PREOPERATIVE PLANNING TO PREVENT DISLOCATION OF THE HIP

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Postoperative dislocation (Fig. 1) is a common complication after total hip arthroplasty (THA) with an incidence ranging from 0.3% to 9.2% after primary THA. This troublesome complication undermines patient confidence in the operation, increases the cost of care, and has a true biologic expense. In a study by Chandler et al, using preoperative and postoperative quantitative gait analysis on primary THA patients, multiple dislocations significantly compromised the recovery time and 1-year postoperative gait pattern of patients.

The dislocating THA poses a major therapeutic challenge. According to the literature, the incidence of redislocation after closed reduction of a THA is approximately 1 in 3. Another study places this incidence at 16%. Revision of THA to address dislocation provides limited success. In two reports, only approximately two thirds of unstable THAs were stabilized with revision surgery using standard revision techniques and components.

Recognizing the morbidity and the management difficulty that instability produces, every effort should be made to decrease its incidence. The importance of preoperative templating (Fig. 2) has been shown previously, particularly as an aid to leg-length equalization and component selection. To minimize the potential for postoperative dislocation, preoperative planning must include not only radiographic templating, but also the identification of patient and surgical variables that predispose to dislocation. This article discusses how the operative and postoperative plan can be altered to address such concerns.

DECREASING THE INCIDENCE OF DISLOCATION

It is essential that planning and patient education identify situations in which a documented increased risk of dislocation exists. Patient factors may be present that are beyond the control of the surgeon, but surgical technique can be altered in high-risk cases to attempt to minimize the likelihood of instability. Modification of the postoperative protocol may decrease problems of instability further.

Patient Risk Factors

Preoperative patient factors that have been implicated as increasing the likelihood of instability are age, female sex, prior hip surgery, diagnosis leading to arthroplasty, alcoholism, motor disorders such as Parkinson’s disease, and dementia. Although age has not been found to be a risk factor for dislocation in several studies of relatively young (average age, 63) patient populations, it has been found to be a factor in older groups. In
a study by Ekelund et al\textsuperscript{13} of patients older than age 80, the incidence of dislocation increased to approximately 4\%, in contrast to the 2\% to 3\% usually cited for all THA.\textsuperscript{40} This increased incidence may be due to confounding factors, such as decreased muscle tone; associated dementia; and the indication for the THA, such as a previous hip fracture. Female sex has been related to increased risk of dislocation in with 3 : 1 and 4 : 1 ratios reported, with a particularly strong association with late dislocations (> 5 years postoperatively).\textsuperscript{8,22,52}
Previous surgery on the hip has been found in several series to be highly related to postoperative instability.\(^8,14,29,35,40\) In 1 study, the dislocation rate was 5 times greater in previously operated hips. The incidence of instability after revision THA is approximately 10% to 20%.\(^40,55\) Previous osteotomy,\(^35\) open reduction and internal fixation after fracture, and attempted arthrodesis all have been found to predispose to dislocation.\(^8,9,56\) In 1 of these studies,\(^9\) the rate increased from 2.4% for patients without previous surgery to 4.8% for patients with previous surgery. This association was independent of preoperative diagnosis.\(^39\) Contralateral hip surgery has not been shown to be a risk factor for THA dislocation.\(^8\)

Diagnosis leading to THA is an additional variable often thought to be related to risk of postoperative dislocation. There is little support for this concept in the literature. In two studies, when degenerative arthritis, osteonecrosis, rheumatoid arthritis, fracture, and developmental hip dislocation were compared as independent variables, there was no difference in risk of instability.\(^41,44\) Because some of these diagnoses often lead to multiple surgeries before THA, an indirect association does exist.

Alcoholism has been reported in several studies as a risk factor for postoperative dislocation.\(^19,40,44\) Many studies that have failed to document this relationship cited difficulty in documenting abuse accurately. One study placed the incidence of instability in alcoholics to be 23% versus 5% in their typical primary THA patient.\(^44\)

There is little information on the incidence of dislocation in motor disorders, such as cerebral palsy and Parkinson's disease, because THA is performed infrequently in these patients. One study of patients with instability\(^14\) found that urogenital psychosis, senile dementia, cerebral palsy, and alcoholism were present in 22% of the one-time dislocators and in 75% of the multiple dislocators. These diagnoses were found in only 14% of the patients with stable hips. One study\(^4\) specifically examined the results of 19 cemented THAs in patients with varying degrees of severity of cerebral palsy. All of these patients were treated postoperatively with spica casting for 6 weeks in an effort to prevent instability. Although there were 2 dislocations, these were thought to be due to component malposition and were treated successfully with revision.

