INTRODUCTION

The goals of adult reconstructive surgery are to maintain optimal function, minimize disability, and remove pain. Diseases that affect the ability to walk obviously have a tremendous impact on our independence, ability to be productive, and general quality of life. In addition to locomotion, the hip joint has an important role in allowing other normal functions such as sitting, standing, bending to the floor, lifting objects, and dressing. Reconstructive surgery of the hip in adults encompasses surgical procedures to restore optimal function of the hip joint. The most common and successful surgical intervention has been total joint arthroplasty for arthritis of the hip; that is the primary focus of this chapter.

ANATOMIC CONSIDERATIONS

Joint Anatomy

Developmental Anatomy

The acetabulum develops from the confluence of the ilium, pubis, and ischium. These three bones contribute to the triradiate cartilage, which forms the primary growth center of the acetabulum. Normal growth and development of the socket requires the presence of a round femoral head. If the femoral head is partially or completely dislocated, the acetabulum will be shallow and/or malformed. The proximal femur has a single epiphysis at birth that differentiates into the proximal femoral epiphysis (femoral head) and trochanteric apophysis (greater trochanter). The terminal branch of the medial circumflex artery (called the lateral ascending cervical artery) provides the primary blood supply to the femoral head. The hip joint is formed by the 11th week of gestation. The femoral epiphysis secondary ossification center is usually evident by 4 to 7 months of age and fuses to the femoral diaphysis on average at age 14 to 15 months in females and 17 to 18 months in males. The majority of the acetabular growth occurs by 8 years of age.

Capsule/Labrum/Synovium

The capsule of the hip joint is a specialized structure that allows motion and assists in stability of the hip joint. The normal hip joint has a suction effect created by the conformity between the articular surfaces, the labrum, and the hydrostatic forces of the synovial fluid layer. The capsule is composed of the iliofemoral ligament, pubofemoral ligament, ischiofemoral ligament, and zona orbicularis. The iliofemoral ligament (ligament of Bigelow) is a capsular thickening in the shape of an inverted Y that resists extension of the hip and is reported to be the strongest ligament in the body. In the arthritic hip, these ligamentous structures are abnormal and contribute to its limited motion. Traditionally, nearly the entire hip capsule was resected with the transtrochanteric approach to the hip. Resection of the hip capsule affects the stability of the hip after joint arthroplasty; therefore most modern approaches strive to preserve some portion or the complete capsule. In the posterior approach, repair of the capsulotomy has been associated with a decreased dislocation rate. In the anterolateral or anterior approach to the hip, dislocation is a less common problem and many surgeons remove the anterior capsule as part of the exposure of the hip joint.

Blood Supply

The obturator artery has three branches that supply the acetabulum. These include the acetabular artery (cotyloid
fossa), preacetabular artery (pubis), and infraacetabular artery (inferior acetabular rim). The superior gluteal artery supplies the ilium through the supraacetabular artery branch as well as through the attachments from the gluteal muscular origins. The retroacetabular artery branches from the inferior gluteal artery to supply the posterior wall and ischium. There is a rich anastomotic network between the inferior gluteal artery, superior gluteal artery, medial and lateral circumflex arteries, and obturator artery.

The blood supply to the femoral head is more limited and is at risk during operative treatments and injuries of the hip. The medial circumflex artery (MCA) branches from the posteromedial aspect of the profunda femoris artery and courses between the pectineus muscle and iliopsoas muscle, emerging on the posterior aspect of the hip between the obturator externus and the quadratus femoris muscles. The MCA travels posteriorly to the obturator externus muscle insertion and penetrates the joint capsule between the obturator externus muscle and conjoint tendon. The lateral ascending cervical branches travel in the subsynovial fold to the intraarticular subcapital arterial ring and supply the blood flow to the femoral head. In the adult, when the epiphysis fuses to the neck, there is a medullary blood supply to the femoral head. The lateral circumflex artery has multiple penetrating arterioles into the metaphysis of the proximal femur and also supplies the greater trochanter.

**Nerve Supply to the Hip Joint**

**Peripheral Nerve Contributions to the Hip Joint**

The nerve supply to the hip joint is provided by the obturator, inferior gluteal, and superior gluteal nerves. The innervation of the capsule and synovium varies and is altered in pathologic conditions of the hip. The greatest concentration of nerve endings is in the anteroinferior aspect of the hip capsule. Some orthopaedic surgeons have proposed obturator nerve ablation for patients with refractory hip pain, but nociceptive innervation contributions also come from the superior and inferior gluteal nerves. In addition to the innervation of the periosteum, somatic and autonomic nerve fibers transverse the haversian canals of bone, with the highest concentration in the metaphyseal regions.

