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Basics of Primary Total Hip Arthroplasty: Preoperative and Postoperative Decisions

Douglas A. Dennis, MD
Raymond H. Kim, MD
Thomas S. Thornhill, MD
Robert T. Trousdale, MD

Abstract

Preoperative planning, choice of implant-bearing surface materials to reduce wear, factors to minimize the incidence of postoperative dislocation, and the critical postoperative care issues to facilitate a rapid recovery are important considerations in patients undergoing total hip arthroplasty.

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The decision to perform a total hip arthroplasty (THA) is based on clinical, functional, and radiographic criteria. Plain radiographs should show destructive arthropathy of the involved hip. Moreover, the surgeon must evaluate other possible sources of pain that could either mask, intensify, or complicate the pain pattern produced by the hip arthrosis. The clinical criteria should determine that the patient's symptoms can be corrected only with a THA. The patient should have undergone an adequate trial of medical therapy, physical therapy, and adjustment of functional activity. The functional criterion should be limitation or failure of the patient to perform reasonable physical activities because of the arthrosis.

Preoperative Planning

It is essential that the surgeon and patient align their goals and incentives. Informed consent is critical, but a more accurate description of the process would be "informed decision making." This indicates that the patient and family have actively participated in the decision-making process. The patient must understand that surgery is the only remaining option to improve function. At this point, the surgeon must discuss and document the known complications of the procedure and anesthesia, as well as any additional complications that may occur due to the patient's associated medical conditions.

The surgeon must determine the best choice of implant and discuss the risks and benefits of a THA and alternative treatment options with the patient. Is it best that the implant be cemented or cementless? Should the bearing surface be metal on cross-linked polyethylene, ceramic on ceramic, or metal on metal? Should resurfacing arthroplasty be considered? Should a large femoral head diameter be chosen to improve the head-neck ratio? What is the best surgical approach for the patient? Is it best to use a small posterolateral muscle-sparing approach or should an anterolateral approach be selected, particularly if the patient is at increased risk of postoperative dislocation? Is it best to perform the surgical procedure with a minimally invasive or standard incision? The advantages and disadvantages of the numerous issues that must be shared with the patient are discussed later in this chapter.

As patients are generally admitted the day of surgery, their medical history, including anesthesia risks, must be evaluated and known before the surgical procedure. The demographics of patients undergoing THAs are similar to those who have multiple medical comorbidities such as cardiovascular and respiratory disease. Moreover, the limited function caused by the arthritis may prevent the patient from exercising sufficiently to unmask silent coronary artery disease. To minimize perioperative risks, the patient must have a complete medical evaluation prior to surgery, typically performed by the patient's internist. In recent years the use of a beta-blocker in many patients has proved

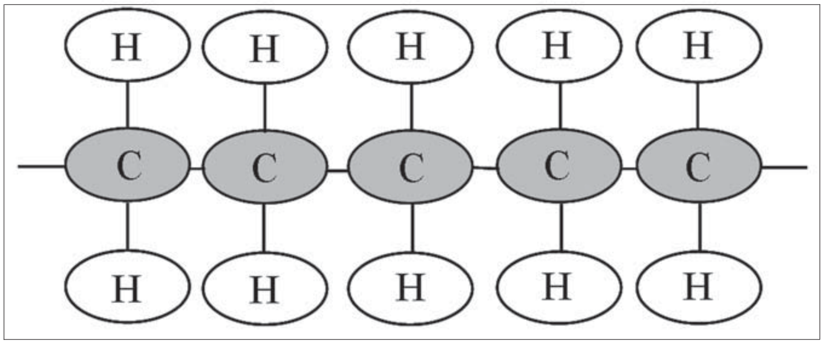

Figure 1 The chemical structure of polyethylene, showing long chains of carbon (C) with attached hydrogen (H) atoms.

to lower perioperative risk.[1-5] There are also data indicating that the pleiotropic effects of statins may reduce perioperative morbidity following noncardiac surgery.[6] This discussion should be held in concert with the patient's internist.

The emerging use of drug-eluting cardiac stents has created a large pool of patients who are on long-term anticoagulation medication. Recent studies of thrombosis in drug-eluting stents has led to the recommendation that the patient be maintained on clopidogrel for at least 1 year following stent insertion,[7-9] which substantially increases the risk of bleeding. Preoperative discussion with the patient's cardiologist is wise to determine the best treatment methodology, such as delaying the surgical procedure until this medication can be discontinued or considering perioperative platelet transfusion.

