CHAPTER 43

Operative Treatment of Arthritis

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- Surgical treatments of arthritis and musculoskeletal diseases may be used to prevent progression, relieve pain, and/or improve joint function.
- The success of surgical interventions is dependent on careful considerations of pre-, intra-, and postoperative aspects of the surgery.
- Total joint replacements are now possible for most of the major joints affected and damaged by arthritis.

Pain not relieved by other treatments is the most common indication for operative treatment of arthritis. Loss of joint function is a less common indication for surgical treatment because function restoration is usually less predictable than pain relief. Operative treatments include joint debridement, synovectomy, osteotomy, soft tissue arthroplasty, resection arthroplasty, fusion, and joint replacement. In addition, people with rheumatoid arthritis (RA) may benefit from tenosynovectomy and repair or reconstruction of ruptured tendons.

Although operative treatments can produce excellent results, they also expose patients to serious risks. Potential operative and perioperative complications include extensive blood loss, cardiac arrhythmia and arrest, nerve and blood vessel injury, infection, venous thrombosis, and pulmonary embolism. Late postoperative complications include delayed infection and loosening and wear of implants. Even in the absence of complications, the results of surgical procedures such as joint debridements, synovectomies, and osteotomies may deteriorate with time. For these reasons, the potential risks and expected short-term and long-term outcomes of operative treatment must be carefully considered for each patient. Nonetheless, individuals who fail to gain satisfactory results from nonsurgical therapy or who have progressive disease should be evaluated by a surgeon before they develop deformity, joint instability, contractures, or advanced muscle atrophy. Delaying surgery until these problems develop can compromise the results and increase the risk of complications.

PREOPERATIVE EVALUATION

With the exception of people in whom arthritic disorders have caused or may cause spinal instability and neurologic damage, operative treatment is elective. Patients should have an extensive preoperative evaluation and should understand the full range of therapeutic options. The physician needs a thorough understanding of the degree of pain and functional limitation and an understanding of the patient's social and occupational needs and expectations. Before planning surgery, patients should understand the potential benefits and risks. In general, the patients most likely to notice significant lasting benefit from operative treatment are those with joint pain unrelieved by nonsurgical treatment. Patient age, overall health status, and capacity to adhere to postoperative rehabilitation and precautions also help determine the outcome.

Even in people with obvious joint disease, pain, and loss of function, failure to carefully evaluate the cause of the symptoms can lead to disappointing results. Common diagnostic dilemmas include differentiating hip joint pain from lumbar radicular pain and shoulder joint pain from cervical radicular pain. Rheumatoid arthritis and other types of inflammatory arthritis may cause such severe joint deformity that detecting neurologic involvement becomes difficult. Patients may develop joint sepsis that is not readily apparent because of the inflammatory nature of their underlying disease and the use of medications that suppress the inflammatory response to infection. A careful history, physical examination, and plain radiographs are sufficient to

define the cause of symptoms for most, but in some cases, joint aspiration, electrodiagnostic studies, and additional imaging studies are needed to clarify the cause of pain and loss of function.

Before considering surgical intervention, patients should first be treated with nonoperative interventions including medications, ambulatory aides, activity modification, physical therapy, and orthoses. Braces may control instability and decrease pain in the spine, knee, ankle, wrist, or thumb. A cane may be considered for patients with lower extremity arthritis. In addition to reducing the body weight load to the joints of the lower extremity, a cane reduces the hip abductor forces required to keep the pelvis level during gait, thereby reducing hip joint reactive forces by up to 20% in the contralateral hip.

Weight reduction for obese patients can decrease symptoms and increase the probability of successful operative treatment. There is some evidence of an increased incidence of infection in obese patients following total joint arthroplasty (1), as well as increased intraoperative blood loss (2). It is not clear whether or not obesity increases the risk of implant loosening, but this may be because heavier patients are less active. For some overweight patients, the pain and loss of mobility caused by arthritis makes it more difficult to reduce their weight or avoid gaining weight. In these individuals, surgeons may recommend proceeding with operative treatment despite the increased risks associated with obesity.

The importance of a thorough preoperative history and physical examination, as well as careful perioperative medical management, cannot be overemphasized. Many patients who could benefit from surgical treatment, especially people with osteoarthritis (OA), are elderly and may have decreased cardiac, pulmonary, renal, or peripheral vascular function. These conditions require evaluation and, in some cases, treatment before surgery. Carious teeth, pharyngitis, cystitis, and other potential sources of infection should be treated prior to surgery. Men with symptoms of prostatic hypertrophy need a urologic evaluation before surgery and women should be evaluated for asymptomatic urinary tract infections. Preoperative laboratory evaluation should include a measure of hemoglobin and hematocrit, urinalysis, and other diagnostic tests as indicated by the individual's medical history.

PREPARATION FOR OPERATIVE TREATMENT

All patients should receive instruction concerning the planned procedure, the risks and common complications, the type and extent of postoperative rehabilitation, and expectations for postoperative pain relief and function. To reduce the risks of operative and postoperative complications, including excessive bleeding and compromised healing, doses of nonsteroidal antiinflammatory drugs (NSAIDs) and corticosteroids should be decreased before surgery when possible. Preoperative evaluation and instruction by physical and occupational therapists facilitate rehabilitation for some patients. In selected patients, delaying surgery will make it possible to achieve optimal management of cardiovascular or other systemic disorders, allow them to improve their nutritional status and muscle strength, or reduce their weight.

DISEASE-RELATED FACTORS

Options and indications for surgical treatment vary considerably among the arthritic diseases. Thus, the physician must consider the unique features of each disease in making decisions or advising patients concerning operative treatment.

Osteoarthritis

A number of surgical procedures have the intent of decreasing symptoms for people with OA while preserving or restoring a cartilaginous articular surface. These include arthroscopic joint debridement, resection or perforation of subchondral bone to stimulate formation of cartilaginous tissue, and use of grafts to replace degenerated articular cartilage. By removing loose fragments of cartilage, bone, and meniscus (and, in some instances, osteophytes), joint debridement may improve joint mechanical function and may decrease pain. Penetration of subchondral bone in regions of advanced cartilage degeneration stimulates formation of cartilaginous repair tissue, but because it lacks the properties of normal articular cartilage, this tissue frequently degenerates. Replacing localized regions of degenerated cartilage with osteochondral, perichondral, periosteal, and chondrocyte grafts has produced promising short-term results in small series of patients. Overall, current procedures performed with the intent of preserving or restoring a cartilaginous articular surface and decreasing symptoms are not likely to be beneficial in people with advanced joint degeneration, but they may be helpful in selected people with less severe disease.

Osteotomies correct malalignment and shift loads from severely degenerated regions of the articular surface to regions that have remaining articular cartilage. In selected patients with OA, osteotomies of the hip and knee decrease pain, but in general the results are less predictable than joint replacement. For these reasons, surgeons most commonly recommend osteotomies for young active people who have a stable joint

with a functional range of motion, good muscle function, and some remaining articular cartilage.

