Arthritis and Total Knee Replacement

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A total knee replacement is performed surgically to remove the diseased knee joint and replace it with an artificial joint.

For more than 15 years total knee replacement has been performed to eliminate the pain in the knee due to different types of arthritis. More than 75 million Americans suffer from joint pain. Twenty-two million have moderate problems from their arthritis and nearly 3 million Americans are severely affected.[1]

Currently, 127 kinds of arthritis have been identified. These are categorized into eight major areas (Table 1).[1] Both surgical and nonsurgical modalities may be used to help relieve the symptoms and slow down the disease process. This article will discuss the surgical procedure of total joint replacement.

Pathophysiology of Arthritis

A normal knee has smooth cartilage on the weight-bearing surface; in osteoarthritis this smoothness is lost to bone (no cartilage) and results in bone rubbing on bone (Figure 1). There is a degeneration of the joint cartilage and growth of new bone at the marginal aspects of the joint (boney spurs), caused by a breakdown of chondrocytes, which are essential elements of articular cartilage. This breakdown is initiated by biomechanical stresses and, most commonly, affects weight-bearing joints.[2]

Rheumatoid arthritis is a chronic systemic disease characterized by inflammation of synovial tissue. This thin tissue can become more than 1/4-inch thick due to the invasion of tiny inflammatory cells. Enzymes released by the inflammation slowly digest the joints. This disease involves all weight-bearing joints as well as some smaller joints (Figure 2).

Preoperative Examination

A clinical evaluation for range of motion (ROM), deformity (either varus or valgus), vascularity (pulses within the feet), motion and sensory functions in the entire leg, and the condition of the skin (ie, scars, ulcers, open wounds) is given to all prospective patients (Figure 3). Patients are always asked whether they would be able to do the things they want to do if their knees were better. If a total knee replacement is desired, the complications and risks are discussed.

A preoperative evaluation ensures that patients are medically cleared to have the surgery. An autologous blood donation is made in case a transfusion is needed after surgery. One unit is donated for a single knee procedure and two

Table 1. Major Categories of Arthritis

Category	Causes	Most Typical Disease
Cartilage degeneration	Breakdown of joint cartilage	Osteoarthritis
Synovitis	Inflamed membrane in joint	Rheumatoid arthritis
Attachment arthritis (enthesopathy)	Inflamed ligaments attached to the bone	Ankylosing spondylitis
Crystal arthritis	Chemical crystals in joint fluid	Gout, Staphylococcus
Joint infection	Bacteria in joint fluid	Gonococcus
Muscle inflammation	Inflamed muscle tissue	Polymyositis, Polymyalgia, Rheumatica
Local condition	Local injury	Low back strain, tennis elbow, frozen shoulder
General condition	Poorly defined	Fibrositis

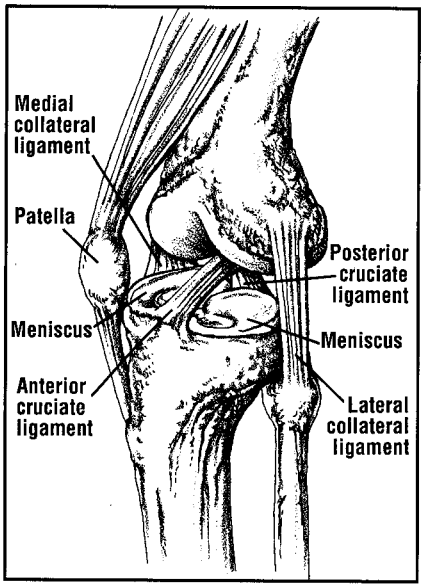

Figure 1. Ligaments of knee.

units for a bilateral knee procedure. At our hospital, approximately 80% of our total knee patients are between the ages of 60 and 80.

Patient Preparation

Surgery is performed under spinal or general anesthesia with the patient placed in a supine position. The operative leg or legs are placed in a leg holder to hold the leg for prepping. A tourniquet is applied to the upper thigh and a 6-inch bump is placed 10 inches to 14 inches distal to the buttock and taped to the bed (Figure 4). The bump helps hold the foot and keep the knee in place during surgery.

A 1988 study demonstrated an iodophor-impregnated drape applied to the area for the skin incision following a simple 1-minute alcohol prep was, and still is, our preferred method of skin preparation.[3]

The patient is prepped with alcohol or the surgeon's preference. The leg is draped sequentially with a stockinette and an extremity drape. The bottom half of this drape is kept sterile to put on top of the instrument table and under an instrument pan. The instrument table is placed up against the laminar air flow filters and the patient is now perpendicular to the filters. This prevents traffic between the laminar air flow and the patient. The stockinette is cut at the incision site and an iodine sterile drape (Ioban) is applied around the entire knee, from mid-thigh to mid-calf. At our center, total joints are performed with laminar air flow or ultraviolet lights.

