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Dislocation after total hip arthroplasty: risk factors and treatment options

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Objective: The aim of this study was to analyze the setting for dislocations and redislocations after primary and revision total hip arthroplasty (THA), identify risk factors and optimize treatment.

Methods: This study included 56 patients with a dislocated hip following THA (n=5,205) between 1984 and 2005 and a matched control group (n=55). Hospital charts and radiographs of all patients in both groups were analyzed. Thirty-one patients in the study group were followed both clinically and radiologically.

Results: The dislocation rate after primary THA was 1.1% (56/5,205) and the redislocation rate after a first occurrence was as high as 39%. There was a positive correlation between the time intervals from the surgery to first dislocation and from the first dislocation to second dislocation (r=0.4). Most of the primary dislocations occurred within a short period of time after surgery, thus favoring consecutive dislocations. Female gender, as well as revision arthroplasty, was associated with a higher incidence of dislocations. No relation was found between the orientation of the acetabular cup and dislocation.

Conclusion: To prevent redislocations after the first occurrence, we suggest thorough evaluation of possible technical faults which should be addressed surgically. Considering the high redislocation rate, we also advocate a stringent conservative treatment regime especially after the first THA dislocation.

Key words: Dislocation; total hip arthroplasty; treatment.

Total hip arthroplasty (THA) is one of the most frequently performed orthopaedic procedures, with over 200,000 primary arthroplasties in Germany each year. A considerable number of complications which have major influence on the postoperative outcome may occur during and after surgery. In addition to aseptic loosening of the prosthesis, intraoperative incidents, infection and heterotopic ossification, dislocation following THA is an important complication because it usually is very painful, may result in restriction of mobility and may cause mental stress to the patient.[1-6]

Dislocations after THA most commonly occur posteriorly, usually resulting from hip flexion, adduction, and internal rotation.[4,7] This typically may occur when the patient uses the restroom and bends forward. The frequency of dislocation after primary THA is between 2% and 3%. A markedly higher frequency of between 9% and 21% has been reported following revision THA.[4,6,8-10] Dislocation after THA may result from several factors[8,11-20] with the highest risk occurring in the first few postoperative weeks.[11,20,21] Patient-specific factors such as advanced age and female sex may be

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associated with a higher frequency of THA dislocation,[8,18,20] while weight has no influence.[19] Other factors such as surgical approach, experience of the surgeon and implant factors such as offset, head diameter and positioning of the components may be important.[14,15,17,20,22] The positioning of the acetabular cup and femoral stem may influence the stability of a THA. A diminished femoral offset and/or anteversion may cause impingement of the components, which also is a risk factor for dislocation.[18,19,23,24]

Computer-assisted navigation has been developed to improve intraoperative acetabular cup positioning. Navigation systems usually use the pelvic inlet plane to detect and account for the frequent changes in pelvic position during implantation.[25,26] These systems also help the surgeon select the correct inclination and anteversion for the implant.[25] However, adequate orientation of the acetabular cup may be difficult in many patients due to excessive weight or the use of smaller incisions.

Despite advances in THA during the past few decades, postoperative dislocation still occurs. While the effect of acetabular cup position has been reviewed extensively using different measurement methods, studies have not taken into account the pelvic tilt on the radiographic film, which may strongly influence the cup projection and limit the accuracy of measurements.[25]

The aim of the current study was to evaluate the frequency of hip joint dislocation after THA, including redislocation, and their associated risk factors and treatment strategy. In addition, we aimed to determine the acetabular cup position with a recently developed plain radiographic method[25] and explore the influence of cup position on the dislocation rate.

Patients and methods

Between 1984 and 2005, 5,205 THAs were performed at the Department of Orthopaedics in the University Hospital Tübingen. This study included the 56 patients with dislocation following THA (Group 1) and a control group of 55 patients without dislocation (Group 2) matched with the dislocated patients for age, preoperative diagnosis, operative approach, and surgical site.