Joint fusion (i.e., arthrodesis) can relieve pain and restore skeletal stability and alignment in people with advanced OA. Because this procedure eliminates joint motion, it has limited application. Furthermore, fusion of one joint increases the loading and motion of other joints, perhaps accelerating degeneration. For example, fusion of the hip increases the probability of developing degenerative disease in the lumbar spine and ipsilateral knee joints. Currently, surgeons most commonly perform fusions for treating degeneration of cervical and lumbar spine, hand interphalangeal, first metatarsophalangeal, wrist, and ankle joints.

For selected joints, resection of degenerated articular surfaces and replacement with implants fabricated from polyethylene, metal, or other synthetic materials can relieve pain and allow the patient to maintain joint mobility (Figure 43-1). Over the past several decades, replacing the hip and knee have proven to be effective methods of relieving pain and maintaining or improving function. Recent advances have led to better methods and implants for replacement of the hip, knee, shoulder, and elbow. Unfortunately, joint replacements have limitations, primarily because the new surface lacks the mechanical properties and durability of articular cartilage and because the prostheses must be fixed to the patients' bones. None of the currently available synthetic materials duplicates the ability of articular cartilage to provide a painless, low friction gliding surface and to distribute loads across the synovial joint, nor can current implants achieve the stability and durability of the bond between articular cartilage and bone. Thus, wear of implants limits their life span, and loosening can lead to failure. For these reasons, current joint replacements cannot be expected to provide a lifetime of normal function for young active patients.

Rheumatoid Arthritis

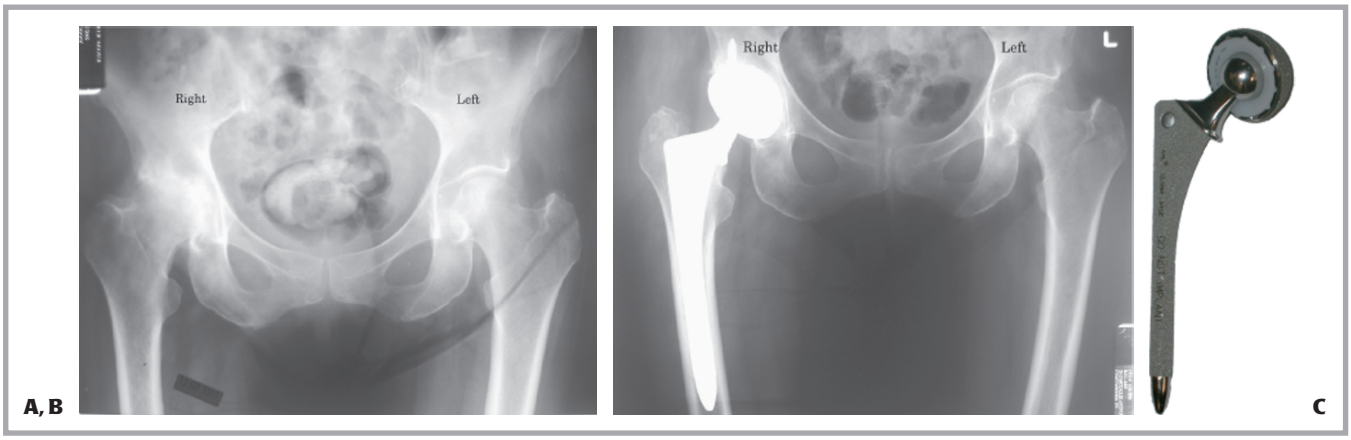
People with RA require careful evaluation to prevent operative and perioperative neurologic injury, establish the sequence and timing of joints to be treated surgically, and reduce the risks of infection and other complications.

People with RA commonly have cervical spine involvement that can lead to spinal instability and increased risk of neurologic deficits. Neurologic changes may be difficult to recognize due to limited joint motion and associated disuse muscle atrophy. To evaluate the risk of neurologic injury, people with RA should have active flexion and extension lateral cervical radiographs within 1 year before surgery. In a retrospective review of 113 patients with RA who underwent total hip or knee arthroplasty, Collins and colleagues (3) reported significant atlantoaxial subluxation, atlantoaxial impaction, and/or subaxial subluxation in 69 patients (61%). Thirty-five of these 69 patients (50%) had no clinical signs or symptoms of instability at the time of admission for joint replacement arthroplasty. Instability of greater than 7 to 10 mm at the atlantoaxial joint or greater than 4 mm at subaxial levels on flexion and extension lateral radiographs generally requires stabilization prior to other elective surgery. Patients with lesser degrees of atlantoaxial and subaxial involvement should be evaluated by the anesthesiologist preoperatively and consideration given to an awake intubation.

Patients with multiple joint involvement require careful planning and timing of various joint procedures to allow optimal rehabilitation. Patients undergoing

FIGURE 43-1

(A) Anteroposterior radiograph of the pelvis of a 61-year-old female showing a normal left hip and severe osteoarthritis of the right hip. Note that the x-rays are turned as though the patient was facing the reader. (B) The same patient after an uncemented total hip arthroplasty. (C) Photograph of an uncemented total hip arthroplasty like that used in this patient.



lower extremity surgery may require surgical stabilization of the upper extremity first to allow crutch ambulation and use of the upper extremities to assist with transfers, rising from a chair, and stair climbing. For example, a person with severe wrist involvement as well as hip involvement may benefit from wrist arthrodesis prior to total hip arthroplasty. The patient with multiple lower extremity joint involvement may benefit from treating joints either sequentially or simultaneously, depending on the joints involved and the severity of the disease. The patient with severe disease and contractures of both knees, for example, may benefit from having both knees replaced at the same time. In that situation, if only one knee is replaced, a flexion contracture in the untreated knee will cause the patient to keep the operatively treated knee flexed when standing and thereby compromise rehabilitation following surgery. Foot and ankle disease are generally addressed prior to hip and knee arthroplasty to provide the patient a stable lower extremity on which to stand and rehabilitate the hip and knee.

Long-term use of corticosteroids increases the complexity of surgical treatment of people with RA. In general, these patients will require "stress dose" steroids perioperatively due to inhibition of their adrenal function. Long-term corticosteroid use combined with the effects of the disease can cause connective tissue changes that make the skin and superficial blood vessels friable. Extreme caution must be used in physically handling such a patient. For example, in severely affected patients, mild pressure can cause a hematoma or skin ulceration and adhesive tape can tear the skin. In addition, chronic low-dose corticosteroid use in patients with RA has been correlated with an increased incidence of fracture, infection, and gastrointestinal hemorrhage or ulcer. People with RA treated with total joint arthroplasties demonstrated a higher incidence of infection than patients with OA treated with total joint arthroplasties (1). Patients with RA frequently have more than one joint arthroplasty, and infection of one arthroplasty is associated with an increased incidence of subsequent infection of another replaced joint (4).

