

Quadriceps Sparing Total Knee Replacement

Dana C. Mears, MD, PhD
Greater Pittsburgh
Orthopaedic Associates
5280 Centre Avenue
Pittsburgh, PA 15206

Seventeen years ago, a technique for a total knee replacement was devised, which displayed a shortened hospital stay and acceleration in the overall recovery period. The method involves a decrease in the surgical incision and a marked diminution in the amount of cutting of the so-called quadriceps tendon and muscles. Implants of a well-accepted design are used to provide a considerable likelihood for a successful and prolonged performance.

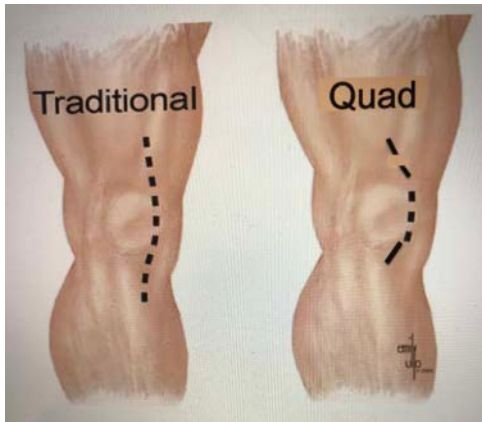
At the University of Pittsburgh Medical Center-Presbyterian Shadyside Hospital (UPMC-SSH), a specialized, quadriceps sparing total knee replacement program was assembled, which included the operative procedure, as well as the pre- and post-operative care. A separate clinical unit was created, which employs innovative techniques of anesthesia and pain management, along with a specialized and intensive protocol for physical therapy. The initiation of therapy within a few hours after the surgery enables most patients to be discharged to their homes within a day after the surgery.

The Quadriceps Sparing Surgical Technique

A total knee replacement is performed to manage severe degenerative arthritis of the knee and, occasionally, other problems.



The orthopaedic surgeon caps the arthritic surfaces within the knee, using intricately contoured metal and plastic implants anchored to the lower end of the thigh bone (femur), the upper end of the lower leg bone (tibia) and the back of the kneecap (patella) using thin layers of bone cement. The implants are available in multiple sizes so that they are appropriately sized for each patient. The incision ranges from 4" to 5", depending upon the thickness and degree of tightness of the soft tissues around the knee and the size of the bone. The incision is made on the front of the knee just medial to the midline.



Traditional versus Quadsparing Incisions

An attempt is made to preserve the quadriceps tendon. A specialized foot and lower leg holder is used, which permits the surgeon to bend the knee to varying degrees of flexion at special stages of the procedure. In this way, shaping of the bones is achieved through the smallest possible incision. The standard technique employs “surgical navigation” for guidance of the shaping tools to prepare the bone. The computer-based system using infrared light permits an alignment of the hip knee and ankle. It documents the appropriate alignment of the knee and the sizing of the implants. Once the bones are precisely shaped, a thin layer of bone cement is applied to the bony surfaces. Each implant is then impacted firmly against the bone while the cement solidifies. The incision is closed with sutures that are below the surface of the skin and that dissolve spontaneously. This technique ensures that a removal of sutures is unnecessary.

After the procedure, the patient is encouraged to bend the knee as much as possible. The rapid restoration of activity also serves to minimize the risk of a deep venous thrombosis (DVT) or a pulmonary embolus (PE). The minimally invasive procedure also decreases the risk of a postoperative wound infection.

