable, forty-one (36%) remained unstable, and the status of nine (8%) was unknown.

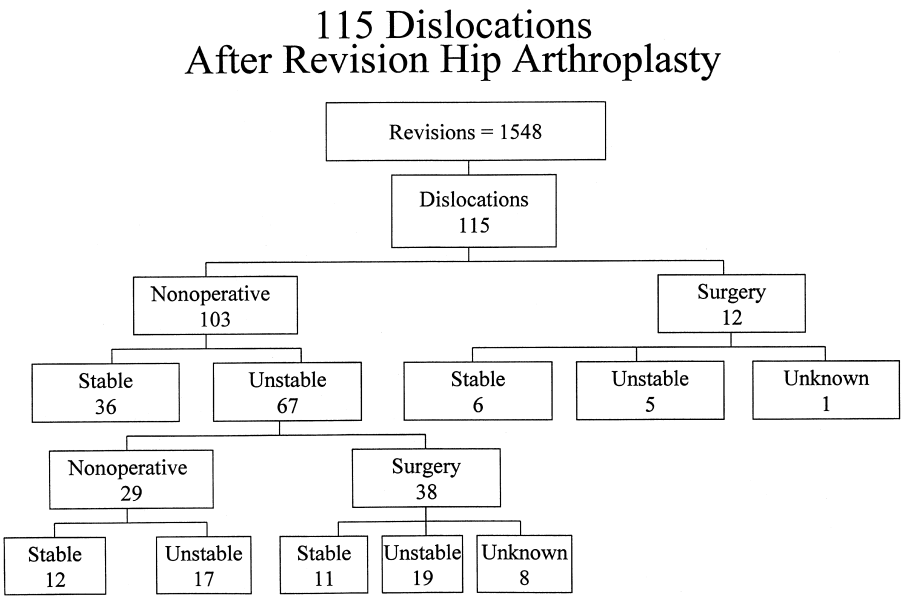

Fig. 1

Distribution, treatment, and status of the 115 hips that had a dislocation after revision hip arthroplasty.

Discussion

A review of the literature yielded twenty-six reports that described 211 dislocations (11.4%; range, 0% to 54%) after 1856 revision procedures[1-3,5-8,10,13-30]. Yet, little information regarding risk factors or outcome was reported in any of these studies.

Unlike the experience with dislocation after primary procedures, age and gender were not found to be significant risk factors for dislocation after revision hip surgery in the present study. Female gender is a well-documented risk factor for dislocation after a primary arthroplasty[6]. The compromised muscle function that exists in both male and female patients following revision surgery may be a factor that overrides the gender difference.

Surprisingly, no significant difference in dislocation rates was detected in a comparison of isolated acetabular revisions (9%), isolated femoral revisions (7.1%), and revisions of both components (7.3%).

Although femoral head size is frequently considered a factor in hip stability, clinical experience has failed to demonstrate that this is the case in primary procedures[6]. In our experience with revisions, however, the larger (28 and 32-mm-diameter) femoral heads were associated with lower rates of dislocation than were the smaller (22-mm-diameter) heads. This variable is within the control of the surgeon and can be adjusted readily with modular designs of femoral components.

Our data confirmed the finding in prior reports that elevated rim liners reduce the rates of dislocation in primary[13,31] and revision[31] arthroplasties. The elevated rim liner was least beneficial with an isolated acetabular revision ($p = 0.07$). When both components were revised, hips that had insertion of a cup with an elevated rim liner were significantly more stable ($p < 0.05$). The additional exposure required to exchange the femoral component may cause further muscle weakness, and therefore those patients are more likely to benefit from an elevated rim liner as suggested in our previous report[31].

The posterior approach has long been shown to be a risk factor for dislocation[4,6,32-34] after primary hip arthroplasty. More recently, some authors have demonstrated that the posterior approach is comparable with other approaches if the capsule and short rotators are carefully repaired[35,36]. It is of interest that we found no difference in dislocation rates in regard to surgical approach.

Surprisingly, in our study, no significant difference between the hips that had had a dislocation and a matched control group of hips that had not had a dislocation was found with respect to the radiographic measurement of the position of the acetabular component. Both groups had a wide range of component orientations, but the average inclination was 45° and 44° for the unstable and control groups, respectively. The average anteversion was 10° in both groups. Standard deviations for inclination and anteversion were also similar in both groups. Although component positioning may be more difficult in revision operations, it did not appear to be a primary factor determining ultimate stability.

Trochanteric nonunion occurred in only 2.3% (nine) of 399 hips that had a trochanteric osteotomy. Yet, seven of the nine hips with trochanteric nonunion had a subsequent episode of instability ($p < 0.001$). This significant risk factor has been demonstrated in other studies as well[4,9,10,37].

Good results can be anticipated after closed reduction of a dislocation after primary hip arthroplasty, with a successful outcome reported in about two-thirds of the patients who had been managed nonoperatively[6]. However, in our experience, the prognosis for a dislocation after revision hip arthroplasty was reversed, with only approximately one-third of the hips remaining stable after initial nonoperative treatment. In our study, only twelve patients underwent surgery as the initial treatment, and an additional thirty-eight patients underwent surgery after failure of nonoperative treatment. This finding suggests that there was no obvious or correctable explanation for the dislocation in the majority of the hips, thus implying a soft-tissue defi-

ciency as the underlying cause. Only seventeen of the fifty hips had no further instability following the additional surgery.

With the introduction of constrained sockets, increasingly favorable outcomes have been reported. This design should be carefully considered, especially in patients undergoing combined revision of the cup and stem.

Appendix

eA Specific details about the thirty-eight patients initially managed nonoperatively and then managed with additional surgery and the twelve patients initially managed operatively because of dislocation following revision surgery are available with the electronic versions of this article, on our web site at www.ejbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). ■

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