**Obturator Branches**

The obturator nerve is formed from the anterior division of L2 to L4 nerve roots. It travels with the obturator artery and vein medial to the quadrilateral plate and the obturator internus muscle, exiting the pelvis at the superolateral aspect of the obturator foramen.

**Superior Gluteal Nerve**

The superior gluteal nerve is formed from the posterior divisions of the L4 to L5 nerve roots. It exits the pelvis through the sciatic notch superior to the piriformis muscle and travels between the gluteus medius and gluteus minimus muscles approximately 4 to 5 cm superior to the greater trochanter. Articular branches supply the superior and anterior aspect of the hip joint capsule and acetabulum.

**Inferior Gluteal Nerve**

The inferior gluteal nerve is formed from the posterior divisions of the L5 to S1 nerve roots and exits the pelvis through the sciatic notch inferior to the piriformis muscle. It innervates the gluteus maximus muscle and the posterior aspect of the hip capsule and acetabulum.

**Sciatic Nerve**

The sciatic nerve is formed from the anterior (tibial) and posterior (peroneal) branches of L4 to S3 nerve roots and usually courses anteriorly and medially to the piriformis muscle. There is a spatial orientation of the two common divisions (common peroneal and tibial), with the common peroneal nerve located laterally. The common peroneal division of the sciatic nerve is more susceptible to injury because it has two fixation points (sciatic notch and fibular head) and larger funiculi with less connective tissue. This makes it susceptible to traction injury.

**Femoral Nerve**

The femoral nerve is composed of the posterior divisions of the L2 to L4 nerve roots and travels between the iliacus and psoas muscles proximally and overlying the iliopsoas muscle, exiting the pelvis on the lateral side of the femoral triangle.

**SURGICAL ANATOMY**

**Approaches**

**Anterior**

The anterior surgical approach is the only internervous anatomic approach to the hip joint. The advantages of this approach are exposure without violation of muscles, a relatively thin subcutaneous fat layer, and excellent visualization of the acetabulum for primary surgery. The disadvantages of this approach are increased difficulty in seeing the femur for preparation, inability to prepare the femur axially, potential injury of the lateral femoral cutaneous nerve, difficulty in performing reconstructions of the posterior column of the acetabulum, and a surgical scar that may be cosmetically unacceptable. This surgical approach can be utilized to perform both the acetabular and femoral reconstruction or for the acetabular reconstruction.
alone in combination with accessory approaches for the femoral reconstruction.

Placement of the surgical incision varies: longitudinal or shorter oblique. The incision is often made approximately 2 to 3 cm lateral to the anterosuperior iliac spine (ASIS) directed distally toward the lateral border of the patella for approximately 8 cm. The superficial interval is between the tensor fascia lata (TFL) muscle and the sartorius muscle. The superficial lateral femoral cutaneous nerve (LFCN) exits the fascia medial to this interval approximately 2 to 5 cm distal to the inguinal ligament and has several branches. By incising the fascia overlying the tensor fascia lata muscle and retracting the muscle belly laterally within its compartment, one will minimize the potential to injure the lateral femoral cutaneous nerve. The deep interval is between the rectus femoris muscle (femoral nerve) and the gluteus medius muscle (superior gluteal nerve). The hip capsule is immediately evident at this stage and can be either excised or incised. Exposure of the femur is enhanced with external rotation, adduction, and extension of the hip. Matta uses a fracture table with a specialized femoral hook to elevate the femur (controlled by the anesthesiologist) in order to achieve the femoral positioning.

**Modified Anterolateral/Direct Lateral**

The direct lateral or modified anterolateral approach for joint arthroplasty typically requires partial interruption of the gluteus medius/minimus insertion on the greater trochanter (typically one-third of the tendon). The advantages of the anterolateral/lateral approaches to the hip are the ability to perform the procedure from both the supine and lateral positions, ease of acetabular and femoral exposure, and greater protection from postoperative dislocation. The disadvantages of the approach are the interruption of the abductor muscle mechanism and the prolonged limp after surgery which this causes. The anterior portion of the superior gluteal nerve supplying the anterior one-third of the gluteus medius and the TFL can be injured if the dissection continues for more than 3 to 4 cm into the abductor muscle.

The surgical incision is directly lateral and the iliotibial band is split between the TFL and the gluteus maximus muscle. There are several variants of the modified anterolateral approach to the hip; however, all entail a release of the anterior one-third to one-half of the abductor insertion onto the greater trochanter with or without a small portion of the anterior trochanter. With the anterior portion of the abductor released, the anterior hip capsule is excised or incised and both the acetabulum and femur can be easily visualized. Axial preparation of the femur is possible with this approach. The abductors are repaired to the trochanter prior to closure.