The surgeon must also preoperatively review the radiographs to be certain that the chosen implant can be sized to the patient's bone. This can be done either with plain or digital radiographs as long as a sizing marker is used to determine the percentage of magnification. Because most implanted femoral components are now cementless, it is imperative to be certain that the implant will reproduce femoral offset and leg length while being able to accommodate any anatomic variances. For example, in developmental dysplasia of the hip, the femur is often excessively anteverted, so a modular femoral component to correct the anteversion is desirable. In these patients, there is frequently acetabular deficiency that may require either a bone graft or prosthetic augmentation to obtain proper fixation.

Bearing Surface Materials

The failure of a THA secondary to particle-induced osteolysis, often associated with polyethylene wear rates greater than 0.2 mm/year,[10] has resulted in the development of various alternative bearing materials, including highly cross-linked polyethylene (HXLPE), metal-on-metal, and ceramic-on-ceramic designs.

Highly Cross-Linked Polyethylene

Polyethylene consists of long chains of carbon with attached hydrogen atoms (Figure 1). The production of HXLPE initially requires the production of free radicals, in which hydrogen atoms are removed from the carbon chains. Creation of free radicals can be accomplished by exposure of polyethylene to either gamma or electron beam irradiation or chemically by the use of peroxides. Most currently available HXLPE products are exposed to an irradiation dose of 5 to 10 Mrad. Exposure to higher doses offers limited improvements in wear properties and reduces mechanical properties (such as fatigue strength and fracture toughness), risking premature material failure. HXLPE is then created by the formation of covalent carbon-carbon bonds between adjacent free radicals, creating an interconnected, three-dimensional material with improved wear characteristics[11] (Figure 2). Avoiding of oxygen exposure during this process is critical because oxygen can combine with free radicals, resulting in chain scission, reduced molecular weight, and inferior wear properties due to oxidation.[11] The material is then treated with a thermal stabilization process (remelting or annealing), which frees the free radicals trapped within the crystalline region, allowing them to combine with each other and further reducing the potential for polyethylene oxidation.

Recent clinical reports with the use of various HXLPE materials have demonstrated substantial reductions in both wear and the incidence of osteolysis when compared with traditional polyethylene.[12-14] Triclot and associates[14] performed a prospectively randomized review of 102 THA patients implanted with either highly cross-linked Durasul (Zimmer, Warsaw, IN; 9.5-Mrad electron beam irradiation) or contemporary Sulene (Zimmer; 2.5- to 4.0-Mrad gamma irradiation in nitrogen) polyethylene inserts. At a mean follow-up of 4.9 years, the mean femoral head penetration rate was 0.025 mm/year in the Durasul group versus 0.106 mm/year in the

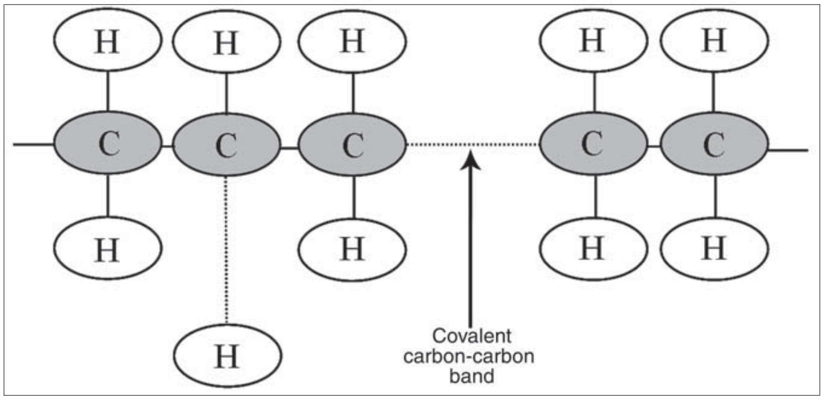

Figure 2 The chemical structure of HXLPE, created by the formation of covalent carbon-carbon bonds between adjacent free radicals, creating an interconnected, three-dimensional material.

Sulene group (P = 0.0027). The mean volumetric wear was 55% less in the Durasul group (P = 0.0058). Leung and associates[13] performed another randomized study of THA subjects implanted with either a Marathon (DePuy, Warsaw, IN) moderately cross-linked polyethylene liner (5 Mrad) or a conventional Enduron (DePuy) liner. Seventy-six participants (36 Marathon, 40 Enduron) were evaluated using CT scans at a mean follow-up of 6.1 years to determine the presence of osteolysis. Twelve of the Enduron participants (30%) and 6 Marathon patients (16.7%) demonstrated osteolytic lesions of 1 cm or larger (P = 0.19). The average lesion volume was significantly larger for Enduron patients (7.0 ± 6.7 cm^3) than those with Marathon acetabular liners (1.2 ± 0.7 cm^3; P = 0.001).