The Selection of Patients

Most patients who have degenerative arthritis of the knee, rheumatoid arthritis or post-traumatic arthritis are suitable candidates for a quad-sparing total knee replacement. If the knee, including the bone structure or overlying soft tissues, is especially large, a bigger incision may be necessary, including an extended division of the quadriceps. If the knee displays a moderate deformity or fails to fully straighten, an additional release of soft tissues is necessary. Currently, most health insurance companies have restrictions on bodily size with a maximum body mass index (BMI) of 40. The companies have some additional restrictions pertaining to the use of recreational drugs, regular medicinal opioid medications, smoking and severe renal (kidney) disease. With respect to the quality of the clinical outcome, a major factor is your degree of physical activity and physical fitness prior to the surgical procedure. An individual with a highly sedentary lifestyle possesses a much greater difficulty to achieve an excellent recovery after the total knee replacement.

Bilateral Arthritic Knees.

When both knees are severely arthritic and painful, either the surgical procedures can be undertaken simultaneously, under one anesthetic, or undertaken sequentially, at two different times. The assets of bilateral, simultaneous procedures include: the use of one anesthetic and one recovery period. The recent introduction of continuous nerve blocks has markedly decreased postoperative pain, which in turn accelerates the therapy program and makes simultaneous bilateral procedures more attractive. Following a single knee replacement, a blood transfusion is a possibility. When both knees are replaced simultaneously blood transfusion becomes a certainty. The postoperative period of physical therapy is uncomfortable. After bilateral procedures, the severity of the pain may hinder the recovery of each knee. In this event, neither knee may achieve as successful a result as would have been achieved if sequential procedures had

been performed. From this perspective, a brief period of about one month between the two knees may be preferred.

In the presence of other serious medical problems, such as heart disease, a patient may be advised to undergo sequential knee replacements to lessen the bodily stress that follows the bilateral procedures. After bilateral simultaneous procedures, most patients benefit by a transfer from the hospital to a skilled nursing center or a rehabilitation center on an in-patient basis, usually for one to two weeks. With the recent changes in the policies of most health insurance companies, the coverage for such inpatient rehabilitation, either at a skilled nursing center (SNC) or a formal rehabilitation facility is no longer assured. This factor becomes a major consideration if bilateral simultaneous procedures are considered. For a patient who has considerable pressures to rapidly resume a light job or who is the principal caregiver to a family member, sequential procedures separated by two or more months are strongly recommended as the most predictable course.

When a patient eighty years or younger undergoes a single knee replacement and the other knee is normal, the patient can usually be discharged directly to his/her home. On the other hand, if a patient has severe bilateral arthritis and undergoes a single knee replacement, the contralateral arthritic knee may hamper the initial postoperative therapy. A consideration for a transfer of the patient from the hospital to an SNC or a rehabilitation center may be advised.

Expectations after a Quadsparing Total Knee Replacement.

Upon completion of the initial recovery period, the total knee replacement generally provides a markedly superior performance in comparison to the previous function of the severely arthritic knee. The arthritic pain is eliminated, while the knee displays stable flexion from a fully straightened position to a bend well beyond a right angle (90°). The amount of flexion is

variable, although it is generally sufficient to sit in a standard chair and to climb or descend a flight of stairs. If a knee is quite stiff prior to surgery, then the likelihood for excellent knee motion after surgery is decreased. Most patients can walk without walking aids, climb and descend stairs unaided and swim, play golf, bike, or take walks. Most patients, however, are aware that the knee possesses some shortcomings that a perfectly normal knee would not possess. Usually, kneeling is painful, although it does not harm the knee. If you sit motionless, possibly in a car or a plane, upon an attempt to resume walking, the knee feels stiff for a few minutes. After prolonged walking on hard surfaces, the knee may swell and ache. With respect to the quality of the clinical outcome, a major factor is your degree of physical activity and physical fitness prior to the surgical procedure. An individual with a highly sedentary lifestyle possesses a much greater difficulty to achieve an excellent recovery after the total knee replacement.