**Posterolateral**

The advantages of the posterolateral approach are excellent extensile exposure of the femur and the acetabulum, protection of the abductor mechanism, full access to the femur for axial preparation, ability to perform extended trochanteric osteotomies, and access to the entire posterior column of the pelvis for complex reconstructions. The disadvantages are the potential for an increased rate of posterior dislocation.

A curvilinear incision is made over the lateral aspect of the femur extending posteriorly in line with the posterolateral iliac spine (PSIS). The iliotibial band is incised and the gluteus maximus muscle fibers are split. The piriformis, conjointed tendon, and obturator externus muscles are released at their insertions on the femur, often with the capsule as one. The capsulotomy may be rectangular (attached medially) or T-shaped. After the arthroplasty, the posterior capsule is repaired so as to minimize rates of dislocation.

“Minimally Invasive” Surgery Compared with “Standard” Surgical Procedures for Joint Arthroplasty

So-called minimally invasive surgical techniques have become popular in all surgical fields, and joint replacement surgery is no exception. Several authors have suggested that there are potential benefits to less invasive surgical procedures, such as earlier recovery, improved cosmetic results, shorter hospital stays, and less pain. Interpreting the literature in this area is difficult because many variables affect short-term outcome (expectations, motivation, comorbidities, anesthetic technique, pain control, restrictions, and surgical invasiveness), and these are difficult to control with randomized trials. Many of the reports on the advantages of minimally invasive surgery suffer from a large selection-bias effect. Furthermore, our measurements for short-term outcomes are neither sensitive nor specific, and many are subjective.

The definition of minimally invasive surgery is not clear. Some authors have utilized more traditional approaches (modified anterolateral or posterolateral) through smaller incisions with a modification of the degree of release in the deeper planes. This technique is achieved with improved instruments (specialized retractors, fiberoptic lighting, offset acetabular reamers and inserters, etc.). Generally speaking, minimally invasive exposures are considered less than 12 cm.

Others have utilized more than one surgical approach (anterior for the acetabulum and posterior for the femur) in an attempt to minimize the need for soft tissue retraction and manipulation of the limb. Although some have suggested that no muscle is injured with these multiple incision techniques, others have shown that the abductor mechanism and the short external
The normal hip has about 130, 45, 20, and 65 degrees of flexion, abduction, internal rotation, and external rotation, respectively. The hip movements needed for activities of daily living is 120 degrees of hip flexion, 20 degrees of abduction, and 20 degrees of external rotation. Bipedal locomotion is a complex interplay of central motor planning and peripheral motor control. In vivo measurements of peak joint reactive force in the hip during walking and climbing stairs range from two to three times body weight. The gait cycle consists of single stance phase and a double stance phase. The center of gravity passes through the near center of the pelvis, creating an adductor moment in the stance phase hip while the contralateral limb is in swing phase. During single-limb stance phase, the pelvis is maintained level to the floor through the abductor moment created in part by the gluteus medius and minimus muscles. A Trendelenburg gait results when the abductor muscle mechanism (strength and/or lever) is unable to support the pelvis level to the floor during the single-stance phase of gait.

The goals of joint reconstruction surgery are to restore the hip mechanics, optimize abductor function, restore equal leg lengths, and minimize the risk of dislocation. The lever arm of the abductor mechanism is optimized through inferior, medial, and anterior placement of the hip center combined with restoration of offset of the femur. The normal hip center is approximately 1 cm superior from the interteardrop line (line connecting the most inferior aspects of the teardrop on the anteroposterior [AP] pelvis). Restoration of the offset, in addition to the effects on the lever arm, restores the working length of the abductor muscle fibers to improve force generation (Starling’s muscle-length curve). Inferomedial placement of the hip rotation center also decreases the joint reaction force, which may affect the wear and durability of the reconstruction.

**COMMON COMORBIDITIES**

**Osteoarthritis**

Arthritis affects about 65 million Americans and is the second most common cause of disability in people over the age of 65 years. Osteoarthritis is the most common form of arthritis; it is characterized by the progressive noninflammatory deterioration of the hyaline cartilage in diarthrodial joints, causing pain, limited motion, and deformity. It is manifest by cartilage fissuring, focal erosive changes, cartilage loss, sclerosis/eburnation of the subchondral bone, osteophyte formation, subchondral cyst formation, and thickening of the joint capsule.

Osteoarthritis does not have a single cause and most commonly presents as a condition without a known cause—primary osteoarthritis. Several secondary causes for osteoarthritis are associated with metabolic, developmental, neurologic, or traumatic conditions. Causes of secondary osteoarthritis include trauma, dysplasia, osteonecrosis, acromegaly, Gaucher’s disease, Paget’s disease, Ehlers-Danlos syndrome, Stickler’s syndrome, calcium pyrophosphate dihydrate deposition disease (CPPD), ochronosis, hemochromatosis, hemophilia, neuropathy, and infection.