Although midterm clinical analyses have demonstrated substantial improvements in wear resistance, longer follow-up is needed to establish the long-term safety of HXLPE materials.[15] As previously mentioned, mechanical properties are reduced as the irradiation dose used to cross-link polyethylene is increased.[11,14,16] Fatigue cracking of retrieved HXLPE acetabular liners prepared with higher dose (9- to 10-Mrad) irradiation methods has been reported, often associated with thin polyethylene and vertical cup placement.[17,18] Continued clinical analyses are required to further evaluate the wear resistance benefits and ideal irradiation dose for HXLPE.

Metal-on-Metal

Metal-on-metal THA designs have been used for more than three decades. Premature failures encountered in the early years of use were often related to inferior materials and manufacturing processes. Substantial design improvements ensued to improve the durability of these devices. Critical design factors in the manufacture of metal-on-metal implants include the choice of metal material, equatorial versus polar contact patterns, boundary versus fluid-film lubrication, diametral clearance, and surface roughness.

Forged, high-carbon cobalt-chromium-molybdenum material is currently favored by most manufacturers due to its excellent hardness, wear resistance, and "self-healing" capacity to polish out surface scratches that may occur.[19] Equatorial contact between the femoral head and acetabular component was typical in first-generation metal-on-metal THA designs and often resulted in increased frictional torque, boundary lubrication, and an increased risk of failure due to implant seizing and premature loosening. Polar bearing contact patterns have been shown to reduce wear, believed secondary to the allowance of fluid ingress for lubrication as well as egress of wear debris particles[20] (Figure 3).

With boundary lubrication, transmitted loads are carried by asperity contacts between the two surface layers. With fluid-film lubrication, loads are carried by a fluid film that separates the bearing surfaces, reducing wear. Factors favoring fluid-film lubrication include polar contact patterns, reduced surface roughness, reduced diametral clearance dimension between the femoral head and acetabular liner, and increased femoral head diameter.[21-23]

The reported advantages of metal-on-metal THA implants include very low wear and subsequent osteolysis, increased range of motion to impingement secondary to the availability of larger femoral head diameters, and the potential to monitor implant performance by serial assessment of metal ion levels.[24-29] Sieber and associates[25] performed a wear analysis of 118 retrieved second-generation metal-on-metal implants and observed a linear wear rate (after initial wear-in phase) of 5 μm/year, which is at least 20 times less than linear wear rates with traditional polyethylene, and a volumetric wear rate of 0.3 mm^3/year, which is at least 60 times lower than with use of traditional polyethylene.

Reported concerns with metal-

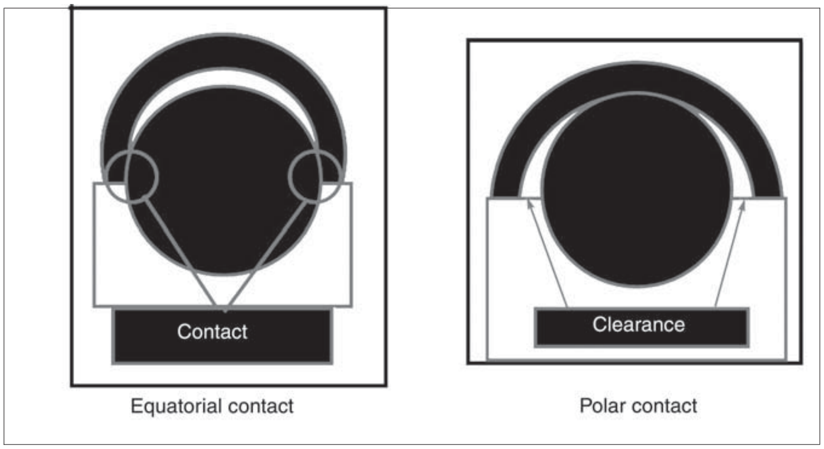

Figure 3 Equatorial versus polar bearing contact patterns.

on-metal THA implants are the elevation in serum and urine metal ion levels typically observed in subjects implanted with these devices and the subsequent risk of carcinogenicity or teratogenic effects.[30-32] Sauvé and associates[30] analyzed metal ion levels in a 30-year follow-up study of subjects implanted with the Ring metal-on-metal THA implant and found levels of cobalt and chromium were elevated by five and three times, respectively. Another report analyzing different metal-on-metal THA designs observed cobalt ion levels 50 times higher and chromium ion levels 100 times higher than controls.[31] Because of these ion elevations, many recommend avoiding metal-on-metal THA implants in patients with renal insufficiency or in females of childbearing age. Because of the potential carcinogenic effects of the associated metal ions, numerous investigations have been performed that have shown no increase in overall cancer risk in patients implanted with metal-on-metal THA designs versus the general population.[33-35]

An additional concern with metal-on-metal THA designs is the risk of metal-induced hypersensitivity reactions.[36,37] Willert and associates[36] analyzed periprosthetic tissue from 19 failed metal-on-metal THA implants and observed perivascular infiltration of both lymphocytes and plasma cells consistent with a hypersensitivity reaction. Associated joint effusions and tissue necrosis were commonly seen. Although the prevalence of this phenomenon appears low, close follow-up of metal-on-metal THA patients is merited to analyze the incidence and clinical significance of hypersensitivity reactions.