Scheduling of the Procedure & Pre-operative Planning

If you reside in Western Pennsylvania or a neighboring state, an initial office evaluation provides the opportunity to undertake a physical examination, to review appropriate radiographs (x-rays) and to discuss the anticipated surgical procedure. If you live further away from Pittsburgh, x-rays of the knee, or a corresponding CD, can be mailed to our office, along with a brief history of the problem. Subsequently, a preliminary discussion by phone call or by e-mail can be arranged. Either an office evaluation may follow or you may elect to schedule surgery and visit our office for the clinical examination on the day before the surgical procedure.

A standard pre-operative medical screening evaluation is necessary, which includes: a history and physical examination, blood and urine tests, an electrocardiogram and a chest x-ray. Your PCP can supervise these tests or they can be may

be undertaken at UPMC Presbyterian Shadyside Hospital.

If a test displays the presence of abnormalities or changes from prior electrocardiograms, further testing may be necessary in order to obtain medical clearance for a completion of the procedure. Prior to the surgery, if a patient possesses a past history of a significant medical problem, such as heart disease or urinary retention, a reassessment of the problem by the relevant medical specialist merits serious consideration. If changes are observed within the appropriate medical tests compared with prior results, further evaluation may be necessary to determine that it is safe to proceed with the surgery. The evaluation by the cardiologist or urologist should occur at least four weeks prior to the date scheduled for the surgery to allow sufficient time to complete additional tests.

The Potential for Blood Transfusion

During the surgical procedure, a tourniquet is used around the upper thigh. The tight wrap ensures negligible blood loss. However, when the thigh is large and obese, the tourniquet may irritate the small sensory nerves in the underlying skin to provoke temporary numbness or excessive sensitivity. Once the tourniquet is released, the prepared bone surfaces and the knee oozes blood for a period of twelve to twenty-four hours. Depending upon the amount of postoperative bleeding, the presence of underlying medical conditions (notably anemia), or of preoperative anticoagulants (blood thinners), a blood transfusion may be necessary. The indication for a blood transfusion has become an uncommon event. Currently, pre-donation of your own blood is no longer recommended.

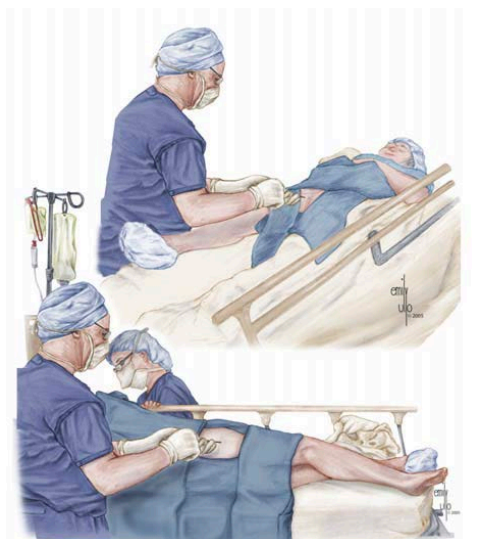
Activities on the Day of Surgery

On the day of surgery, you will report to UPMC Presbyterian Shadyside Hospital for a preliminary assessment by the anesthesiologists.



You are seen by the anesthesiologist before surgery.

He/she will discuss the anesthesia and treatment options to minimize the postoperative pain. Our goals include keeping you as comfortable as possible while still enabling you to begin physical therapy soon after surgery. While we will use narcotics when needed to treat your pain we will also give you a combination of non-narcotic analgesics to reduce that need as much as possible. An important part of this “multimodal analgesia” is the use of a peripheral nerve block.



A nerve block helps with pain after surgery.

This nerve block is a shot that is administered pre-operatively by our acute pain service and is intended to partially numb the surgical site. For knee surgery the nerve block is called a continuous femoral block. The femoral nerve is the nerve that supplies sensation to the front of your knee. This procedure consists of identifying the femoral nerve in your upper thigh with an ultrasound-imaging device. Once the nerve is identified, an injection of dilute local anesthetic, ropivacaine, is made. This is followed by the insertion of a small plastic tube, which is placed along the nerve so that a continuous infusion of dilute local anesthetic can be administered.