Many people with RA are treated with NSAIDs and/or methotrexate preoperatively. A review of 165 patients undergoing total hip arthroplasty found a higher incidence of gastrointestinal bleeding and/or hypotension in patients receiving NSAIDs at the time of hospital admission (5). Several studies have demonstrated that there is no increase in wound or other postoperative complications in patients who continue methotrexate therapy perioperatively. Perhala and colleagues (6) compared 60 patients with RA who underwent a total of 92 joint arthroplasties without interruption of methotrexate therapy to a group of 61 patients not receiving methotrexate who underwent a total of 110 joint arthroplasties. Eight patients on methotrexate had a total of eight wound complications (8.7%) versus five patients with a total of six wound complications in the non-methotrexate group (5.5%, $p = 0.366$). In a randomized, nonblinded prospective study of 64 patients with RA on methotrexate therapy, Sany and coworkers (7) reported no infections and no difference in wound healing between patients whose therapy was discontinued 7 days before an orthopedic procedure and those whose therapy was continued perioperatively.

Tumor necrosis factor (TNF) inhibitors are an exciting class of agents which are relatively new to the treatment of inflammatory arthritis. Tumor necrosis factor alpha (TNF-alpha) is one of the cytokines which stimulates cartilage matrix degradation via metalloproteinases. Whereas these medications have offered decreased pain and increased function to many patients with inflammatory arthritis, they are also now known to be associated with an increased incidence of various infections. Strict guidelines for their perioperative utilization have not been established. Nonetheless, it is currently not advisable to treat patients in the perioperative period with TNF inhibitors, particularly when an implant such as a total joint replacement is being placed.

Juvenile Inflammatory Arthritis

Joint replacement arthroplasty in children with juvenile inflammatory arthritis (JIA) is reserved for patients who are debilitated by pain and/or decreased function, and is generally delayed until patients are skeletally mature. Joint replacement is also delayed because the life expectancy of the young patient is greater than that of current prostheses. Moreover, each subsequent revision surgery necessarily involves greater periprosthetic bone loss and less predictable long-term results. People with JIA are often candidates for tendon lengthening to correct contractures, and prophylactic procedures, such as synovectomy, to alleviate symptoms and possibly delay articular destruction.

Patients with JIA present important anesthetic risks. Although they do not develop cervical spine involvement and accompanying neurologic deficits as commonly as adults with RA, these problems do occur in association with JIA. Therefore, people with JIA require preoperative screening radiographs as described for patients with RA. Unilateral collapse of the lateral mass of the atlas, with or without axis involvement, may result in a fixed rotational head tilt deformity that makes it difficult to establish an airway for general anesthesia. Micrognathia associated with temporomandibular joint involvement can also make endotracheal intubation difficult. Restricted motion of the axial and appendicular skeleton can make regional anesthesia difficult as well.

Osteonecrosis

Treatment of osteonecrosis remains controversial, partially because the natural history of the disorder remains unknown. Nonsteroidal anti-inflammatory agents and decreased joint loading are commonly employed for temporary symptomatic relief, though neither has been shown to affect the long-term results. Electromagnetic stimulation has also been employed on an experimental basis. Most surgical treatments of osteonecrosis have been developed for treatment of the hip. Core decompression (i.e., drilling a channel from the lateral surface of the femur into the necrotic region of the femoral head), with or without bone grafting, has been advocated for patients who have femoral osteonecrosis without collapse or acetabular changes. In most series, these procedures have decreased pain in a high percentage of the patients. This treatment is generally considered ineffective in people whose femoral head shows any signs of collapse; however, for these patients, various other surgical options exist. These options include femoral osteotomies, designed to place an intact segment of the femoral head in a weight-bearing position, and hip arthrodesis. Replacement of the femoral head or total hip have met with excellent results in this population, but prosthesis durability is a concern, particularly in young patients.

Ankylosing Spondylitis

Joint replacements decrease pain and improve function for people with advanced joint disease due to ankylosing spondylitis (AS). Osteotomies that correct spinal deformities can also be of benefit for some. Spinal involvement can lead to extensive ligamentous calcification and heterotopic ossification that make regional anesthesia difficult, if not impossible. Patients with prolonged disease also develop severe kyphotic deformities of the cervical, thoracic, and lumbar spine that impede endotracheal intubation. Restricted chest excursion may further complicate intraoperative and postoperative care. Patients with AS tend to bleed more during and after surgery than similar, otherwise healthy individuals. The explanation for this bleeding tendency appears to be that compared with normal tissues, the ossified soft tissues are less capable of contracting to assist in hemostasis. There does not appear to be an associated defect in blood coagulation or platelet function.

People with AS, diffuse idiopathic skeletal hyperostosis, or post-traumatic osteoarthrosis are at increased risk for postoperative heterotopic ossification. Although patients with AS have excellent pain relief after total hip arthroplasty, gains in total range of motion are often limited due to periarticular heterotopic ossification, as well as longstanding soft tissue contractures and muscle atrophy. Various regimens have been tried to prevent postoperative soft tissue ossification, but radiation therapy delivered locally appears to be the most effective means of preventing heterotopic bone formation after surgery. Fractionated and single low-dose radiation therapy to the hip and abductor musculature have been effective when begun early in the postoperative period.

Psoriatic Arthritis

The perioperative concerns with NSAIDs and methotrexate discussed with RA apply to psoriatic arthritis as well. A unique perioperative risk in people with psoriatic arthritis is the development of a flare of psoriasis at the operative site due to the physiologic and/or psychological stress of surgery. Also known as isomorphic or Koebner's phenomenon, this process may predispose the patient to a generalized flare of psoriasis as well. People with psoriatic arthritis may have an increased incidence of postoperative infections. Menon and Wroblewski (8) reported superficial wound infection in 9.1% and deep wound infections in 5.5% of their 38 patients with psoriasis treated with total hip arthroplasty.

Hemophilic Arthropathy

Despite the risk of excessive bleeding, operative treatment can produce good results in people with hemophilic arthropathy. Synovectomy is commonly performed in the knee and elbow, and gives improved range of motion and decreased pain to the majority of patients. Total knee and total hip replacements can improve function and relieve pain in hemophilic patients with advanced joint degeneration (9).

Hemophilic arthropathy may be particularly difficult to manage perioperatively. Factor replacement has important risks and must be carefully monitored. A thrombotic event may be precipitated by repeated factor infusions, and resultant disseminated intravascular coagulation after elective surgery has been reported. The subgroup of patients with high levels of factor antibody are generally contraindicated for major elective surgery.

Whether or not people with well-controlled hemophilia without acquired immunodeficiency syndrome (AIDS) are at increased risk for non–transfusion-related infection is unclear. Septic arthritis has been reported as a rare complication of hemophilia, but one that must be promptly diagnosed and definitively treated. Human immunodeficiency virus (HIV)-1–infected hemophilia patients who have not developed AIDS do not appear to have an increased incidence of infection after surgery when compared with patients who are seronegative for HIV-l.

Pigmented Villonodular Synovitis

Pigmented villonodular synovitis most commonly involves the knee and has been reported in patients ranging in age from the second to the ninth decade. It also occurs in the ankle and shoulder, as well as in other joints where it may be more difficult to detect. Arthroscopy may allow for early diagnosis. Synovectomy, by arthrotomy or arthroscopy, usually provides symptomatic relief, and may be curative in patients with the localized form of the disease. The diffuse form of the disease responds less favorably to synovectomy, with recurrences in more than one third of patients. Radiation does not appear to decrease the recurrence rate, and may lead to local soft tissue complications.