Hospital charts and radiographs were retrospectively evaluated for patient age, sex, body mass index (BMI), preoperative diagnosis, secondary diagnoses, and hip range of motion. Frequency, mechanism, timing, direction of dislocation and treatment performed as well as implant-specific data such as head diameter and offset were noted for patients in Group 1. In addition, 31 patients in Group 1 with an in situ original acetabular cup were followed clinically using the Harris Hip Score. The study was approved by the local ethics committee.

Preoperative and postoperative radiographs of the pelvis were used to determine inclination and anteversion of the acetabular cup in all patients using the conventional method described by Ackland.[27] The general positioning of the implant components was also analyzed (Fig. 1). For the 31 Group 1 patients with the original acetabular cup, the method described by Lembeck at al. to measure inclination and anteversion of the acetabular cup was also used.[25] Therefore, radiographs of the pelvis in the anteroposterior position and with a 40° rotated X-ray tube were performed and the pelvic tilt was measured using the previously described pelvic scale.[25]

The transgluteal surgical approach was used in all patients. After opening the fascia lata, the gluteus medius and gluteus minimus muscles were split to reach the anterolateral part of the capsule, which was opened with a T-shaped incision and resected. After implantation of the prosthesis, the capsule was left open and the muscles were sutured closed.

Statistical analysis was performed using the two-sample t-test, Wilcoxon test, Fisher's exact test, maximum-likelihood estimation and Pearson correlation with JMP® version 5.1 software (SAS Institute Inc., Cary, NC, USA). Level of significance was $p \leq 0.05$. Descriptive statistics included arithmetic mean, standard deviation and median.

Results

In Group 1 48 patients (86%) and in Group 2 44 patients (80%) were overweight.

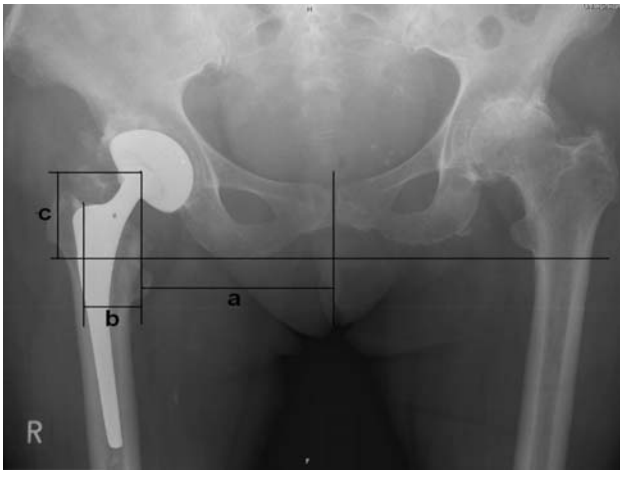

Fig. 1. Anteroposterior radiograph of the pelvis after right total hip arthroplasty. (a: medial/lateral position of the cup; b: femoral offset; c: cranial/caudal position of the cup).

There were a total of 91 dislocations in the 56 patients in Group 1. Recurrent dislocation occurred in 22 patients (39%); 11 patients had 2 dislocations each, 9 patients had 3 dislocations each and 2 patients had 4 dislocations each. There were 36 posterior, 21 anterior and 34 cranial dislocations (Fig. 2).

The most frequent incidents that resulted in dislocation included hyperflexion with adduction, deep seating, and bending (Table 1). The direction or mechanism of the dislocation could not be identified in 13 dislocations (Table 1).

The median postoperative time before the first dislocation was 4 weeks. There were 68 dislocations (75%) occurring within the first 3 months and 80 dislocations (88%) within the first 12 months after surgery. Only 11 dislocations (12%) occurred later than 12 months after surgery (Fig. 3).

First-time dislocation was defined as early (≤6 weeks after THA) in 24 patients (43%) and late (>6 weeks after THA) in 32 (57%). A second dislocation occurred in 11 patients (46%) after an early dislocation and in 11 patients (34%) after a late dislocation. There was a positive correlation between the time intervals from the surgery to first dislocation and from the first dislocation to second dislocation (r=0.4).