Primary osteoarthritis is more common in the elderly, with more than 60 percent of those older than 65 years being affected. Primary osteoarthritis is not a normal result of aging. Age-related changes in the articular cartilage include a decreased chondrocyte density, decreased water content, decreased large proteoglycan content, increased collagen cross-linking, and increased collagen fibril diameter. Osteoarthritic changes include initial chondrocyte proliferation, decreased proteoglycan content and proportion of aggregated proteoglycan, increased water content, and progressive loss of collagens.

**Dysplasia**

The incidence of developmental dysplasia of the hip is 1.5 per 1000 births. Risk factors for its development are female, firstborn, primigravida, and breech presentation. Dysplasia is defined by femoral head uncoverage (lateral center edge angle less than 20 degrees in the adult); subluxation is defined as a break in Shenton's line.
Restoration of the normal hip center usually requires host bone preparation to achieve durable fixation. Normal hip center when possible and achieve adequate motion. Treatment goals are to treat the pain and restore motion. The role of surgical treatment is highly controversial. Prognosis is based on the age of onset, residual femoral head deformity, and residual congruency of the hip joint. The potential of the acetabulum to be remodeled decreases significantly after the age of 8 years. McAndrew and Weinstein found that 50 percent of patients at an average age of 56 years had a joint arthroplasty or severe disabling pain.

**Osteonecrosis**

Osteonecrosis of the femoral head is a relatively common condition, accounting for approximately 10 to 12 percent of hip replacements in the United States. This condition can affect all age groups and can be the result of trauma (dislocation or femoral neck fracture). Atraumatic osteonecrosis can be associated with alcoholism, steroid use, organ transplantation, systemic vasculitis, or pancreatitis; it can also be idiopathic. Idiopathic osteonecrosis accounts for approximately 25 to 30 percent of cases. The etiology of osteonecrosis is unknown; however, it may be related to embolic phenomena (fat or thrombotic), venous hypertension, fat metabolism, or chemical cytotoxic effects. The chances that the disease will progress are high in symptomatic patients.

Surgical treatment options for patients without collapse include percutaneous core decompression (with or without supplemental procedures such as bone grafting or bone marrow injection), proximal femoral osteotomy, and vascularized or nonvascularized fibular grafting. Arthroplasty is often indicated for patients with refractory symptoms and those with collapse. Premature wear (due to the young age of these patients) and instability are issues of concern with total joint arthroplasty (owing to inherent range of motion).

**Inflammatory Arthritis**

Inflammatory arthritis can be related to infection or systemic inflammatory conditions, including rheumatoid arthritis and ankylosing spondylitis. Native hip sepsis is rare and is treated as an emergency, with irrigation and debridement to prevent secondary arthritis. Most of the inflammatory arthropathies lead to osteoporosis and narrowing of concentric joint space; they may cause the development of protrusion acetabuli. During the perioperative period, the systemic manifestations of these inflammatory conditions require special attention. Many of these patients are using immunomodulating medications that may cause wound-healing problems and infection. Patients with ankylosing spondylitis may have spinal abnormalities that make neuraxial anesthesia difficult. Finally, it is important to rule out instability of the atlantoaxial or subaxial cervical spine before surgery.
The indication for total joint arthroplasty is end-stage arthritis of the hip joint that causes pain and disability. The typical patient has a history of gradually worsening pain in the groin, which radiates to the knee with activity and with positions outside the range of allowable motion. Often pain during rest or at night will awaken the patient. The patient also finds it difficult to tolerate normal daily activities such as walking, climbing stairs, rising from a chair, and putting on shoes. Disease-specific questionnaires to measure pain and function are the Iowa hip rating, Harris hip score, and Western Ontario and McMaster Universities Index Questionnaire (WOMAC) score.

The success of hip arthroplasty has led to broadening of the surgical indication. There is evidence that the patient’s function may ultimately be better if the arthroplasty is performed in the earlier stages of disease.
replacement (particularly those with rheumatoid arthritis) have multiple joint contractures that must be protected from further injury. Place pillows between the arms while the patient is in the lateral position to prevent the torso from tilting forward.

**Supine Position**

Supine positioning is more physiologic and reduces potential positioning errors. In addition, this position makes it easier for the surgeon to compare limb lengths. The supine approach is not suitable when a posterolateral exposure is used, and exposure of the femur is more difficult without a trochanteric osteotomy (particularly if axial preparation is desired).