Synovial Chondromatosis

Synovial chondromatosis is a rare condition that results in the formation of cartilaginous fragments that may lie in synovial joint cavities, the synovium, or, in some instances, in the periarticular soft tissues. The condition causes pain, catching, and locking of the joint as well as loss of joint motion and possible degeneration of the articular surfaces.

Removal of intra-articular loose bodies and, in some instances, synovectomy can relieve symptoms and improve motion in patients who have not developed degenerative joint disease. However, the cartilage fragments reaccumulate in many joints. In patients with degenerative joint disease, joint replacement combined with synovectomy can cure the disease.

SITES OF SURGICAL INTERVENTION

The operative treatments that provide the best results vary not only among the different types of arthritis, but also among anatomic sites. Thus, the most appropriate procedure should be chosen based on the joint involved, the type of arthritis, the patient's age, and other social and medical factors.

Hip

The most commonly employed operative treatments for arthritis of the hip are cemented [i.e., anchored with poly(methyl methacrylate) cement] and uncemented total hip anhroplasty. More than 120,000 hip prostheses are implanted in the United States each year (Figure 43-1) (10). Osteotomies and fusions are performed less frequently than hip replacements, but can produce good results in certain patients.

Nearly 40 years of clinical studies now document the success of total hip replacement for the treatment of disabling pain and impairment due to chronic hip diseases. Recent long-term follow-up studies show that total hip replacements will provide excellent function for more than 20 years in appropriately selected patients (11). Initially, surgeons limited hip replacement to patients between the ages of 60 and 75 years, but over the last decade studies have shown that younger and more elderly patients also can benefit from this procedure. Although most patients who have a hip replacement increase their level of physical function, patients with limited expectation for improved function also can benefit from the procedure.

The risk of postoperative venous thrombosis and infection in people treated who have undergone hip replacements has significantly decreased in the past two decades. Early series of hip replacements reported a high rate of failure due to infection, but modern aseptic techniques and prophylactic antibiotics have reduced the incidence of infection to less than 1 % (12). Loosening remains the predominant cause of long-term failure of hip replacements, but recent research has clarified the causes of this problem. Particulate debris, the majority of which appears to be generated from wear of polyethylene surfaces, stimulates osteoclastic bone lysis at the bone–cement interface in prostheses fixed with poly(methyl methacrylate) and at the prosthesis–bone interface in uncemented implants. The osteolysis can lead to loosening of the prostheses, bone loss, and bone fractures (Figure 43-2). Improvements in cement tech-

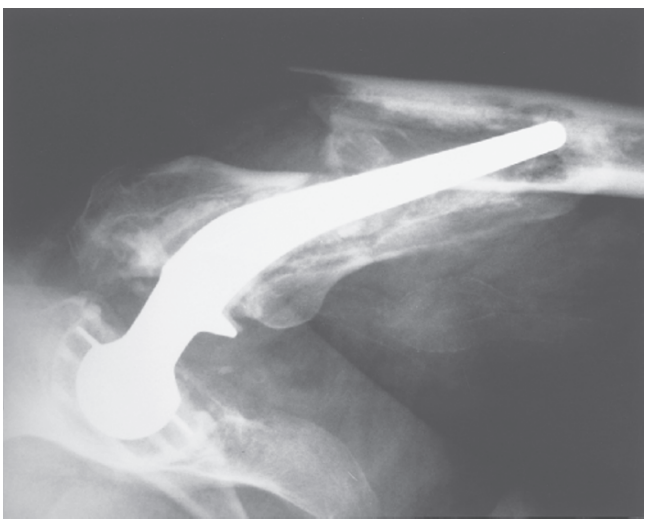


FIGURE 43-2

Radiograph showing a left hip replacement with bone resorption around the femoral bone cement, loosening of the prosthesis, and a fracture through the proximal femur. This 67-year-old man had a hip replacement 14 years ago. He was not evaluated for the last 7 years. Despite the development of severe periprosthetic osteolysis, he did not notice any problems with his hip until he tripped on an electrical cord and sustained the fracture. Earlier detection of the asymptomatic osteolysis followed by surgical revision would have prevented the fracture and extensive loss of bone.

niques have decreased the incidence of aseptic femoral loosening from as high as 40% to less than 5% 10 years after the procedure for many groups of patients. Even in a group of patients who were younger than 50 years at the time of cemented hip arthroplasty, only 8% had evidence of femoral component loosening 16 to 20 years after the procedure (13). In contrast, cemented acetabular components continue to have a high rate of loosening despite improved cement techniques. Preliminary reviews of the results with uncemented acetabular components [Figure 43-1(B)] suggest that they may have better results. The global trend in total hip arthroplasty has been toward uncemented femoral components as well. Through a variety of methods, porous coatings are applied to a portion or all of the intramedullary stem. Bone ingrowth into the pores allows stable intraosseous fixation without the need for cement. Changes in femoral component geometry and porous coating have led to improved tolerance such that the survivorship of the components can be reasonably expected to exceed 20 years in the majority of patients. In September 1994, a National Institute of Health Consensus Development Conference Panel convened to evaluate the available scientific information concerning total hip replacement, and concluded that total hip replacement is a highly successful method of treating pain and disability and that the vast majority of the patients have an excellent prognosis for long-term improvement in symptoms and function (10). The panel noted that implant loosening remains a problem and recommended regular follow-up to detect impending failure early and allow treatment before significant bone loss or fracture occur (Figure 43-2).

Despite its great success, total hip arthroplasty has important limitations, particularly for young patients who are likely to outlive the prosthesis. Alternatives to arthroplasty include osteotomy, arthrodesis, and resection arthroplasty. Femoral and pelvic osteotomy have been shown to be effective in relieving pain in young patients with acetabular dysplasia and minimal or no radiographic degenerative change. Whether or not they alter the natural history of hip dysplasia is unclear. Results are less favorable in adults older than 40 years and in patients with significant degenerative change. Arthrodesis of the hip offers young patients with hip arthritis a dependable, durable, pain-free hip. Once fusion is obtained, the patient may return to vigorous activity without the limitations imposed on arthroplasty patients. However, some patients find the prospect of a stiff hip unacceptable. At long-term follow-up, patients complain of some difficulty sitting in a chair and using public transportation, but otherwise perform activities of daily living very well with excellent pain relief. Patients who develop associated lumbosacral pain later in life may be considered for conversion of the arthrodesis to a total hip arthroplasty.

Minimally invasive surgery (MIS) is a term commonly used with respect to conventional total knee and total hip arthroplasty. MIS is a qualitative term more than one specifically defined by an objective measure, such as the length of the incision. Most orthopedic surgeons would agree that the length of the skin incision is in fact the least important factor in minimally invasive surgery. Improved instrumentation and modification of surgical approaches in these instances now allow preservation of deep tissues to a greater extent. To this end, decreased blood loss, increased function, and quicker recovery can be expected.