At this time, our Physician's Assistant, Liz Hollins, will review the itinerary of activities for the day, including the objectives that you have to achieve prior to a discharge to your home.

For the surgical procedure, most patients benefit from the use of a mini-dose spinal anesthetic with supplementary intravenous sedation. The sedation ensures a lack of awareness of the procedure. At the end of the procedure, a fully awakened state is rapidly restored.

Potential Complications with Nerve Blocks

1. Systemic toxicity. If the local anesthetic is injected as a large quantity into a vein, it can go to the heart and brain to provoke a stoppage of the heart (cardiac arrest) and/or a seizure. To avoid these complications, the local anesthetic is injected as a small amount at a time and after verifying by aspiration that no blood returns to the syringe.
2. Injury to a nerve. The medication can produce persistent numbness and muscle paralysis. These complications are rare. In most such cases the nerve function recovers within weeks or months. Infection or a hematoma (bleeding around a nerve) is a rare complication of a nerve block procedure.

Surgery

After the preoperative evaluation and preparation, you are transported to the operating room for the surgical procedure. A spinal anesthetic is performed, typically while you are in a sitting position.



Most patients choose to have spinal anesthesia.

Then, you are repositioned on your back and given a sedative to rest comfortably during the procedure.



You receive sedation for comfort during surgery.

While the total knee replacement takes about one hour, you are in the Operating Room for 1.5-2.0 hours, including the spinal anesthetic and the preparation for transportation to the Recovery Room.

Post-operative Activities

At the end of the surgery you are transferred to the Recovery Room for a minimum period of two hours. After the procedure, Dr Mears meets with your available family members and friends in the Waiting Room. The family members and significant others are urged to be in the Family Waiting Room for this discussion.

Subsequently, you are transferred to a special ward, 2 Pavilion (2PAV), which is designed for intensive physical therapy. Ideally, you undergo two or three therapy sessions on the day of the procedure. The objectives of the sessions include the ability to transfer from the bed to a chair, to walk with a walker, crutches or a cane and to perform bending and strengthening exercises for the knee and leg. If you have difficulty to bend your knee, a continuous passive motion machine (CPM) may be used to facilitate the flexibility of

the joint.

Post-operative Medications and Therapy

Several medications are given before, during, and after the knee replacement to minimize the risk of complications. Antibiotics are given to minimize the risk of a wound infection. Antiemetics are given to lessen the likelihood for postoperative nausea. Usually, one 81 mg tablet of aspirin is given twice daily for a four-week period to minimize the risk of a post-operative blood clot. If a patient possesses an exceptional risk for a blood clot or if he/ she regularly takes a blood thinner such as Coumadin, Xarelto, Eliquis or Plavix an alternative medication, other than aspirin, may be given. For a control of pain, both oxycodone and Tylenol are used. If you have an allergy to oxycodone, a suitable alternative medication is used. Prior to your discharge from the hospital, a concierge service, “Meds to Beds”, is available to bring your medications for use at home to your room. The service provides a seven-day supply of pain medications. The service ensures that if you were to arrive at your home after the local drug store is closed, you would have the appropriate medications.



After surgery, a pump is connected to your nerve block catheter.

As the therapy sessions progress, you are encouraged to advance from a walker to crutches or a cane. You can place all of your weight on the operative leg. You will walk progressively longer distances and practice climbing stairs.



Initially, you will walk with a walker.

The therapists provide devices to help with activities of daily living, such as the application of socks.



Criteria for Discharge to your Home

Before your discharge, you have to be able to walk substantial distances, equivalent to your home environment. You have to be able to climb stairs to the degree that is needed in your home. Your pain has to be well controlled. You have to be eating and drinking and passing urine. All other medical considerations have to be stable.

Our PAC, Liz Hollins, will meet with you to confirm your completion of these objectives and discuss your appropriate activities after the return to your home.