Clinical results of both first- and second-generation metal-on-metal THA implants have been favorable, with a low incidence of osteolysis and good survivorship.[26,27] Jacobsson and associates[26] compared the results of 107 McKee-Farrar (metal-on-metal) and 70 Charnley (metal-on-polyethylene) THA implants at an average follow-up of 20 years and observed a 20-year aseptic probability of survival of 77% and 73%, respectively, with minimal osteolysis in the metal-on-metal group. Grübl and associates[27] analyzed 105 second-generation metal-on-metal implants at a minimum follow-up of 10 years and observed a 98.6% probability of survival, with rare osteolysis and no renal insufficiency.

Ceramic-on-Ceramic

Ceramic-on-ceramic prostheses were first implanted by Boutin in 1970.[38] Many first-generation failures, including ceramic fracture rates as high as 7.5%,[38] were attributed to inferior ceramic material (large grain size, low density, increased porosity) and poor manufacturing processes (sphericity deviations, diametral clearance mismatches, large taper tolerances).[39,40] Early failures resulted in multiple mechanical property improvements, including clean-room processing, improved sintering techniques to reduce grain size and increase material strength, hot isostatic pressing to increase density and improve surface finish, proof testing, and laser marking to reduce stress raisers within the ceramic.[39,41-43] These changes have resulted in substantial increases in material strength and hardness, as well as a reduction in grain size and the incidence of ceramic fracture.

Alumina ceramic (Al_2O_3) was initially used because of its excellent hardness, biocompatibility, wettability, fluid-film lubrication, and low coefficient of friction.[44] Zirconia ceramic was introduced in the 1980s to address alumina fracture. Pure zirconia is unstable, exhibiting three crystalline phases (monoclinic, cubic, and tetragonal).[44] Stability is provided with the addition of oxides (yttrium) to maintain zirconia in the tetragonal phase. Yttrium-stabilized zirconia has a small grain size (0.2 μm) and exhibits nearly double the fracture toughness of alumina ceramic.[45] Zirconia, however, may undergo phase transformation from the tetragonal to monoclinic phase over time.[44,46] Phase transformation to the monoclinic phase results in increased surface roughness and may account for the inferior wear characteristics of zirconia as compared with alumina ceramic.[46]

More recently, alumina matrix composite (AMC) ceramics have been developed that combine the hardness and excellent wear characteristics of alumina with the fracture resistance of zirconia ceramic.[47,48] Testing of AMC composites of alumina and zirconia (Biolox delta; CeramTec AG, Plochingen, Germany) has demonstrated a nearly twofold increase in fracture toughness when compared with alumina ceramic, with maintenance of excellent wear resistance. AMC ceramic composites are currently approved by the US Food and Drug Administration (FDA) for use only as femoral head components. AMC-on-AMC ceramic couples currently remain under FDA study, although they are clinically implanted internationally. Major advantages reported for the use of ceramic THA designs are extremely low wear rates (attributed to material hardness), low surface roughness (Ra = 0.02 μm), and increased wettability that favors a fluid-film lubrication regimen.[44] In vivo retrieval linear wear rates as low as 0.016 to 0.025 mm/year have been observed,[49-51] which is approximately 4,000 times less than with historical metal-on-polyethylene devices. Bohler and associates[52] found that the concentration of debris in periprosthetic membranes of loosened implants was 2 to 22 times lower with alumina-on-alumina than with metal-on-polyethylene wear couples. Higher wear rates can be observed, particularly in association with loose or vertically positioned sockets, femoral neck-acetabular rim impingement, and with the use of poor quality alumina ceramic.[39] Stripe wear has been observed in retrievals due to intragranular ceramic loss believed to be secondary to impingement and femoral head microseparation.[48]

An additional advantage of ceramic bearings is the relative bioinertness of ceramic microparticulate debris. Analyses of periprosthetic membranes of failed alumina-on-alumina implants typically demonstrate a fibrocytic response with limited inflammatory cells. In a study by Sedel and associates,[53] prostaglandin E_2 levels in retrieved membranes surrounding loosened prostheses were 69 ± 56 fmol/mg in failed alumina ceramic implants versus 202 ± 156 fmol/mg in failed metal-on-polyethylene implants. Petit and associates[54] compared the macrophage response to alumina and polyethylene microparticulate debris of identical size and volume by measuring the production of tumor necrosis factor-α, a cytokine known to induce osteolysis. They observed 8 to 10 times higher levels of tumor necrosis factor-α release in the presence of polyethylene than with exposure to alumina microparticulate. These data are supported by numerous long-term clinical studies that show a very limited incidence of osteolysis associated with ceramic THA designs.[44,51,55-57]