Resection arthroplasty, originally described for treatment of tuberculous arthritis of the hip and osteomyelitis, is seldom employed as a primary procedure today. It remains an option for people with recalcitrant infection involving a total hip arthroplasty and for low-demand patients who are not candidates for more extensive reconstruction. After resection arthroplasty, the proximal femur is allowed to articulate with the acetabulum or the ilium. Surprisingly, the majority of otherwise healthy patients are pain-free and ambulatory, but generally require one or two crutches and a substantial heel lift to walk. Today, resection arthroplasty is generally reserved for salvage of a failed hip arthroplasty that is not amenable to revision.

Knee

A variety of operative procedures have been described for treatment of arthritis of the knee, including arthroscopy, osteotomy, and replacement arthroplasty. The indications for these procedures differ significantly.

Arthroscopy has advanced the diagnosis and treatment of many forms of knee arthritis. It is particularly useful for people whose symptoms may be attributed to a specific mechanical etiology, such as a meniscus tear or loose body (Figure 43-3). Arthroscopic synovectomy can decrease pain and swelling for patients with hemophilia, pigmented villonodular synovitis, synovial chondromatosis, and early RA without significant cartilage erosion. Whether or not it alters the long-term course of these diseases is unclear. Arthroscopic debridement or chondroplasty for degenerative knee arthritis, except in cases of degenerative meniscal tears or intra-articular loose bodies, does not appear to affect the natural history of the disease. It may, however, provide short-term relief of symptoms for some patients.

Osteotomy about the knee is intended to redirect the weight-bearing axis away from a degenerative portion of the tibiofemoral joint, and may also stimulate development of fibrocartilage in the unloaded degenerative compartment. The majority of knee osteotomies are valgus osteotomies of the proximal tibia, performed to redirect weight-bearing forces from a degenerative medial tibiofemoral articulation through a better-

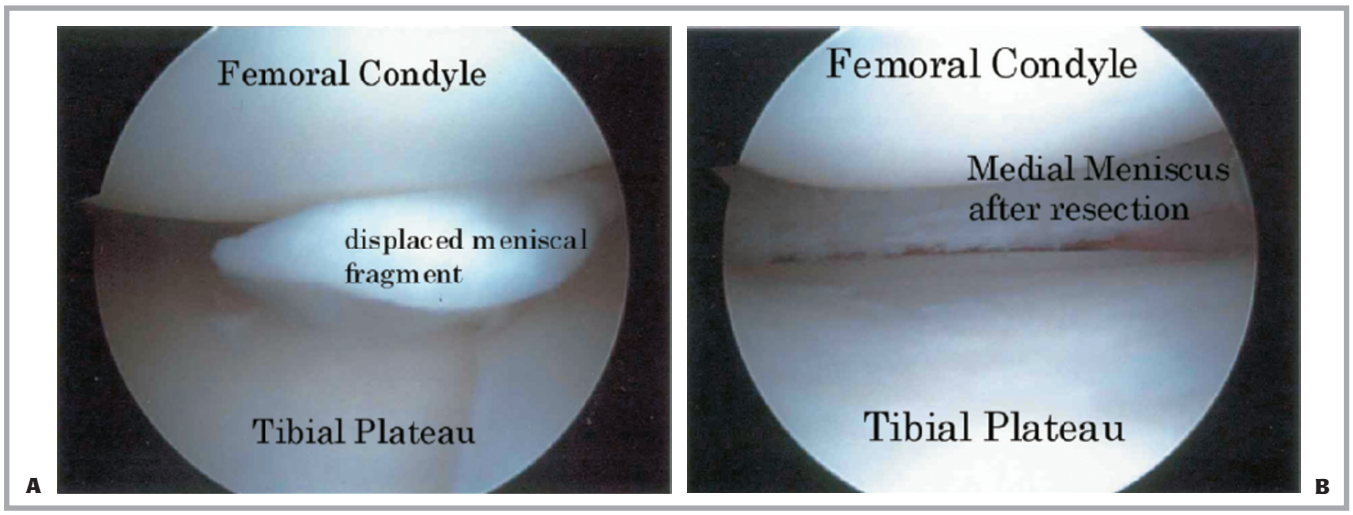


FIGURE 43-3

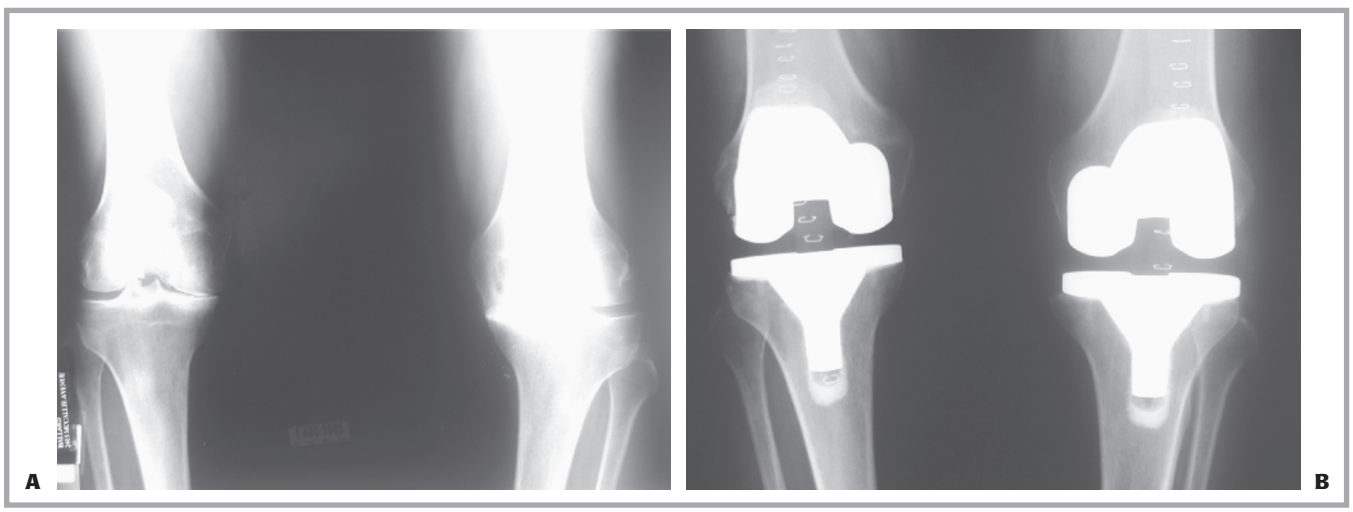
(A) Arthroscopic view of the medial knee compartment of a 35-year-old male showing a displaced medial meniscal tear. The fragment is between the medial femoral condyle and the medial tibial plateau. (B) The same medial compartment after removal of the meniscal fragment.

preserved lateral compartment. Femoral osteotomies are preferred for valgus and excessive varus deformities of the knee. Osteotomies generally are chosen over total knee arthroplasties for young, heavy, active patients, and should be reserved for patients with non-inflammatory disease. Appropriate candidates have <50° of flexion contracture, >90° of flexion, and isolated medial or lateral tibiofemoral arthritis without significant patellofemoral involvement. Good results have been reported in 80% to 90% of patients for 6 to 9 years postosteotomy, with 60% to 70% good results at 10 to 15 years follow-up (14). It is difficult to compare these results with those of total knee arthroplasty, where the patients are generally older and less active.