Patient compliance with dislocation and activity precautions after THA generally is agreed to be a significant factor related to the development of instability. No studies specifically have evaluated this issue, however. Patients who for any reason are expected to be noncompliant with dislocation precautions should be regarded as at increased risk, and their treatment should be planned accordingly.

Although not a patient-specific factor, a surgeon's experience is a factor for risk of dislocation. In 1 study,\(^21\) the effect of surgical experience on dislocation rate in 4230 primary THAs was evaluated. Surgeons who had performed fewer than 30 THAs had significantly higher dislocation rates than more experienced surgeons. The incidence of dislocation decreased 50% for each 10 THAs performed.

**Operative Factors**

The surgeon has control over operative decisions to minimize instability in all patients, particularly patients at increased risk. The choice of surgical approach used for THA involves many considerations, including surgeon experience and familiarity, ease, operative time, blood loss, exposure, and postoperative limp. Although all of these issues are important, when the posterior (Moore), transtrochanteric, anterolateral (Watson-Jones), and direct lateral (Hardinge) approaches are compared in terms of dislocation risk, the direct lateral approach has a decreased incidence of instability.\(^22,36,38,42,51,56\)

In 1 study directly comparing the posterior and transtrochanteric approaches in a series of 3199 primary THAs, the dislocation rate was comparable between the 2—approximately 3%.\(^23\) In a large series from the Mayo Clinic, in which the transtrochanteric, anterolateral, and posterior approaches were performed, the dislocation rates were approximately 3.1%, 2.3%, and 5.8%.\(^56\) In this same study, postoperative displacement of the osteotomy when the transtrochanteric approach was used resulted in a dislocation rate approaching 17%. These rates are in sharp contrast to 2 reports\(^36,42\) describing the incidence of instability using a direct lateral approach in THA. One series\(^42\) reported a 0.3% incidence of instability in a group of 770 primary THAs followed for greater than 2 years. In another study,\(^36\) using a similar modification of the direct lateral approach, the rate of instability in 1518 primary THAs was 0.79%. Given these results, when instability is a concern, surgical planning should include the consideration of the use of a modification of the direct lateral approach.
Component Design and Size

Several modifications in component design have been made in an attempt to improve stability, including increasing femoral offset and building in femoral neck anteversion as well as use of larger femoral heads, built-up acetabular liners, elevated lip liners, and constrained liners.6, 15, 30, 52

The concept of increasing offset to increase soft tissue tension while minimizing limb lengthening has intuitive appeal. One study14 documented increased instability with decreased offset. This report of 1443 THAs found that decreased distance between the femoral head and the trochanter in the form of a stem placed in significant valgus alignment resulted in an increased dislocation rate. Although this finding supports restoring the patient’s normal offset, no studies have investigated whether increasing femoral offset over normal anatomy increases stability.

There are no specific reports evaluating the effect of built-in femoral component anteversion on dislocation rates. When the posterior approach is used, however, it seems reasonable to use this type of stem to decrease posterior instability. This is particularly true with some cementless implants in which the proximal metaphyseal profile may not allow safe rotation of the stem to the desired amount of version. When other approaches, such as the direct lateral approach, are used with these types of femoral stems, care must be taken to avoid excessive anteversion, which can produce anterior instability.

Another design issue often raised relative to THA instability is femoral head size. One study30 stated that in the presence of poor tissue tension, a subluxating femoral head of larger diameter has relatively further to travel before slipping over the edge of the acetabulum. These investigators stated that the femoral neck can impinge on the acetabular rim at extremes of flexion, extension, or abduction and that head-to-neck size ratio is important in this mechanism of dislocation. Although 1 study52 found a relationship between increasing femoral neck diameter relative to femoral head diameter and dislocation, there have been no clinical studies that strongly support the theoretic concept of increasing stability with increasing femoral head diameter. In 1 study, 10,500 THAs were performed using 22-, 28-, and 32-mm femoral heads via transtrochanteric, posterior, and direct lateral approaches. Only in the posterior approach group with 32-mm heads was there any correlation between larger head size and increasing stability. Other studies14, 50 have failed to show any relationship between head size and stability.