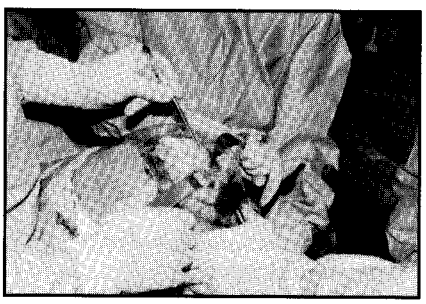

Figure 2. Degeneration of medial femoral condyle.

Surgical Procedure

Surgical technique utilizes the intramedullary AGC knee, Total Knee System.[4] A long vertical incision is made over the anterior aspect of the knee, starting approximately 2 inches to 3 inches above the patella and ending about 2 inches below the tibial tubercle. Methylene blue lines are placed across the medial border of the patella as a visual aid for closure. A medial parapatellar arthrotomy is performed and the patella inverted laterally. The leg is moved into flexion and the foot is rotated externally. The foot is placed behind the bump to hold the leg in flexion. It is important to note that if the leg is in valgus preoperatively, it is not externally rotated to prevent avulsion of ligamentous tissue.

The anterior cruciate is cut, if present, and the tibial plateau is dislocated anteriorly. A mark is made to identify the center of the anterior tibial plateau and the tibial cutting guide is placed on the mark. The two sliding nails are tapped into the anterior tibia. The superior surface of the tibia is cut, keeping the saw blade flat against the guide surface. The surgeon must exercise caution to protect the posterior cruciate and the posterior neurovascular structures from being damaged.

A large drill hole is placed slightly medial to the center of the intercondylar notch of the distal femur anterior to the posterior cruciate ligament. The hole is enlarged at the

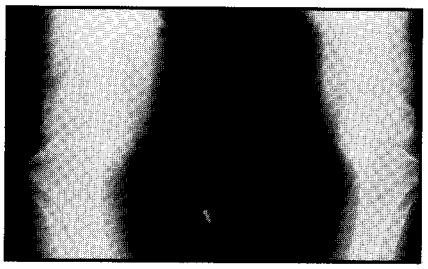

Figure 3. X-ray film of patient with arthritis of knee.

surface of the knee. The drill is then passed into the medullary canal and the intramedullary canal is irrigated. An intramedullary reamer, which displaces considerable fatty tissue in the canal, is used before the rod is placed. The intramedullary guide rod is then placed within the medullary canal.

The angle jig is assembled on the intramedullary rod. The jig's feet are brought into contact with the distal femoral condyles. If bone deterioration is present, only one foot may touch a condyle. The angle jig must be resting against the distal femur and should be parallel with a line connecting the medial and lateral epicondyle. The two posts of the distal femoral resector are then slid into the two holes on the anterior surface of the jig. The resector's nails are hammered into the anterior femur and the primary distal femoral cut is made. Thinner blades will tend to skive and promote a suboptimal cut. A thick blade with rake teeth may require side-loading.

The medial, lateral, and posterior condyles are used to determine the component size on the distal femur. The femoral positioner is inserted. The block should set flush on the primary distal femoral resection. The feet are centered under the pos-

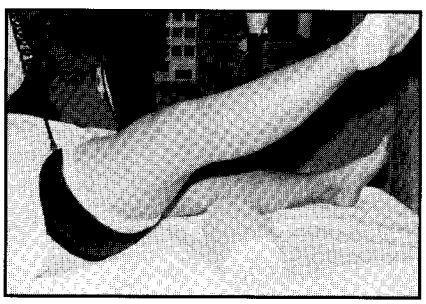

Figure 4. Proper placement of bump to support knee in flexed position.

terior condyles. The threaded post's locking ring is tightened down (the soft tissue must be removed to expose the anterior cortex). The femoral sizes are inscribed on the front of the threaded post. The bottom edge of the sliding sleeve will lie within one of these sizes. The two drill guides are then set to the indicated femoral size. Prior to drilling, a drill bit can be inserted into the guide hole as a final check of orientation. When viewed from the side, the bit should be parallel to the shaft of the femur.

Two 1/4-inch holes are drilled in the distal femur using the guides. The stabilizing pegs of the back of the femoral component will match these holes.