Matta has repopularized the use of a fracture table when total hip arthroplasty is performed through a direct anterior exposure. With this technique, the patient is placed supine on the fracture table with both legs in boot traction. A peroneal post is used to maintain the position of the pelvis while intermittent traction is exerted on the operated extremity. The nonoperated extremity is also placed in a boot traction device, but no traction is exerted on it. The purpose of the fracture table is to allow external rotation, extension, and adduction of the operated extremity for proximal femoral exposure through the anterior approach. In addition, a femoral hook (elevator) is used to maintain support for the proximal femur during preparation. Use of this table requires assistance from a circulator and the anesthesiologist to control the positioning of the limb and the femoral hook mechanisms. Clear communication between the surgeon and the people controlling the table is critical to prevent injury to the patient.

### SURGICAL TECHNIQUE

**Primary**

**Options**

The surgical approach for a primary hip replacement depends on the surgeon’s preference, as outlined above in the discussion of surgical anatomy. Most surgeons do not perform a complete capsulectomy for primary arthroplasty; however, it is often necessary to release the retained capsular structures partially if significant contractures are present (Fig. 10-1). Capsular retention and repair with the posterolateral approach has led to a reduction in the rate of postoperative dislocation.

The acetabulum is prepared with hemispheric reamers corresponding in size and shape to the acetabular implants. Specialized retractors are generally placed on the anterior wall, posterior wall, and obturator foramen. The medial wall of the acetabular fossa, pubis, and the obturator foramen are important anatomic landmarks for correct placement of the acetabular component to restore normal biomechanics of the hip. There is usually a medial osteophyte overlying the pulvinar fat, which must be removed with osteotomes or reamers. Removal of the osteophyte and pulvinar fat allows correct orientation in preparing the acetabulum.

The options for acetabular fixation include cemented fixation with an all-polyethylene cup or biological fixation with an uncemented modular acetabular component. Initial implant stability to allow bone ingrowth can be achieved with press-fit techniques, screws, spikes, or some combination of these. Most uncemented acetabular components have modular bearing inserts. There are several options for the bearing surface, with different advantages and disadvantages. Since the formation of
particles due to wear is one of the major concerns, a so-called alternative bearing (highly cross-linked polyethylene, metal on metal, ceramic on polyethylene, and ceramic on ceramic) is being utilized more frequently in order to minimize dislocation rates (larger femoral heads) and the risk of osteolysis. Some of the concerns about these alternative bearings are susceptibility to fatigue failure (highly cross-linked polyethylene), systemic metal ion levels and lymphocyte proliferation (metal on metal), and implant fracture (ceramics).

The femur is prepared with the combined use of broaches and/or reamers. Limb positioning is important during femoral preparation in order to achieve appropriate anteversion of the implant and to minimize the risk of sciatic nerve injury. It is important to flex the knee to minimize the chance of a traction injury of the nerve with combined hip flexion and knee extension. In addition, when broaching and/or inserting cementless implants, it is important to provide support to the limb and counter the axial forces exerted in the femur when these devices are hammered into position. Failure to do so may contribute to nerve traction injuries.

The options for femoral fixation include cemented and cementless implants. With cemented femoral fixation, a broach-only technique is desirable so as to maintain the stable cancellous bone and provide the interface for cement interdigitation. Modern cementing techniques include porosity reduction of the cement, measures to minimize blood in the interface during cement placement, distal plugging of the femoral canal, retrograde filling of the femur, and pressurization to enhance interdigitation. There have been reports of hypoxia, hypotension, and cardiac arrest with cement insertion; this may possibly be due to monomer toxicity or embolization of bone marrow.

There are varieties of uncemented femoral designs that have provided successful results. The options include anatomically designed proximal fixation with circumferential coating, tapered designs, modular stems, and extensively coated distal fixation stems. The preparation concepts for all of these designs are beyond the scope of this chapter; however, the goal is to provide axial and rotational stability of the implant through the use of a combination of broaching and reaming techniques.

Revision

Options

Revision hip arthroplasty varies in complexity from exchanging a polyethylene liner to a complete revision, which necessitates additional femoral exposure techniques, a long femoral stem, and acetabular reconstruction for bone loss. The variety of options available to the reconstructive surgeon has increased.

Hip exposure in revision operations generally is through a posterolateral approach for extensile acetabular exposure and axial preparation of the femoral diaphysis. Management of scar tissue may require either a partial or complete capsulectomy, depending on the circumstances. Exposure techniques such as an extended trochanteric osteotomy (cutting off the trochanter with an approximate 12- to 15-cm portion of the lateral third of the proximal femur, keeping the abductor mechanism and vastus lateralis muscle in continuity) have been very helpful in femoral reconstructions with extensively coated long stems (8- and 10-in. bowed stems). Modular femoral stems with tapered designs (Wagner type) have also been useful for difficult femoral arthroplasty revisions.