In 1 series,30 large acetabular component size correlated with an increased incidence of instability. In this study of 308 primary cementless THAs with 28-mm heads, the rate of dislocation was 14% when an acetabular component of 62 mm in diameter or larger was used compared with a rate of 4% when cups smaller than 60 mm were implanted. These authors prospectively compared the dislocation rates between small groups of patients who had either 22- or 28-mm femoral heads implanted. These authors found that increasing acetabular component diameter relative to the hip ball size significantly increased instability and postulated that this represented an anatomic mismatch, pseudocapsule attachment, or prosthetic impingement. A graduated hip ball sizing system was recommended to optimize stability and polyethylene thickness based on acetabular component size. In such a system, 22-mm heads are used for acetabular components smaller than 50 mm in diameter; 26-mm heads, for components 52 to 54 mm in diameter; 28-mm heads, for components 56 to 60 mm in diameter; and 32-mm heads, for components 62 mm or greater.

Although femoral head size alone has not been shown to affect stability significantly, the femoral head-to-acetabular diameter ratio is a consideration in choosing head size in THA. Issues such as polyethylene thickness and wear characteristics should be balanced with concerns about instability in choosing a femoral head diameter. It is reasonable to choose a small femoral head to ensure adequate polyethylene thickness, and a larger femoral head can be used with larger acetabular components in which polyethylene thickness and wear are lesser concerns.

Lateralized acetabular liners are another prosthetic variable that may affect stability after THA. These liners have increased amounts of polyethylene centrally, which moves the hip center laterally. This increased polyethylene also increases soft tissue and abductor tension, while minimizing the lengthening of the limb. No clinical studies have evaluated the effect of lateralized liners on stability, and their chief value may be only allowing a thicker polyethylene bearing surface.

Elevated lip liners have been produced in an effort to improve stability. These liners typically have a 10° to 20° built-up peripheral lip that can be rotated to provide increased coverage for an area of relative instability. There is
controversy regarding their routine use in primary THA. In a study of the effect on stability of 3 different elevated lip liners in a hip joint simulator, Krushell et al. showed that the position of the liner simply changed the arc of stable hip motion rather than increase global hip stability. Krushell et al. raised concerns about the long-term effect of joint forces on the unsupported polyethylene rim, difficulty in accurate positioning of the rim in some designs, and a prominent lip preventing reduction in the dislocated hip.

There are clinical results that support the use of lipped liners in THA. In a clinical study comparing instability rates in 1949 primary THAs in which a 10° elevated-rim acetabular liner was used with 2168 primary THAs in which a standard liner was implanted, the incidence of dislocation was 1.43% and 2.35%.7 In 520 revision hips with an elevated-rim liner compared with 530 revisions using a standard liner, the rates were 5.02% and 10.03%. Surgical approach and sex did not affect the outcome. Although the study found an association between the use of an elevated-lip liner and hip stability, the authors stopped short of recommending their routine use in primary THAs because of the limited difference in their results with primary THAs and concerns of long-term prosthetic loosening and excessive polyethylene wear.

Although in the short-term polyethylene wear and component loosening with these liners have not been found to be excessive, theoretic concern exists about their long-term performance. These liners may be most appropriate for use in the specific situations of hip instability related to a malpositioned well-fixed acetabular shell or of excessive instability in a specific quadrant of a well-positioned acetabular component.

Constrained liners of varying designs have been introduced to treat chronic dislocations not responsive to standard treatment. These components typically capture the femoral head with a snap-fit acetabular liner and locking ring. Although there have been reports of success in revision situations, these components are not recommended for use as a primary treatment option because of concerns related to accelerated polyethylene wear, prosthetic loosening, or failure of ingrowth of the acetabular component.

Component Positioning

Component orientation is probably the most important operative factor affecting the stability of a THA, but there is surprisingly little objective data concerning acceptable component orientation. One study defined a safe position of 15° ± 10° of anteversion and 40° ± 10° of anteverision. This study found a dislocation rate of 6% when out of the safe zone compared with 1.5% when in it. The authors' own data, looking at acetabular component orientation derived from three-dimensional computerized wear analysis, have shown no difference in orientation (version or verticality) between 27 known dislocators and 807 hips in the database.