The matching anterior or posterior cutting block should be selected. The pegs on the back of the block will match the holes in the distal femur. The saw must remain flat against the anterior and posterior jig surfaces throughout the cuts. Caution should be taken to avoid damaging the posterior cruciate and the medial or lateral collateral ligaments.

The chamfer guide corresponding to the femoral size is inserted into the 1/4-inch holes drilled into the distal femur. A slotted cutting block may be substituted to complete the same cuts.

Determining the Flexion Gap

The anterior/posterior femoral cuts have been made. These procedures have created a gap of unknown dimension between the posterior femur and the proximal tibia. With the knee in full flexion, one of the five spacer blocks is selected and placed on the resected tibial plateau to reinstate natural joint stability in flexion.

Soft tissue balancing and alignment are achieved by inserting a tensor into the gap with the leg in extension. The tensor should rest on the resected tibial plateau. Holding the tensor in position and with the knee extended, the thumb knobs are turned clockwise until equal tension has been applied (approximately 30 lbs) on the medial and lateral sides. An alignment rod is fitted into the tensor to check for proper leg alignment. The rod should run to the center of the femoral head and parallel to the anterior tibial crest. If it does not, further medial or lateral soft tissue releases are necessary (Figure 5). The joint should not be over-tensed.

Patellar Preparation

A patellar drill guide is centered on the top of the medial ridge of the patella with equal distance proximally and distally. A 1/4-inch drill hole is made into the patella but does not violate the cortex on the anterior surface. A depth gauge determines the patellar thickness. A patellar planer then removes just the amount of posterior surface necessary for the prosthesis.

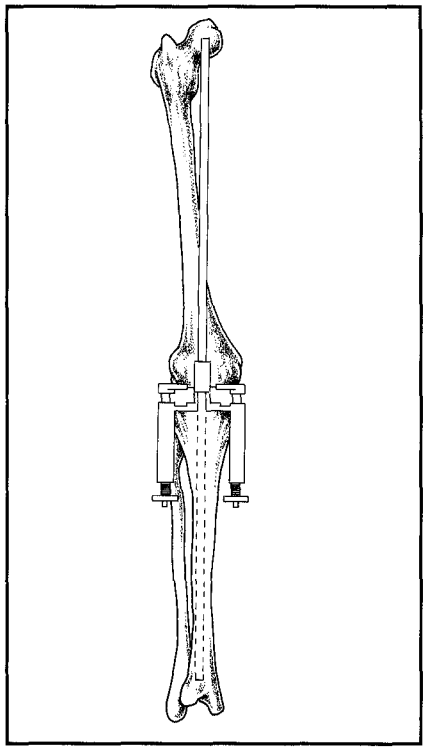

Figure 5. Alignment rod from femoral head to tibial crest.

Sizing the Tibia

With the leg flexed, one of the tibial templates is placed over the resected surfaces. The template must lie in the proper rotation.

The correct template size provides maximum surface coverage without extending over the medial or lateral edges of the tibia or in the anterior/posterior direction. After establishing the correct rotation, two marks are placed on the tibia inside the square with methylene blue. These will be used as references during tibial preparation (Figure 6).

Trial Reduction

The sizes selected earlier will be used. The femoral provisional is placed on the distal femur and should fit snugly with the contours of the femur. The tibial provisional is then inserted. Joint alignment in extension should be confirmed by running a string from the center of the femoral head to the center of the ankle. The string should pass directly through the center of the knee or a little on the valgus side. The knee should be slowly flexed; if the tibial tray begins to lift off the tibia at any point, the posterior cruciate ligament is too tight. Any tightness is resolved by recessing the posterior cruciate ligament off the proximal tibia. The amount varies.

With the patella reduced, the knee is moved through a range of motion to evaluate patellar tracking. The patella should track centrally without the use of thumb pressure to keep it in place. A lateral release may be indicated if the patella does not stay in place.

Preparing for the Tibial Stem

A cut should be made into the methylene blue marks on the tibial surface with a chisel or saw. A gouge can be used to remove the bone piece inside the marks. This piece of bone can then be used as a bone plug for the drill hole on the distal femur.

The punch is marked with the sizes of the tibial components, so that the proper depth will be punched for the stem. Punching should stop at the tibial size marked

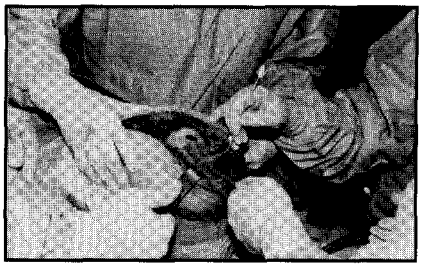

Figure 6. Marking of tibia.

or slightly deeper. This channel can be extended anteriorly or posteriorly.