As therapy progresses, you will switch to two crutches or a cane.

You need to have made plans for a ride to your home for whenever the discharge is arranged. At home, you need to have arranged for someone to assist you for at least a part of the day and at night for a minimum of one week. The individual should be able to assist with shopping for groceries and other provisions, along with washing clothes or other activities. You will be unable to drive after a right knee replacement for **THREE WEEKS** and after a left knee replacement for at least one week. Suitable alternative arrangements need to be made in advance of the surgery. In previous years, if these arrangements were not available, your health insurance provider would fund your transfer to a skilled nursing center (SNC) for a temporary period. At present, the insurance carriers are increasingly reluctant to cover this expense. Unless there are unusual circumstances, you need to have made arrangements to return to your home after the surgery with the appropriate assistance.

Activities at Home and Continuation of Physical Therapy

As soon as you return to your home, you make arrangements to start outpatient therapy three times weekly for eight weeks. The therapy plays a critical role for the rehabilitation of your knee including the restoration of the bend and straightening along with the return of normal strength of the leg. While home therapy is a potential alternative, the home environment does not provide valuable resources such as a stationary bicycle and weights or weight machines. The outpatient therapy is somewhat uncomfortable but an essential contributor to a successful outcome of the surgery. One month after the surgical procedure, you will have an evaluation with Dr Mears to assess your progress and to review x-rays of your knee replacement. The objectives of therapy will be reviewed along with your progress.

After the formal therapy is completed, you are encouraged to join a health club or a comparable facility to continue a regular exercise program for a year after the surgery. The appropriate activities include the use of a stationary bicycle, a treadmill and weight machines.

Swimming is another potential supplementary activity. The exercising is necessary to restore the strength of the thigh muscles that atrophied during the progression of the arthritis.



About one month after surgery, you can resume daily walks.

Resumption of Driving

For a safe resumption of driving, it is critical that you be effectively in control of the vehicle. Otherwise, in the event of an accident, you may not have coverage provided by your insurance carrier. As a reasonable guideline, for a procedure on the right knee, the resumption of driving is deferred for **THREE WEEKS** after the surgical procedure.

After an uncomplicated post-operative recovery from a left knee, driving can be resumed one week after surgery, provided that you can enter and sit in the vehicle without difficulty.

Return to Work

The time for a return to a regular job depends upon several factors, including the degree of physical activities that are necessary to perform the position. Another critical factor is whether you are permitted to start on a part-time basis and progressively return to a full-time capacity. Another major factor is the presence or absence of other medical problems, including another major arthritic joint. Still another factor is travel to the job and your capability to drive or to have alternative travel arrangements. If you are a sedentary worker in an office, a part-time return to the job within a week may be feasible. A full-time performance may be reasonable within two to four weeks. If the job involves heavy labor, a more prolonged deferral is anticipated. If the position involves walking and climbing stairs along with carrying objects of up to twenty-five pounds, a deferral of about two months after the surgery is likely. If the position involves strenuous activities including the climbing of ladders, working in awkward positions and carrying heavy loads, a deferral of at least two to three months is likely.

How to Address a Post-operative Problem

After any surgical procedure, some type of medical problem may arise. While most of the issues are minor, a suitable plan to address the situation is needed. Within a few days after a return to your home, you may elect to undertake extensive activities so that your operative knee becomes painful and fails to resolve rapidly. If you “overdo activities”, this situation may follow. At this stage, the appropriate recourse is to markedly reduce your activity level and to take one of the pain pills that were prescribed when you left the hospital. If you are concerned about the severity of the pain, then call the office to explain the situation. During weekdays from 8am to 4 pm, you can talk to Michelle Phillips to discuss the situation. If necessary on a weekend or evening, you can discuss the problem with a surgeon on call for GPOA. The surgeon will not be familiar with you or your surgery. If possible, a discussion with Michelle is preferable. Other problems that may be addressed by Michelle include: drainage or discoloration of an incision, calf pain, numbness of the thigh or a difficulty with your exercises.