As crucial as it may be, accurately determining the position of the acetabulum intraoperatively is difficult. One study comparing the position estimated using an intraoperative guide with the position measured using radiographic techniques found that 21 of 50 cups were placed outside the desired zone of stability. In another study, in which the acetabular position in 8 patients was estimated using an intraoperative guide and compared with the true acetabular position as determined by a computerized, intraoperative positioning system, all estimates of position were incorrect.

Because determining the exact anatomic position of an acetabular shell is difficult, surgical technique must emphasize the use of trial components to find the best component position for stability for that individual patient. When this position is found, an intraoperative guide and anatomic landmarks can be used to reproduce the version and abduction of the trial components. Although these guides are inaccurate in estimating the measurement of component orientation, they can be used successfully to place the true components in the same orientation as the trials. Consistent, secure positioning of the patient is needed for accurate recreation of the trial implant position with the true acetabulum.

The position of the femoral component may be equally important but receives less attention because the estimate of version intraoperatively is thought to be relatively simple. Femoral version is difficult to evaluate accurately postoperatively with plain radiographs. Clinical studies of optimal version are difficult. One study was able to determine that the most common orientation error in cases of hip instability was excessive femoral anteverision. When determining the desired position of the femoral component, the use of a femoral trial to determine the optimal position for stability is crucial. The final implant must reproduce the stable trial position regardless of the measured version.
A variety of techniques for determining leg length intraoperatively have been described, including commercially available devices that reference off of the ileum to a point on the greater trochanter, similar techniques using a bent Steinmann pin placed in the ileum, and measuring the difference between the position of the flexed knees with the heels placed together. No studies have shown conclusively that intentionally lengthening the limb routinely increases hip stability. Myofascial tension should be restored when possible, however, because an excessively lax soft tissue envelope theoretically would promote instability.

POSTOPERATIVE TREATMENT

The surgeon has little control over many factors that predispose a patient to dislocate after a THA. Recognition of the high-risk patient should prompt consideration of alterations in surgical technique that can diminish the risk of hip instability. The surgeon also has influence over postoperative decisions that can decrease the incidence of hip instability. These involve issues of bracing and patient education.

Prophylactic bracing of the primary THA has received little attention in the literature; this is likely because many patients tolerate bracing poorly, and compliance is often poor. One group evaluated the use of a hip cast-brace in 30 primary and 37 revision THAs. This group found that 3 of the revision cases dislocated postoperatively. One of these dislocated while wearing the brace. No dislocations occurred in the primary group. Primary and revision patients wore the brace an average of less than 24 days. The patient numbers were too small to be statistically significant; however, these authors thought that the technique was valuable in the revision patients. Another study recommended the routine use of a knee immobilizer for 4 weeks after primary endoprosthesis placement in which a posterior approach was used. The immobilizer simply prevents the patient from placing the hip in an excessively flexed position. These authors cited a 0% dislocation rate in 98 patients in whom an endoprosthesis had been placed as a primary procedure as support for their recommendation. Although there is little support in the literature for routine bracing after standard primary THA, high-risk cases, such as in revision arthroplasty, should be considered for an orthosis. The brace can prevent the patient from placing the limb in a position of instability and serves as a constant reminder to the patient that he or she is at risk for dislocation.

Educating the patient of his or her risk for dislocation is a crucial responsibility of all involved in the patient’s care. The patient and the treating staff need to be informed and reminded of the positions of the hip that should be avoided postoperatively for each case. One study of patients in a rehabilitation hospital setting showed that transfers were the most risky maneuver patients performed. These investigators recommended particular attention on the part of caregivers in observing precautions in this area. Physical and occupational therapy are needed to provide assistive devices, such as reachers, elevated toilet seats, and shower benches, and to instruct patients in their use. As mentioned before, the entire treatment team needs to be involved in this phase of planning to prevent THA dislocation.

SUMMARY

Instability after THA undermines patient confidence in the operation and in the treating surgeon as well as having true morbidity. Because closed treatment of instability is often unsuccessful and the results of revision surgery are disappointing, prevention of this complication is paramount. Preoperative planning should include assessment of a patient’s risk and alteration of the surgical treatment to address that risk. These measures, along with postoperative education to teach the patient safe performance of transfers and activities of daily living, can lower the likelihood of dislocation significantly.

References

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