A hemispheric uncemented acetabular component is the workhorse in socket reconstruction. Structural bone grafts, cages, and modular porous metals are available to solve problems of bone loss when necessary. Some of the more complex acetabular procedures require partial elevation of the abductors from the lateral ilium.

Special Considerations in the Revision Patient

In revision operations, greater blood loss is expected due to the complexity and duration of the surgery. In addition to the greater complexity of their hip reconstruction, many of these patients are older and frailer than those in whom primary hip arthroplasties are done. It is therefore critical for the surgeon and the anesthesiologist to anticipate blood loss and have open and frequent communication.

Comorbidities

Since the prevalence of arthritis increases with increasing age, many of the patients undergoing joint arthroplasty have comorbidities that affect their perioperative management. Medical optimization before surgery minimizes the risk of perioperative complications. There is evidence that medical comanagement of these patients decreases cost, minimizes complications, and improves patient outcomes.

Some of the comorbidities commonly seen in these elderly patients include coronary artery disease, atrial fibrillation, chronic obstructive pulmonary disease (COPD), diabetes mellitus, and systemic inflammatory conditions. Alcoholism, a history of steroid use, and solid-organ transplants are commonly encountered in patients with osteonecrosis. Joint arthroplasty is often a treatment option for malignancies involving the hip. This may affect the choice of anesthetic if the chemotherapy regimen had cardiopulmonary effects.

Many of these patients have arthritis or replacements in other joints, which require care during positioning of the nonoperated extremities. Special care is
necessary in patients with rheumatoid arthritis; cervical spine risk factors must also be evaluated when they are being positionned.

**Thromboprophylaxis**

Thromboprophylaxis is an important and controversial area. This topic has been fully discussed in Chap. 4. Almost all patients undergoing hip replacement are receiving some form of thromboprophylaxis (mechanical and/or chemical prophylaxis). There must be a balance between the risk of fatal pulmonary embolism and that of surgical bleeding. Chemical prophylaxis is often started on the day of surgery. Warfarin requires approximately 48 h to take effect. Anesthetic techniques can play a large role in reducing the risk of thromboembolism. Neuraxial anesthesia decreases the risk of deep venous thrombosis and pulmonary embolism.

**Antibiotics**

The use of preoperative prophylactic antibiotics has been shown to decrease infection rates. Antibiotics should be administered for 1 h before and up to 24 h after surgery (see Chap. 3).

**Heterotopic Ossification**

Heterotopic ossification is the formation of bone in the soft tissue around the hip, and it may limit motion. The most common location is in the gluteus minimus and medius muscles. Patients at risk are those with a history of heterotopic ossification, trauma to the abductor muscles during surgery, hypertrophic osteoarthritis, and males. The majority of heterotopic ossifications (Brooker I and II) do not cause functional limitation of movement. For patients at high risk, prophylaxis of heterotopic ossification calls for with a single dose of external radiation (700 cGy, shielding the prosthesis) or a 2- to 4-week course of indomethacin (50 mg bid) or celecoxib (200 mg bid for 2 to 3 weeks). There is some evidence that irradiation within 24 h preoperatively may be more effective than postoperative administration.

► **ANESTHETIC CONSIDERATIONS**

**Preoperative**

Patients presenting for hip arthroplasty often fall into the older age groups; therefore comorbidities associated with advanced age, including rheumatoid arthritis and obesity, should be considered (see Chaps. 7, 8, and 12).

**Surgical Requirements**

Optimal anesthetic techniques for lower extremity joint arthroplasty are those that provide analgesia of the operated extremity, adequate relaxation for retraction, the ability to monitor nerve function postoperatively, and avoidance of additional risks. The experience of the anesthesiologist and the hospital environment may dictate the safest and most effective anesthetic technique.

Techniques that minimize central “hangovers” are optimal for recovery and initiation of physical therapy. Preemptive pain control (oral narcotics and COX II nonsteroidal anti-inflammatory agents) and antiemesis measures are desirable. To improve the patient’s transition from the operating theater to physical therapy, many surgeons utilize local administration of long-acting anesthetics at the time of wound closure.

**Block**

Neuraxial anesthetic techniques have several advantages. They decrease blood loss, minimize the effects of central inhalational agents, and help to prevent thromboembolism by up to 55 percent. Experience and attentiveness are critically important to minimize the risk of cardiopulmonary consequences with anesthetic techniques involving hypotension. Unilateral blocks for major proximal lower limb surgery are generally not optimal, since the nonoperated leg can become very uncomfortable for the patient; the patient may then move this leg and distract the surgeon.