Total knee arthroplasty, similar to total hip arthroplasty, may be performed with cement or bone ingrowth as the means of fixation (Figure 43-4). Several large series reveal that tibial and femoral results are excellent regardless of the type of fixation, with 97% survivorship of prostheses at 10- and 12-year analyses (15). Despite

FIGURE 43-4

(A) Anteroposterior radiograph of both knees in a 74-year-old patient with severe osteoarthritis. (B) Acute postoperative radiograph showing bilateral cemented posterior stabilized total knee arthroplasties. Note the staples from surgical repair of the skin.



excellent results with cement fixation, some surgeons reserve cemented tibial and femoral components for patients older than 50 or 60, or patients with poor bone stock, based on the assumption that uncemented components will last longer for young patients and preserve their bone stock. Patellar problems are the leading cause of failure after total knee arthroplasty. Unlike tibial and femoral results, results of uncemented patellar components, which require a metal backing for bone ingrowth, are substantially inferior to results of cemented all-polyethylene patellar components, and have thus fallen out of favor in recent years.

Unicompartmental arthroplasty is a type of knee arthroplasty wherein the femoral condyle and adjacent proximal tibial plateau in either the medial or lateral compartment is replaced while the opposite side is left with native cartilage. Although these devices have been available for several decades, there has been a resurgence of interest in their utilization due to the fact that they require removal of less bone and allow preservation of more of the native joint. In addition, they may offer appropriately selected patients less blood loss and quicker recovery than total knee arthroplasty. However, these devices are not recommended for patients with substantial deformity or tricompartmental osteoarthritis.

Knee arthrodesis is an option for patients with recalcitrant infection or failed total knee arthroplasty that cannot be revised effectively. Despite loss of knee motion, a functional lower extremity that permits painless weight bearing can be expected using current techniques. Resection arthroplasty has also been used for patients with failed total knee arthroplasty.

Foot and Ankle

Surgical options for arthritis of the foot and ankle include cheilectomy (resection of an osteophyte), arthroscopic debridement, osteotomy, arthrodesis, and replacement arthroplasty.

Osteophytes may develop at the periphery of a joint and cause symptoms related to impingement during normal walking. These are not uncommon on the dorsum of the first metatarsophalangeal joint and the anterior aspect of the tibiotalar joint. Although it does not cure the underlying disease, cheilectomy often provides relief of mechanical symptoms and associated pain. Loose bodies may also be a source of mechanical symptoms and are amenable to arthroscopic removal.

Supramalleolar tibial osteotomy allows realignment of the weight-bearing axis through the tibiotalar joint. This can help to preserve the joint in various congenital and post-traumatic degenerative conditions of the ankle. Low tibial osteotomy has been shown to be particularly effective in long-term relief of symptoms with intermediate-stage primary OA. Osteotomy is generally reserved for non-inflammatory arthritides, but it may also provide relief of pain and decreased frequency of intra-articular bleeding in patients with hemophilic arthropathy.

Arthrodeses of the foot and ankle offer pain relief and stability to people with severe arthritis. Fusions of these joints are well tolerated, even by children, despite some restriction of stressful activities such as hilI climbing and running. Although the vast majority of patients with ankle and/or peritalar arthrodeses obtain excellent relief of pain and increased function, initial nonunion of the arthrodesis occurs in 5% to 30% of cases. Infection and delayed wound healing have been reported in 25% to 40% of patients with RA who undergo tibiotalar arthrodesis, yet the majority have an excellent long-term result.

Unlike total replacement arthroplasty of the hip and knee, ankle replacement arthroplasties have not produced predictable results. By 5 to 10 years after surgery, 60% to 90% of these prostheses have failed. Most surgeons now limit the use of this procedure to treatment of inflammatory arthritis in minimally active elderly patients who have multiple joint involvement.

Hand and Wrist

The distal interphalangeal joints and thumb carpometacarpal joints are the most commonly involved joints in OA of the hand, while proximal interphalangeal, metacarpophalangeal, carpometacarpal, radiocarpal, and distal radioulnar joints are more commonly involved in inflammatory arthropathy. Surgeons use a variety of joint and soft tissue procedures to treat these disorders.

When evaluating the wrist and hand in people with RA, it is imperative to obtain a history of the patient's functional abilities, carefully noting any recent changes. Inability to actively flex or extend interphalangeal and/or metacarpophalangeal joints with preservation of passive motion usually signals a ruptured tendon. Flexor and extensor tendons in patients with rheumatoid disease are more susceptible to rupture than normal tendons. Underlying ultrastructural changes associated with the inflammatory process weaken the tendons, and abnormal bony prominences, particularly at the distal radioulnar joint, abrade the weakened tendons, making them prone to rupture. Tenosynovectomy not only provides decreased pain with increased range of motion and grip strength, but also appears to protect the tendons, particularly when combined with resection of abnormal bony prominences. Acute tendon ruptures should be evaluated early by a surgeon for consideration of reconstruction prior to the development of fibrosis and contractures. In the rheumatoid hand, the metacarpophalangeal joints of the fingers are generally reconstructed with silicone implants that function as

flexible spacers. Ulnar drift of the digits with resultant ulnar subluxation of the extensor tendons may be at least partially corrected by surgical centralization of the extensor tendons and transfer of the intrinsic hand muscle insertions from one digit to the adjacent digit on the ulnar side.

Arthrodesis is commonly employed in the interphalangeal joints, carpus, and wrist for end-stage joint degeneration due to most arthritic disorders. Interphalangeal joints are best managed with arthrodesis in a partially flexed position. Solid fusion can be reliably obtained in more than 95% of cases using various techniques. Arthrodesis may also be performed at the radiocarpal joint or selectively at diseased intercarpal joints. Although some reduction in wrist motion and grip strength are commonly noted with limited intercarpal arthrodeses, long-term pain relief and stability are excellent.

Surgeons rarely recommend arthrodesis of arthritic thumb carpometacarpal joints, because motion of these joints is particularly important for overall hand function. The degenerative thumb carpometacarpal joint is amenable to interposition arthroplasty (resection of the joint surfaces and interposition of soft tissue, usually a portion of the abductor pollicis longus or flexor carpi radialis tendons), which yields excellent pain relief and increased grip strength. Experience with arthroplasty of the wrist is limited, partially due to the predictable results obtained with wrist fusion. Intermediate-term results have been mixed. Silicone spacer implants yielded a high incidence of failure with poor pain relief in approximately 50% of patients an average of 5 to 6 years after the procedure. Wrist arthroplasty designs have yielded improved clinical outcome, but component failure remains a problem. In selected patients with degenerative disease of the radiocarpal joint, resection of the proximal row of carpal bones (i.e., proximal row carpectomy) can reduce pain.