Closed reduction was performed in 48 patients (86%) and revision surgery in 8 patients (14%) following the first dislocation (Fig. 4). Closed reduction was attempted in all patients with the exception of one patient with an aseptic loosening of the acetabular cup and one patient with an aseptic loosening of the femoral stem. In one patient, closed reduction was not successful because of soft tissue interposition, therefore open reduction was necessary. In one case, revision surgery was performed because of clear malpositioning of the acetabular cup associated with a severe instability. In four patients, revision surgery was performed due to severe instability in functional examination directly after closed reduction. Treatment plans following THA reduction is given in Table 2. Therapy using a Hohmann antiluxation-bandage was used more frequently and for a longer duration following redislocations (Fig. 5). There was no significant difference in mean Harris Hip Score between patients with single and multiple dislocations (p>0.05).

Table 1. Cause of dislocation of total hip arthroplasty in 56 patients.

Cause	Number of dislocations (%)
Hyperflexion and adduction	31 (34)
Deep seating	12 (13)
Bending	12 (13)
Getting up	11 (12)
Rotational movement in bed	7 (8)
Walking	5 (5)
No specific incident	13 (14)
Total	**91 (100)**

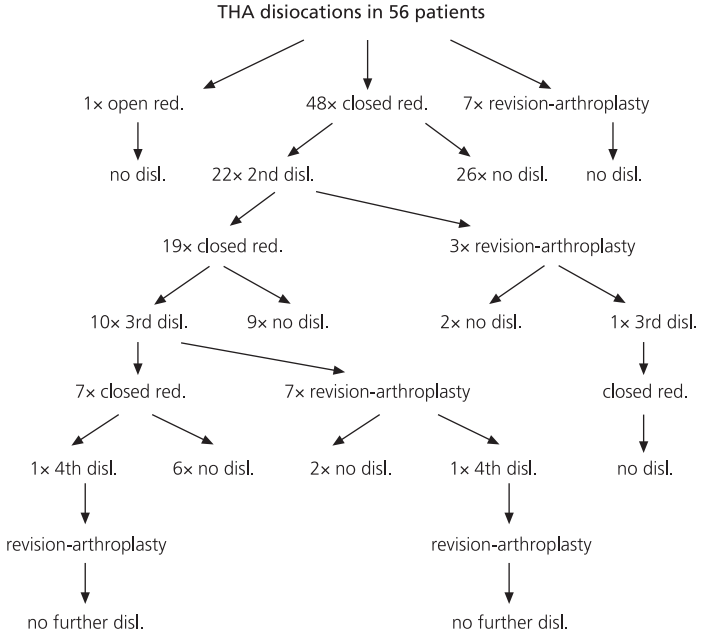

Fig. 2. Treatment course for all 91 dislocations of total hip arthroplasty in 56 patients.

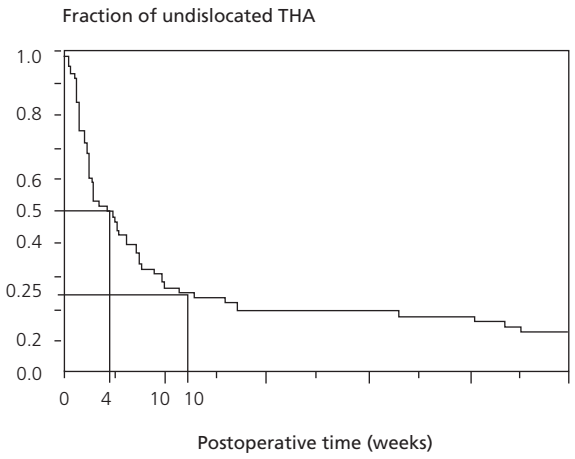

Fig. 3. Kaplan-Meier curve for the first 50 postoperative weeks showing time course of dislocations after total hip arthroplasty.

Female gender (Group 1: 64.3%; Group 2: 34.6%) as well as revision arthroplasty (Group 1: 26.8%; Group 2: 0%) were associated with a higher incidence of dislocations. There was no significant difference in mean head diameters and neck length between the patients with and without dislocation ($p>0.05$).