Disadvantages associated with ceramic THA bearing materials include the risk of fracture or squeaking, a risk of premature bearing wear in ceramic components revised because of fracture due to remaining third-body microparticulate debris, increased cost, and a reduced range of error during component implantation.[38,44,57-63] Willmann[59] reported a fracture rate of 0.02% based on implantation of more than 1.5 million ceramic femoral heads since 1974. Hannouche and associates[58] observed 13 fractures (0.23%) in a group of 5,500 patients with ceramic THA implants. Fracture rates of ceramic implants are affected by material quality, manufacturing techniques, component malposition resulting in ceramic impingement, and patient factors. Squeaking following implantation of ceramic THA materials historically has been rare. Lusty and associates,[57] in a recent analysis of a third-generation alumina-on-alumina ceramic THA implant, observed this phenomenon in 0.3% (1 of 301 cases). However, Jarrett and associates (unpublished data presented at the American Association of Hip and Knee Surgeons annual meeting, 2006) observed an incidence of squeaking of 7% (10 of 159) in a group of subjects implanted with a modular design in which the ceramic liner is positioned within a titanium encasement that has an extended rim designed to prevent metal-on-ceramic impingement. The exact etiology of squeaking remains unclear but is theorized to be related to factors that enhance femoral head microseparation and femoral neck-acetabular component impingement such as component malposition,[62] patient factors (younger, heavier, taller),[60,62] and implant designs with elevated acetabular component rims.[60]

The results of using alumina-on-alumina in THA have been favorable, with minimal failures related to the ceramic material and absent or minimal incidence of periprosthetic osteolysis.[51,57,64] In the recent analysis by Lusty and associates,[57] a rate of survival based on revision for either aseptic loosening or osteolysis was 99% at 7-year follow-up.

Avoiding Instability

Dislocation after THA is a frustrating complication, with a reported incidence of 0 to 10%.[65-74] It may

Table 1
Risk Factors for Dislocation After a THA

Preoperative	Intraoperative	Postoperative
Previous hip surgery	Intraoperative patient positioning	Incorrect limb positioning
Gender	Surgical approach	Trochanteric nonunion/ migration
Mental health disorders	Capsular repair	Retained foreign debris
Neuromuscular disorders	Component malposition	Entrapped soft tissues
Alcohol abuse	Decreased prosthetic offset	
Older age (octogenarians)	Decreased soft-tissue tension	
	Femoral head-neck ratio	
	Femoral head diameter	
	Acetabular liner geometry	
	Retained periacetabular osteophytes/cementophytes	

occur in either a posterior, anterior, or superior direction. Posterior dislocations result from lower extremity positioning in excessive flexion, adduction, and internal rotation. Limb placement in extension, adduction, and external rotation risks anterior dislocation.

Most initial dislocations occur early, with 60% to 70% reported within the first 6 weeks following the surgical procedure.[75,76] The risk of recurrent dislocation is variable, with two large series reporting an incidence of approximately 33%.[77,78] The risk of recurrent dislocation is greater in patients suffering their initial dislocation late, after primary healing has occurred.[76] von Knoch and associates[79] reviewed 19,680 patients following THA and observed that 165 (0.8%) suffered their initial dislocation more than 5 years postoperatively (mean, 11.3 years), and 55% of those with late dislocation suffered a recurrent dislocation. Risk factors observed for late dislocation included female gender, younger age, trauma, polyethylene wear greater than 2 mm, and cognitive or motor neurologic impairment.[79-81]

Risk Factors

Risk factors can be classified into preoperative, intraoperative, and postoperative categories (Table 1). A predominant preoperative risk factor for dislocation is previous hip surgery.[66,75,76,78] Woo and Morrey[78] found a twofold increase in dislocation in those with previous hip surgery (158 of 3,259; 4.8%) versus those without previous hip surgery (171 of 7,241; 2.4%; $P < 0.001$). Dislocation occurs twice as frequently in females and three times as often in females who suffer a late dislocation.[66,75,76,78,80] Additional preoperative risk factors for dislocation include mental health disorders, neuromuscular disease, alcoholism, and advanced age.[75,76,82-84]