Our choice of anesthetic for hip arthroplasty is a spinal-epidural block (CSE) combined with sedation (see Chap. 30). The type and amount of sedation depends on the requirements of the patient. Continuous infusion of propofol is often used at various infusion rates, although we prefer to use midazolam in varying dosages with or without small doses of meperidine, depending on the patient’s requirements. We also provide patients with noise-cancellation headphones and music of the patient’s choice.

A common anesthetic technique is, however, still general anesthesia, although it is not optimal. Its use depends on the choice of the patient, the experience of the anesthesiologist, and the choice of anticoagulation agent and its timing (see Chaps. 4 and 30).

New long-acting opiate epidural solutions for postoperative pain relief are currently being introduced. Practitioners should, however, be cautious, for although the duration of the analgesic effects may be increased, the duration of the adverse effects will also be increased. Preliminary reports show these agents to have an unacceptable profile of adverse effects, including long-lasting hypoxia, nausea and vomiting, and pruritus in a large percentage of patients. Long-term analgesia is usually not necessary for primary hip replacement.

Postoperative pain associated with primary hip arthroplasty is variable, and many patients have more preoperative than postoperative pain. Analgesic coverage
is most essential for the first 24 h. We usually cover that period with the continuous epidural part of the CSE and remove the epidural catheter the morning after surgery, before the full effect of the warfarin sets in.

Neuraxial anesthesia decreases the central venous pressure by dilating the capacitance vessels. This is thought to reduce the bleeding from venous sinuses in bone and therefore the blood loss. As described in Chaps. 7 and 14, the anesthesiologist can play a significant role in decreasing operative blood loss by keeping the venous pressure low. If the epidural is used for this, it is essential to keep the cardiac output normal or elevated. This further lowers the venous pressure, which decreases the bleeding but also keeps the arterial blood pressure normal. Sherrock et al. demonstrated that blood loss is substantially less with this technique than with normotensive general anesthesia, and the cardiac output is maintained with a low-dose infusion of epinephrine. This has the added advantage of stimulating the beta-1 adrenergic receptors in the cerebral vasculature, which, in addition to causing a normal arterial blood pressure, increases cerebral blood flow.

In contrast to primary arthroplasty, revision hip arthroplasty can be very painful postoperatively. A revision operation is therefore a good indication for continuous lumbar plexus (psosas compartment) block (see Chap. 29). If a continuous epidural block is used, the timing of its removal must be carefully considered in patients using anticoagulants (see Chap. 4).

Communication between the surgeon, anesthesiologist, and acute pain physician is absolutely critical to minimize complications and optimize the efficiency of joint arthroplasty procedures.

**POSTOPERATIVE PROTOCOL**

The postoperative protocol varies and is based on the surgeon’s preferences, surgical approach, patient’s age and comorbidities, and implant choice. Interest in short-term outcomes with minimally invasive surgical techniques has led to more proactive perioperative pain control and accelerated rehabilitation.

Nursing for the patient with total hip arthroplasty includes monitoring of pain and vital signs, advancement of oral intake, management of urinary catheter if present, and reinforcement of “total hip precaution” protocols.

Physical therapy is initiated on the day of surgery or the day after surgery. The goals of therapy are to instruct the patient on appropriate total hip precautions, safe transfers, and walking with crutches. Occupational therapy instructs the patient in the use of aids (such as reachers, toilet elevators, and assistive devices to put on socks) and getting into a car. Preoperative physical therapy improves functional recovery after surgery.

Weight bearing may be protected, restricted, or assisted based on the surgeon’s preference, the complexity of the procedure, quality of bone, implants used, and surgical approach. Protected weight bearing with a walker and/or crutches for 6 weeks is usually preferable with uncemented implants. The purpose of these restrictions is to minimize micromotion of the implant, which would increase the risk of fibrous fixation, and to avoid worsening of an unrecognized fracture. Postoperative protocols that encourage tolerable weight bearing have become more common.

**Potential Complications**

**Dislocation**

Dislocations should occur in a low percentage of patients. With an anterolateral/direct lateral approach, the rate ranges from 0.6 to 2.6 percent. Without a capsular repair, the posteroserial approach had a reported higher dislocation rate; however, this rate is similar to that reported rate for anterolateral approaches when a posterior capsular repair is performed. Factors contributing to dislocation are increased range of motion, poor compliance with precautions, failure to achieve appropriate offset and leg length, use of skirted femoral head components, neuromuscular disorders affecting the abductor mechanism, and poor component position.