Mean acetabular cup inclination (conventional measurement) was 42° for Group 1 and 43° for Group 2. There was no significant difference between the two groups ($p>0.79$). There was also no difference in acetabular cup torsion between Group 1 (mean: 14.5°) and 2 (mean 15.0°). Regarding inclination and torsion, the majority of cups in both groups (56% and 61%, $p>0.05$) were positioned in the "safe zone" defined by Lewinnek et al.[16] Evaluation of component position revealed no significant differences between the two groups (Fig. 1, Table 3).

The mean difference between the conventional and newly developed measurement methods concerning cup inclination and torsion was 3.0° and 6.5° for Group 1 and 2.8° and 6.4° for Group 2, respectively.

Discussion

Dislocation after THA remains an unsolved problem and agreement on the risk factors is limited.[6,28-30]

Fig. 4. Anteroposterior radiograph of the left hip joint shows a cranially dislocated total hip arthroplasty, even though the acetabular cup is in a proper position.

Fig. 5. The Hohmann antiluxation bandage (Brillinger GmbH & Co., Tübingen, Germany) with their integrated lateral splints limits external rotation and adduction in cases of an "instable hip joint". [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

Table 2. Treatment after reduction of dislocation of total hip arthroplasty in 56 patients.

Type of treatment	First dislocation		Recurrent dislocation	
	Number of patients (%)	Mean duration	Number of patients (%)	Mean duration
Cast	14 (25)	2.5 weeks	4 (11)	3 weeks
Bandage*	10 (18)	3.5 months	19 (54)	5 months
Cast and bandage*	26 (46)	2.5 weeks and 3.5 months	6 (17)	2 weeks and 7 months
No special treatment	6 (11)	-	6 (17)	-
Total	**56 (100)**	-	**35 (63)**	

*Hohmann bandage

Multiple factors may result in dislocation and the reported number of dislocations has remained steady over the past few decades despite advanced implant systems and highly experienced surgeons.[20] The incidence of THA dislocations is between 2% and 21%.[18,31-35] This wide range can be explained by different study designs, implant types, surgical approaches, patient selection and surgeon experience.

Different treatment protocols exist for dislocated THA including a more or less stringent immobilization period. Usually, after closed reduction, we prefer a temporary immobilization of the patient in a cast with an attached rod that maintains the leg in 0° to 10° internal rotation, followed by a preventive bandage (such as a Hohmann bandage) that allows extension and flexion of the hip joint but limits external rotation. Open reduction is rarely necessary; in such patients, the position of the components is evaluated and revised if indicated.[36-39]

In the present study, patients who underwent a transgluteal approach with an anterior capsulectomy had a low dislocation frequency (1.1%), comparable to previous studies.[40,41] The type of the surgical approach (anterior, posterior, or transgluteal) and the capsular repair and repair of the external rotators, especially with the posterolateral approach, may influence the dislocation frequency.[40,41] A dislocation frequency of 4.8% after capsulectomy and 0.7% after capsular repair has been reported following the posterolateral approach.[40,41] Higher dislocation frequencies (9% to 21%) have been reported after revision THA.[6,8,10] These scores have been attributed to the greater technical difficulty, loss of bone and soft tissue and presence of scar tissue. Repeat dislocation after reduction occurred in 39% of the present patients, similar to the previously published data.[14]

The most common cause of dislocation in our patients was movement in flexion and adduction (Table 1). The risk of dislocation was especially high in the first few postoperative weeks,[42] presumably because the soft tissues and the stabilizing muscles had not yet healed; 50% of dislocations occurred within the first 4 postoperative weeks, similar to previous studies.[11,14]

In the present study, early dislocation was a risk factor for recurrent dislocation, similar to previous work in which other risk factors were identified, including component malposition, tissue tension, implant design, experience of the surgeon, and preoperative diagnosis.[43] Initial treatment after reduction of THA with cast immobilization followed by a supporting bandage was successful in most patients (86%) and also has been recommended in other studies.[20,21,43]