Intraoperative patient positioning can affect the incidence of dislocation by enhancing the probability of acetabular component malpositioning.[78,85] The normal lumbar lordosis is decreased from the standing position to the lateral decubitus position by as much as 20° to 35°, resulting in pelvic flexion and increasing the risk of acetabular component retroversion when the patient is in an erect position.[85] Placement in the lateral decubitus position often results in pelvis adduction (10°-15°), increasing the risk of vertical cup placement. Anterior tilt of the patient positioned in the lateral decubitus position is fairly common, enhancing the chance of acetabular component placement in less anteversion than desired.[78]

The risk of dislocation is highest when a posterolateral surgical approach is used.[70,78,85-87] Berry and associates[87] analyzed the 10-year dislocation rates in more than 21,000 THAs and observed dislocation rates with a 28-mm femoral head of 3% with the anterolateral approach, 3.5% with the transtrochanteric approach, and 6.9% with the posterolateral surgical approach. Dislocation rates using a posterolateral approach can be reduced with posterior capsular repair. Robinson and associates[70] reported a 7.5% rate of dislocation using this approach without capsular or external rotator musculature repair versus less than 1% when the capsule was repaired.

Component malposition, particularly of the acetabular component, is a critical factor in dislocation.[66,78,82] Lewinnek and associates[69] determined that the "safe zone" of acetabular component position was 40° ± 10° of abduction and 15° ± 10° of anteversion. Patients with acetabular components positioned within this safe zone had an incidence of dislocation of 1.5% versus 6% in those in whom the acetabular component was oriented outside this range ($P < 0.05$).

Failure to restore both vertical and horizontal soft-tissue length risks dislocation. Vertical length is determined by the level of femoral neck resection, prosthetic neck length, and axial acetabular component position. Horizontal soft-tissue tension is determined by the level of neck resection, the length of femoral neck selected, and the femoral component offset. Horizontal length (offset) may be increased by a more distal femoral neck resection and selection of a longer femoral neck or with the use of femoral components with increased offset built into the component.

Additional prosthetic risk factors for hip dislocation include the femoral head-neck ratio, the femoral head diameter, and acetabular liner geometry. Larger femoral head-neck ratios are favored because they increase the range of motion to impingement. This ratio can be increased both with the use of larger femoral head diameters and the selection of femoral components with narrower neck diameters, particularly in the coronal plane.[88] Many have reported reduced dislocation with larger femoral head diameters, particularly greater than 36 mm.[87,89-91] Crowninshield and associates[91] demonstrated that the use of larger femoral head diameters results in increased displacement (drop height and lateral displacement) required for dislocation as long as the acetabular component is not vertically positioned. Impingement can still occur with large diameter femoral heads, but it typically involves osseous impingement (proximal femur against the pelvis), in contrast to component-component impingement with lesser diameter femoral heads.[92,93]

The use of modular extended lip acetabular liners theoretically improves hip stability by providing additional support in regions of compromised hip stability.[94] Cobb and associates[94] reviewed patients treated with a 10° extended lip versus a standard, nonelevated liner. The incidence of dislocation in those with an extended lip liner was 1.43% (25 of 1,949) versus 2.35% (50 of 1,068) when a nonelevated rim liner was used ($P = 0.04$). The use of elevated-lip liners risks premature polyethylene wear and component loosening due to earlier neck-liner impingement, particularly when used in combination with a long femoral neck with a femoral-neck skirt.[94,95] Modular lateralized liners increase horizontal soft-tissue tension, theoretically reducing the risk of dislocation; however, clinical data are lacking with the use of these devices.

Noncompliance with postoperative instructions regarding limb positioning is the most frequent cause of early postoperative THA dislocation. Perioperative education, emphasizing the need to avoid lower limb positioning in excessive flexion, adduction, and internal rotation (posterior dislocation) or placement of the extended limb in marked external rotation (anterior dislocation), is imperative to minimize dislocation. Other postoperative risk factors include trochanteric nonunion associated with proximal migration of the trochanteric fragment greater than 2 cm and entrapment of either soft tissue or foreign debris postoperatively.[67,78,96-98]

Dislocation Management

Postoperative THA dislocations can be managed by either nonsurgical or surgical methods. The best nonsurgical management of THA dislocation is prevention, by using good surgical technique and educating the patient on the mechanisms of dislocation and the importance of avoiding high-risk limb positions. Should dislocation occur, most can be treated with closed reduction (longitudinal traction plus hip rotation) with appropriate anesthesia. Additional external devices, such as hip abduction braces, knee immobilization splints, or a hip spica cast, can be used after reduction to lessen the risk of recurrent dislocation.[99-102] The success of nonsurgical treatment is variable, with 10% to 44% eventually requiring surgical treatment.[78,80]