Cementing Procedure

All surfaces are cleaned with a pressurized water pic and dried by suctioning all the water off the surfaces.

A low-viscosity cement in a semiliquid state is used. The cement is first applied to the tibia by filling the channel and then the cement is pressurized into the tibial surface. The femur and patella should be prepared using the same technique. The cement should penetrate into the chamber cuts. Cement should be placed on the inner surfaces of the components; this ensures a more complete bonding of the cement to both surfaces.

The tibial component is inserted and any excess cement is cleaned off with a 1/4-inch osteotome or curette. The femoral component is then inserted and the knee extended, keeping the knee straight. The patellar prosthesis is placed on the knee and held in place with a clamp (Figures 7 and 8). The cement is allowed to harden.

After the cement hardens, it is very important to clean out any excess or loose cement. The knee is then irrigated with copious amounts of H_2O to remove as much debris as possible. Bupivacaine hydrochloride with epinephrine can be injected into the soft tissues to help control pain and bleeding.

Closure and Dressings

The vastus medialis fascia is closed with a 0-PPS-violet monofilament 0 polydioxanone suture; 2-0 uncoated monofilament polyglactin 910 is used for the subcutaneous tissue with an interrupted stitch, then skin closure strips (Steri-strips) or skin staples according to the surgeon's preference.

The knee is dressed with a thick bulky dressing with elastic bandages from the toes to the top of the thigh. Knee immobilizers and space boots are applied in the operating room to maintain proper alignment and prevent skin breakdown on the heels.

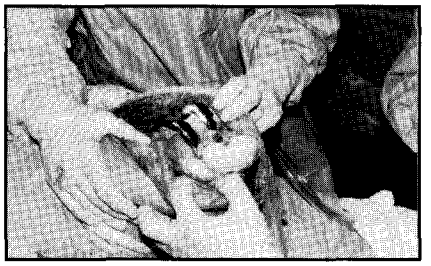

Figure 7. Total knee prosthesis.

Rehabilitation

The patient will remain in the recovery room 24 hours. A patient control analgesic (PCA) machine is routinely used for pain control for the first 2 or 3 days. The patient will begin physical therapy the first day postoperatively; however, the knee is not bent until the second postoperative day. Patients are seen twice daily by physical therapists. A copy of exercises is placed at the foot of the bed and the patient is encouraged to do these on his or her own, five times per day. No continuous passive motion (CPM) device is used. Certain goals must be achieved before a patient is discharged, which include flexion greater than 75°, extension less than 10°, independent transfers, and ambulation for 80 feet with an assistive device. A home exercise program and stair training are also provided. These goals are usually met in 4 to 5 days. Home instructions for the next 8 weeks include the use of a walker or crutches, elastic support hose (TED) hose, and the knee immobilizers at bedtime only. Ice,

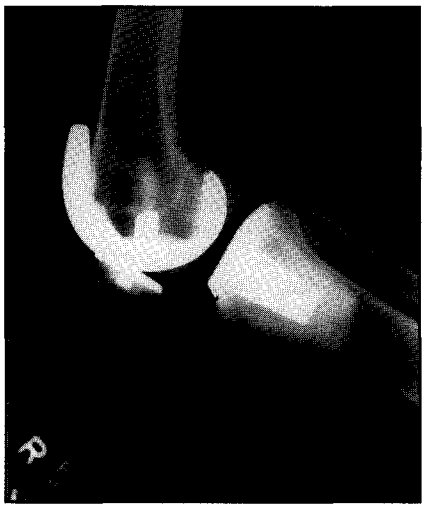

Figure 8. Lateral view of knee replacement.

elevation, and oral pain medication are recommended for pain relief. A follow-up appointment is scheduled for 8 weeks, 6 months, and then every 2 to 3 years thereafter.[5]

Postoperative Complications

The major complications of total knee replacement include infection, thromboembolic disease, and dislocation or fractures. Poor ROM may necessitate the manipulation of the knee within 4 to 8 weeks following surgery to improve ROM. Nerve damage is observed as a complaint of numbness, tingling, or weakness in the foot, while loosening of the prosthesis may occur over a period of several years and may require surgical revision.

Lifetime Restrictions

Individuals who have had total knee replacement must not twist, pivot, or jerk, lift or carry more than 20 lbs, or run and jump. They must also take antibiotics for any medical procedures or dental work where there might be bleeding in order to prevent infections.Δ

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