Elbow

Routine activities of daily living require a wide range of elbow flexion and extension as well as pronation and supination. Although elbow fusion can be reliably obtained with internal fixation, this results in substantial impairment because shoulder and wrist motion cannot adequately compensate for loss of elbow motion. Fortunately, radial head excision, synovectomy, arthroscopy, and arthroplasty are alternatives that have yielded good results.

Arthritis involving primarily the radiohumeral articulation is not uncommon with rheumatoid and posttraumatic joint disease. Radial head resection offers increased range of motion and decreased pain in appropriately selected patients. Resultant proximal migration of the radius is minimal after this procedure, and elbow instability is seldom a concern if the medial collateral ligament complex is intact. Patients generally have good intermediate-term relief of pain with increased range of motion. In one series, 84% of people with RA reported good pain relief 6 months after the procedure (16). Synovectomy may be performed alone or in conjunction with other procedures, such as radial head resection. Patients with hemophilia likewise have decreased pain and swelling following synovectomy, as well as a decreased incidence of hemarthrosis. Arthroscopy has been used effectively to perform synovectomies as well as remove loose bodies and osteophytes from arthritic elbows.

Elbow joint replacement arthroplasty, while newer than hip and knee arthroplasty, has developed rapidly. The rate of loosening in young active patients with posttraumatic arthropathy approaches 50% at 5- to 8-year follow-up. However, intermediate-term results in low-demand patients with inflammatory disease are promising, with survival of the components and good or excellent results reported in more than 90% of RA patients at 3- to 8-year follow-up (17). Motion was reportedly improved to a functional range and pain relief was substantial for >90% of these patients.

Shoulder

The high degree of compensatory movement in the scapulothoracic articulation, as well as elsewhere throughout the upper extremity, may be responsible for the relatively low incidence of patients requiring operative treatment of arthritic glenohumeral joints. Nonetheless, some patients will be debilitated by an arthritic shoulder, fail nonoperative treatment, and present for consideration of surgical intervention.

Shoulder arthrodesis yields excellent pain relief and provides a stable upper extremity with long-term durability for young patients with severe glenohumeral arthritis. Fusion is reliably obtained in the majority of patients with relatively few complications. Despite rigid fusion of the glenohumeral joint, abduction of 50° and flexion of 40″ in the shoulder girdle is possible via scapulothoracic motion.

Total shoulder arthroplasty has recently become increasingly used for the treatment of severe glenohumeral arthritis (Figure 43-5). The majority are performed for RA of the glenohumeral joint. Pain relief and improved general functions of daily living are reported in the majority of patients; the most common long-term complication reported is glenoid component loosening (18). To this end, recent efforts have explored the use of hemiarthroplasty, which is the replacement of the humeral head without resurfacing the glenoid. This method has proven effective in selected patients including those with cuff tear arthropathy—chronic,

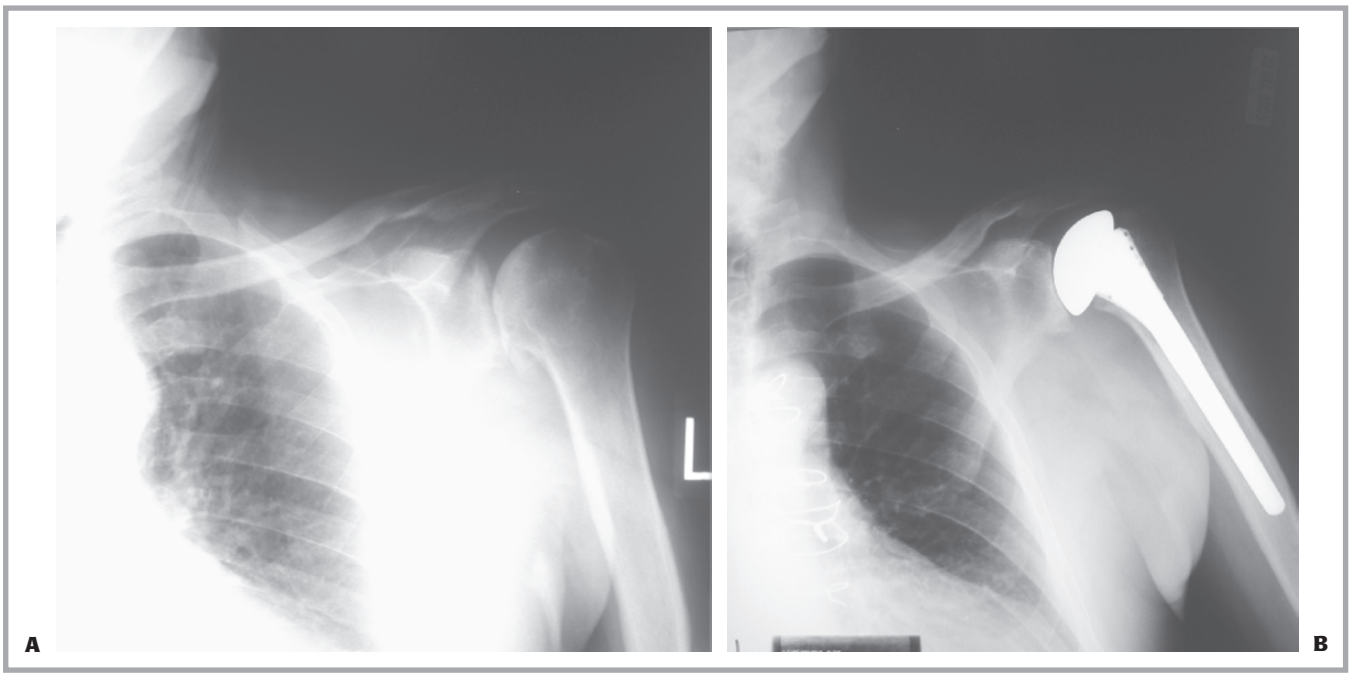


FIGURE 43-5

(A) Radiograph of an 80-year-old male with severe glenohumeral arthritis of the left shoulder. (B) Same patient after a shoulder arthroplasty.

massive rotator cuff tears with secondary superior migration of the humeral head and resultant erosive changes of the glenohumeral joint and inferior surface of the acromion.

Cervical Spine

The clinical problems caused by arthritis of the cervical spine are pain, compromised neurologic function, and mechanical instability that causes or has the potential to cause pain and neurologic deficits. Spinal fusions can decrease pain, restore stability, and, in some instances, prevent development of neurologic deficits. Surgical decompression of the spinal cord and nerve roots can relieve pain and improve neurologic function in selected patients.