Surgical treatment is considered when a concentric reduction is not obtainable by closed methods or when nonsurgical treatment of recurrent dislocation is unsuccessful. Multiple surgical procedures may be used (Table 2). The choice of surgical procedure is based on the etiology of the dislocation. A determination of the accuracy of component position is critical. If substantial malposition is found, reorientation of the acetabular component is often required, particularly if retroversion is present. Daly and Morrey[103] reviewed 95 patients reoperated for chronic THA instability and observed that correction of retroversion of the acetabular component was the procedure most likely to produce a stable hip. If acetabular component malposition is limited, insertion of a modular, elevated-lip liner can reorient the peripheral boundaries of the acetabular component, providing additional support in regions of compromised hip stability.[94] If component placement is satisfactory but soft-tissue tension is inadequate, distal advancement of the greater trochanter can be used to increase abductor muscle tension and function. Kaplan and associates[104] used this technique to treat 21 recurrent dislocations, obtaining hip stability in 76% (16 of 21). The soft-tissue tension can also be increased by increasing femoral neck length or by using lateralized modular acetabular component liners.

Table 2
Surgical Options for Recurrent Hip Instability

Component revision
Extended-lip acetabular liner
Acetabular augmentation
Trochanteric reattachment/advancement
Constrained acetabular component
Bipolar/tripolar acetabular component
Increased femoral head diameter
Increased femoral neck length
Impingement correction

As previously discussed, larger femoral head diameters can lessen dislocation secondary to increased hip motion until component impingement occurs. The use of jumbo femoral head diameters in surgical treatment of the unstable THA is therefore logical, although long-term clinical data supporting this concept are not yet available other than when a bipolar or tripolar acetabular prosthesis is selected. These devices offer additional hip stability because motion can occur at multiple bearing surfaces, thus allowing increased motion before the femoral head dislodges from the acetabular component. Beaulé and associates[105] reported on 12 cases of recurrent dislocation revised with a jumbo femoral head (11 of 12 with a tripolar construct) at mean follow-up duration of 6.5 years. No further hip instability was observed in 11 of 12 cases (91.7%). When the previous treatment modalities have failed, the use of constrained acetabular components is considered. Indications for these devices include extremity shortening, excessive weakening or loss of the hip musculature, an elderly and disoriented patient, and a multiply revised THA that continues to dislocate. Disadvantages of these components include reduced motion until impingement, premature polyethylene wear, and component loosening, as well as mechanical breakdown of the constraining mechanism with recurrent dislocation. Results of the use of constrained acetabular components are variable, with failure rates ranging from 0 to 42% with follow-up durations up to 10 years.[106-108]

Results of revision for hip instability are variable and often related to the type and extent of the surgical procedure. Correction of hip instability with surgical treatment has been reported to occur in 60% to 70% of patients treated with surgery.[78,81] Failure to correct all factors contributing to dislocation intraoperatively was often associated with failure of the revision. Many of the surgical methods described can be used in combination to achieve THA stability (Figure 4).

Patient Management: Start to Finish

In addition to performing a technically sound operation, a successful THA requires comprehensive management of the patient from the preoperative visit in the office to postoperative care after discharge from the hospital.

Preoperative Patient Education

Patients commonly approach their hip replacement with significant anxiety. The fear of the unknown can be minimized with preoperative education for the patient as well as the patient's family or caregivers. Educational material in the form of handbooks, videotapes, and patient education classes can provide useful information and has been shown to have beneficial effects on the outcome of total joint arthroplasty patients.[109-111] It is important for the surgeon to be attentive to the patient's specific fears and to provide appropriate reassurance. The surgeon should understand the patient's preoperative expectations to ensure that the patient has realistic goals for the postoperative recovery and acceptable activities after a THA. Patient satisfaction postoperatively is influenced by whether the patient's preoperative goals and expectations are achieved.[112] Length of hospital stay should also be discussed with patients preoperatively so that they can anticipate the timing of postoperative discharge from the hospital.[111]

Anesthesia Optimization

Anesthesia for total joint arthroplasty has dramatically evolved over the past decade. In addition to reducing postoperative pain, anesthesia techniques have been developed with the goal of minimizing the use of parenteral narcotics to prevent medication side effects such as nausea, vomiting, oversedation, bowel and urinary retention, and pruritus, while allowing patients to participate in their physical therapy rehabilitation. Multimodal anesthesia, incorporating preemptive analgesics and regional nerve blocks, is an effective means of achieving pain control and avoiding prolonged hospitalization due to inadequate pain control or complications resulting from medication side effects.[113-118] The use of preemptive analgesics (long-acting oral narcotics and nonsteroidal anti-inflammatory medications) that are administered before surgery has been demonstrated to effectively reduce postoperative pain.[114,117,119-122] Advancements in techniques for peripheral nerve blockade, using lumbar plexus or sciatic nerve blocks, now provide improved regional pain control postoperatively.[114-116,120]