**Fracture**

Periprosthetic fractures can occur during broaching or insertion of uncemented components. If detected intraoperatively, a femoral fracture can be treated with cerclage wiring or the placement of a longer stem if necessary. Fractures noted on the postoperative radiograph can be treated with restricted weight bearing if they are not displaced. With an extensively coated femoral stem, a fracture involving the posterior cortex is at greater risk of displacement.

**Fat Embolism**

Fat embolism can occur during the broaching of the femoral canal and has been documented with intraoperative transesophageal echocardiography (see Chap. 5).

**Nerve Injury**

**Sciatic Nerve**

The incidence of clinically detected sciatic nerve injury is 0.2 to 2 percent. These injuries can occur during retractor placement, manipulation of the dislocated hip (particularly when hip flexion is combined with knee extension), traction during broaching or affecting extensively coated implants, limb lengthening, or postoperative hematoma. A large percentage (approximately 50 percent) have an unrecognized cause. Electromyographic and
nerve conduction abnormalities are common during routine total hip replacements. The initial evaluation of sciatic nerve palsy must include an assessment of hematoma formation and placement of the limb in a position to decrease the traction on the sciatic nerve (hip extension and knee flexion). Only a small percentage of patients acquire full function of the nerve after injury. The most common and problematic residual effect is neuropathic pain. In general, compression injuries fare better than traction injuries. Therefore prevention of these injuries is critical. Preventive measures are meticulous retractor placement, support of the limb during broaching and implant placement, keeping the knee flexed when the hip is flexed, dissecting the nerve out in cases of heterotopic ossification resection, and prevention of lengthening more than 3 cm.

**FEMORAL NERVE**
Femoral nerve palsy is less common than sciatic nerve injuries and generally has less residual deficits. They are most commonly associated with aberrant anterior retractor placement. If nerve function does not recover, the residual quadriceps motor weakness is debilitating.

**Hip Arthroscopy**

**Patient Selection/Indications**
Hip arthroscopy has become a more commonly performed procedure for synovial conditions, labral pathology, certain traumatic fractures of the femoral head, and the diagnosis of cartilage lesions. Some surgeons have expanded the use of arthroscopy for the treatment of acetabulofemoral impingement caused by an inadequate femoral head-neck offset.

**Positioning on the Operating Table**
The patient is positioned in the lateral decubitus position or supine. Distraction of the hip joint is necessary and requires both a lateral and distally directed force. A fracture table is utilized when the patient is in the supine position and a specialized distraction device is necessary when the lateral position is chosen. The choice depends on the surgeon’s experience and familiarity. The lateral decubitus position may allow better access for posterior portals.

**Surgical Technique**

**Options**
The working portals for hip arthroscopy are direct anterior, anterolateral, and posterolateral portals. A C-arm fluoroscopic unit is used for the placement of portals. The first portal placed is usually the anterolateral one positioned at the level of the anterolateral tip of the trochanter and directed toward the superior articular surface of the hip joint. A distraction force is applied to the limb by boot traction. The fluoroscope is used to confirm distraction (typically a nitrogen air layer will form in the joint from the negative pressure created). A spinal needle is inserted into the joint through the anterolateral portal. The entry of air generally breaks the intraarticular negative pressure and cause increased distraction. Most hip arthroscopy equipment sets have cannulated trochars that can be passed over a wire. The wire is introduced through the spinal needle, followed by cannulated dilators. The anterior portal is placed using a similar technique under direct visualization from a camera placed in the anterolateral portal. The starting point for the anterior portal is approximately 6 to 8 cm distal to the ASIS (generally at the level of the superior aspect of the pubic symphysis).

Most of the evaluation of the hip joint is performed through these two portals. The most common location of labral pathology is in the anterosuperior portion. Occasionally accessory portals, such as the posterolateral portal, are necessary.

**Anesthetic Considerations**
Although these patients are generally young and healthy and general anesthesia is appropriate, subarachnoid block is ideal for this surgery. Anesthetic considerations are generally similar to those for hip arthroplasty; continuous nerve block is usually not necessary for the treatment of postoperative pain. If it does prove to be necessary, lumbar plexus block is well indicated here (see Chap. 29).

**Antimicrobial Prophylaxis**
The risk of infection with joint arthroscopy is generally low, and hip arthroscopy is no exception (see Chap. 3).

**Common Complications**
Complications are usually related to the patient’s positioning and the need for joint distraction. Peroneal nerve palsies have been reported. Adequate padding and placement of the perineal post and minimizing the duration of traction are important in decreasing the risk of the complications. The anterior portal can cause injury to branches of the lateral femoral cutaneous nerve. Aberrant anterior portal placement poses a potential risk for branches of the femoral nerve, and the posterolateral portal puts the sciatic nerve at risk.

**SUGGESTED FURTHER READING**