Generally accepted indications for surgical intervention in people with RA with cervical spine involvement are pain refractory to nonoperative modalities, neurologic deterioration, and radiographic evidence of impending spinal cord compression. Whereas the anterior atlantodental interval has been traditionally used to determine the degree of atlantoaxial instability, the posterior atlantodental interval has been shown to be an important predictor of the potential for postoperative neurologic improvement (19). The available evidence also suggests that patients who undergo cervical arthrodesis earlier in the course of their disease have more satisfactory results than those in whom arthrodesis is delayed. Some authors have recommended that patients with atlantoaxial subluxation and a posterior atlantoodontoid interval of 14 mm or less, patients who have atlantoaxial subluxation and at least 5 mm of basilar invagination, and patients who have subaxial subluxation and a sagittal spinal canal diameter of 14 mm or less, even in the absence of neurologic findings, undergo posterior surgical fusion at the involved levels. Pain is relieved in the majority of patients, but neurologic improvement is variable and closely related to preoperative radiographic instability and neurologic status.

Radiographic evidence of OA in the cervical spine occurs in about 50% of people older than 50 years and 75% of people older than 65. In contrast to people with RA, these patients rarely have instability. However, they may develop pain and neurologic signs as a result of degenerative stenosis. Posterior decompression may be accomplished via laminectomy or laminaplasty. Laminectomy, or removal of part or all of one or more cervical laminae, allows excellent visualization and decompression at the expense of potentially destabilizing the spine with resultant kyphosis. Laminaplasty may be performed by one of many techniques, but in general involves cutting through the laminae completely on one side at the involved levels of the spine and cutting 80% of the way through the contralateral laminae at those same levels. The cervical spinal canal may then be opened on the hinge of the partially cut laminae. This allows excellent multilevel decompression at the expense

of decreased cervical motion. The choice between these two procedures remains controversial.

PERIOPERATIVE MANAGEMENT

The goals of perioperative management include restoration of motion and function, relief of pain, and prevention of complications. To obtain optimal surgical results, joint replacement patients must participate in a physical therapy regimen directed at improving range of motion and restoring function. Physical therapy typically starts within 24 hours after a joint replacement and is generally continued for 6 or more weeks through a combination of inpatient rehabilitation, home health care, and outpatient services. Newer rehabilitation protocols have led to a dramatic increase in the number of patients who are discharged from the hospital after 48 to 72 hours and follow-up with outpatient physical therapy services. In general, inpatient rehabilitation is now reserved for the postoperative care of patients with slow progress or multiple comorbid factors. Whereas continuous passive motion (CPM) machines were previously routinely used in the early phases of rehabilitation, they are now infrequently used except with extenuating circumstances.

Narcotic analgesics are generally required in the acute postoperative period, and are tapered off during the ensuing weeks. Patient-controlled analgesia (PCA) pumps provide effective and efficient delivery of narcotics through a combination of basal infusion rate and intermittent dosing, which the patient dictates as needed by pressing a button. The maximum dose per hour is preset by the physician. As an alternative, spinal and epidural infusions have become increasingly popular for total hip and knee arthroplasty patients. Each not only may be used for surgical anesthesia, but also can provide postoperative analgesia. An indwelling epidural catheter can be left in place for 2 to 3 days postoperatively and titrated to provide pain relief while sparing motor control for ambulation and other exercises. As an added benefit, the vasodilation associated with epidural anesthesia may further decrease the risk of thromboembolus.

Thromboembolic disease is a potential complication after any spine or lower extremity procedure. This complication is particularly common among unprophylaxed hip arthroplasty patients. In the absence of prophylaxis, the incidence of deep venous thrombosis has been reported as high as 74% and the incidence of symptomatic pulmonary embolism as high as 3.4% (20). A recent meta-analysis of thromboembolic prophylactic agents has shown a significantly lower risk of deep venous thrombosis and symptomatic pulmonary embolism with warfarin, pneumatic compression, and low-molecular-weight heparins (20). Of these, warfarin was thought to be the safest and most effective. Low-molecular-weight heparins were associated with a risk of postoperative bleeding.

Patients undergoing major joint reconstruction commonly require perioperative blood transfusion. Concern regarding the associated risks of blood-borne disease, anaphylaxis, and transfusion reaction has given rise to improved techniques for postoperative blood management. For many years, preoperative autologous donation has provided a relatively safe, albeit expensive and time-consuming, alternative to allogeneic transfusion. More recent advances have seen the advent of perioperative blood salvage and erythropoietin analogs. Blood-salvage devices that reinfuse blood from the operative site are an effective means of reducing allogeneic transfusion after arthroplasty (21). Erythropoietin analogs may further reduce the risk by stimulating the patient's marrow to increase erythrocyte production prior to elective surgery.

POSTOPERATIVE COMPLICATIONS

The majority of serious postoperative complications, including infection, nerve and blood vessel injury, pulmonary embolus, and joint dislocation, occur within the first postoperative weeks; however, complications may occur at any time after surgery. Arthroplasty patients in particular must be monitored indefinitely for subtle radiographic evidence of periprosthetic osteolysis, which, when treated early, may halt progression to massive bone loss and catastrophic failure (see Figure 43-2) (10). The vast majority of failures among lower extremity total joint prostheses occur after the first decade postoperatively, and most patients remain asymptomatic until substantial bone loss, subsidence, and even fracture have occurred. It is therefore imperative that routine follow-up, including careful standardized clinical and comparative radiographic evaluation, be obtained on a regular basis throughout the patient's life.

In addition, patients must be carefully monitored for early signs of infection. Early detection of infection in a prosthetic joint may make it possible to save the implants. However, successful treatment of chronic joint infections without removal of the implants occurs rarely. Patients with multiple joint arthroplasties who develop sepsis in one prosthetic joint should be treated aggressively and observed closely because they have a substantial risk of developing a metachronous infection in another artificial joint.

The relationship between bacteremias caused by diagnostic and surgical procedures and subsequent infection of a total joint arthroplasty remain uncertain. However, several reports suggest that bacteremias associated with dental procedures can seed total joint arthroplasties. For this reason, 2 g of penicillin 1 hour prior to dental manipulation and 1 g 6 hours after the

first dose have been recommended for patients with total joint arthroplasties (22). One gram of erythromycin 1 hour prior to dental manipulation and 500 mg 6 hours after the first dose may be utilized for penicillin-sensitive patients. Oral antibiotic prophylaxis appropriate for the regional flora has also been recommended prior to and following urologic, gastrointestinal, and other bacteremia-evoking manipulations.

NEW OPERATIVE TREATMENTS

Replacements of the hip and knee predictably relieve pain and provide stability and motion for large numbers of patients. Unfortunately, wear and loosening can cause failure of these implants. Other current operative treatments also relieve or reduce pain for many patients with arthritis: however, they are generally less successful in restoring joint function. Joint fusions and even joint replacements place important limits on function and other current treatments do not reliably arrest or reverse joint degeneration. Thus, there is a clear need for new therapeutic approaches. New articular bearing surfaces, including highly polished metallic alloys, highly cross-linked polyethylene, and ceramic surfaces are under investigation. Improved results of wrist and ankle joint replacement may be possible with new implant designs.

Although they have not yet been shown to be effective in arthritic joints, operative approaches intended to preserve or restore cartilaginous articular surfaces that include surgical debridement of degenerated tissue and correction of mechanical abnormalities combined with implantation of artificial matrices, growth factors, and transplanted chondrocytes or mesenchymal stem cells have the potential to restore a joint surface.

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