Weight-Bearing Status After THA

Postoperative instructions on the amount of allowed weight bearing should be provided to both the patient and the physical therapists involved in mobilizing the patient after surgery. It is reasonable to permit weight bearing as tolerated when good implant fixation is achieved and the surgical exposure avoids violation of the abductor mechanism. Historically, patients with cementless femoral stems were required to ambulate with protected weight bearing or even no weight bearing for up to 12 weeks, out of concern for stem subsidence. Multiple recent studies, however, demonstrate excellent results using cementless THAs, even with unrestricted weight bearing.[123-126] Rapid mobilization beginning the day of surgery or the following morning is recommended to avoid complications associated with immobilization (such as thrombosis, ileus, or pneumonia).

Dislocation Precautions

Some controversy exists regarding the need to adhere to postoperative restrictions designed to limit postoperative dislocation, such as avoiding certain limb positions. Although two studies question the role of patient restrictions in preventing dislocation, these studies examined patients who underwent a THA using an anterolateral approach.[127,128] Most believe patients should receive instructions on avoiding certain ranges of motion and limb positions that increase the risk of postoperative dislocation.[129,130]

Deep Venous Thrombosis Prophylaxis

Patients undergoing THA are at increased risk for venous thromboembolism. Katz and associates[131] reported a 0.93% nonfatal pulmonary embolism rate in 58,521 Medicare patients undergoing THA at 90 days postoperatively. From the Scottish morbidity record, Howie and associates[132] reported a 0.22% fatal pulmonary embolism (90-day) rate in 44,785 patients undergoing THA. The American College of Chest Physicians provided their most recent evidence-based guidelines for thromboembolic prophylaxis in 2004.[133] The grade 1A guidelines are recommendations based on clear evidence of benefit and are supported by consistent results from randomized clinical trials. The grade 1A recommendations for postoperative pharmacologic thromboembolic prophylactic agents include warfarin with a target international normalized ratio of 2.5, low molecular-weight heparin, or fondaparinux. They recommended at least 10 days of postoperative prophylaxis and 28 to 35 days of prophylaxis for high-risk patients (history of deep venous thrombosis or pulmonary embolism, cancer, obesity, and advanced age).

Recognizing that the benefits of preventing symptomatic pulmonary emboli should be balanced by the risks of bleeding complications, the American Academy of Orthopaedic Surgeons has preoperative, intraoperative, and postoperative guidelines based on a systematic review and meta-analysis of the literature.[134] Preoperatively, patients should be assessed for elevated risk for pulmonary embolism and bleeding. Intraoperatively, the use of regional anesthesia and mechanical prophylaxis should be considered. Postoperatively, acceptable chemoprophylactic agents for patients at standard risk of both pulmonary embolism and major bleeding include aspirin, low molecular-weight heparin, synthetic pentasaccharides, or warfarin.

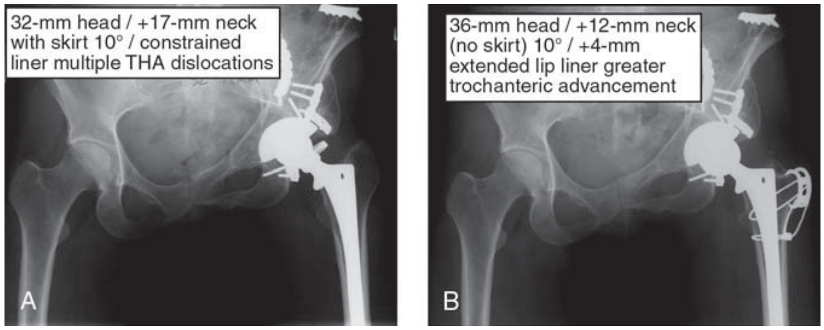

Figure 4 **A,** Preoperative radiograph of the pelvis of a patient who sustained multiple THA dislocations despite the presence of a constrained liner. Note the wide femoral neck skirt resulting in a reduced femoral head-neck ratio. **B,** AP pelvic radiograph following revision THA involving femoral head (larger diameter/no femoral neck skirt) and liner (nonconstrained) exchange, greater trochanteric advancement, and subsequent resolution of hip instability.

Summary

Before THA is performed, the goals of the surgeon and patient should be in alignment. The surgeon must select the best choice of implant and discuss possible risks and benefits with the patient. Preoperative patient education, optimization of anesthesia, providing instructions on weight-bearing status and hip precautions, and administration of thromboembolic prophylactic measures are some of the important details that should be carefully managed by the surgeon to ensure a successful THA.

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