Table 3. Relation between dislocation and radiographic parameters of total hip arthroplasty.*

Radiographic parameter	Group 1 (Dislocation)	Group 2 (No dislocation)	p†
Number of patients	56	55	
Acetabular cup inclination (°)‡	42	43	NS
Acetabular cup anteversion (°)‡	14.5	15	NS
Number (%) of acetabular cups in safe zone§	31 (56)	34 (61)	NS
Medialization of cup (mm)	-6±1	-3±1	NS
Femoral offset (mm)	5±2	6±2	NS
Cranialization of cup (mm)	3±1	1±1	NS

*Data reported as mean; number (percent); or mean±SD; †NS: not significant (p>0.05); ‡Inclination and anteversion measured according to Ackland et al.[27]; §Safe zone as defined by Lewinnek et al.[34]

The present data also showed that the time between surgery and first dislocation was a predictor of recurrent dislocation, possibly because of the different causes for early and late dislocations. Although insufficient soft tissue tension and absent scar formation may cause early dislocation, late dislocation is more likely caused by malposition of implants, neurologic or psychiatric disorders, trauma or implant wear.[43-45]

No consensus on the contribution of sex as a risk factor for dislocation has been reached.[6,10,20,40,46,47] In the present study, women had a higher dislocation rate, consistent with some studies[20,46,47] but in contrast to others.[6,10,40] Excess weight was not a risk factor in the present study.[19,48]

All 8 patients treated with open revision surgery after the first dislocation did not develop an additional dislocation (Fig. 4), most likely because revision in these patients were due to component-related problems. A common technical complication associated with dislocation is inaccurate anteversion of the acetabular cup, which may occur as often the surgeon cannot precisely determine the position of the patient on the operating table.[37,49-51] Intraoperative computer-assisted navigation may decrease this potential chance of error.[26,51,52]

Acetabular cup position is an important risk factor for THA dislocation.[2,5,11,34,35,53] A "safe zone" had been defined previously as 45°±10° for inclination and 15°±10° for anteversion.[16] In a study with a larger population without standardized measurement, almost 50% of dislocated THAs had high anteversion or inclination,[11] but other studies could not confirm these results.[10] These inconsistencies may be caused by different and imprecise radiographic measurement methods. In some studies, the radiographic method had not been described.[50,54] In the present study, there was no association between the occurrence of dislocation and cup position, femoral offset or head diameter. This suggests that there may be a wide range of acceptable implant positions and that multiple causes may contribute to dislocation.

Various methods have been developed to avoid incorrect measurement of acetabular cup position.[25,54] Applying the present methods, most acetabular cups were within the "safe zone", without any significant difference between patients with or without dislocation (Table 3).[30] Therefore, no acetabular cup position gave full protection against dislocation. Although a well-positioned acetabular cup does not guarantee a stable THA, cup position is a key issue in dislocation. A precise method to measure cup position may help create guidelines which may avoid inaccurate measurements that could result in technical errors during revision arthroplasty. The present data show that measuring acetabular cup position is inaccurate using the common methods of measurement.

Several measures should be taken for prevention of THA dislocation. Patient instruction is very important, including exercises on how to move and act after the surgery, with emphasis on activities of daily living such as getting out of bed, sitting, getting up, and using a car.[55] Applying an abduction-wedge and a foam positioning aid for the operated leg in the operating room immediately after surgery reduces range of motion during the first few postoperative days and may prevent dislocation.

In conclusion, THA dislocation is a serious complication that may be attributed to multiple factors. To prevent redislocations, we suggest the thorough evaluation of possible technical faults concerning positioning of the acetabular cup and femoral stem, femoral offset, soft tissue tension and tendency to redislocate during closed reduction maneuvers. If this is the case, revision arthroplasty should be performed. Considering the high redislocation rate and the positive correlation between the time intervals, we also advocate a stringent conservative treatment regime especially after the first THA dislocation.

Conflicts of Interest: No conflicts declared.

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