When you depart from 2 PAV, you are provided with post-operative instructions. The document includes a phone number for the ward as a potential way to contact a nurse who would be familiar with your post-operative recovery and able to advise you. Usually, you are unable to discuss your concerns with a nurse who can provide useful information. A call to Michelle is more likely to resolve the concern.

Certain issues, such as an abnormally high or low blood pressure, are best addressed by your family physician (PCP). If your medications for diabetes mellitus are failing to optimize your blood glucose level, your PCP should be alerted. Rarely, a true medical emergency arises, such as severe chest pain or shortness of breath. Likewise, a fall that culminates in severe hip or leg pain and an inability to walk merits a prompt assessment in an emergency room. Historically, an assessment in

an ER was widely undertaken to undergo an evaluation for widely diverse post-operative problems. Overall, apart from a serious medical emergency, this site is inappropriate for an evaluation of a minor issue. The medical staff at the ER is unfamiliar with your surgical procedure. Health insurance companies are concerned about this costly means to undertake an evaluation. Recent changes in insurance policies dictate that your insurance company will review such an evaluation. If the assessment concludes that the assessment in the ER was unnecessary, you will be financially liable for the cost of the ER visit.

Potential Complications

To some degree, all of the complications that have been reported for a traditional total knee replacement pertain to a quadriceps sparing procedure. This limited review is of insufficient length to present complications that have been all of the reported after total knee replacement, including many uncommon ones. Currently, there is no statistical evidence to indicate that the complication rates after a traditional and a quad sparing procedure are materially different. A post-operative wound infection is an uncommon and yet potentially serious complication. The treatment may include a surgical cleansing (debridement) of the knee, along with appropriate and generally intravenous antibiotic therapy. Occasionally, it necessitates the surgical removal of the implants and the insertion of a so-called cement spacer, impregnated with a potent antibiotic. Usually, after a period of months, the total knee replacement can be reinserted by resorting to a traditional open procedure.

While general and spinal anesthetics are quite safe and minimize the risk of a serious complication, no surgical procedure, including the anesthetic technique, is wholly safe and free from the risk of a potential problem. Many of the risks pertain to rare events. One example is the risk of injury to a major blood vessel. After every total knee replacement, the skin on the outside of the incision is numb to a variable degree. Over a

subsequent period of about two years, the size of the numb patch shrinks and may vanish. Routinely, a sensory nerve crosses the path of the incision and has to be severed, thereby to account for the post-operative numbness. An injury to a larger nerve is unusual, although, rarely, after a knee replacement, a foot drop, including numbness of the lower leg and foot, may ensue. This problem is most likely to arise where the arthritic knee possesses a “knock-knee” or genu valgum deformity, which is corrected as part of the knee replacement. The peroneal nerve is vulnerable to a stretching injury. The likelihood for a substantial but potentially incomplete spontaneous recovery is favorable.

Despite the use of prophylactic anticoagulants or “blood thinners,” a deep venous thrombosis (DVT) or a pulmonary embolus (PE) may occur. The latter complication is an extremely rare source of fatality. Certain medical conditions are recognized that greatly increase the post-operative risk for a DVT/PE. No known prophylactic regime is wholly successful to prevent these problems. As a routine anti-coagulant, we prefer to use enteric-coated aspirin, which is simple to use and requires no monitoring blood tests. Also, the use of aspirin is unlikely to culminate in excessive bleeding into the knee joint, a complication, which more frequently follows the use of other available anticoagulants. After a total knee replacement, despite intensive physical therapy, the amount of flexion of the knee that is achieved is highly variable. Typically, a favorable outcome culminates in full straightening or extension, with further flexion beyond a right angle, or 90° , potentially to about 125° . Occasionally, the knee fails to bend to a right angle or to fully straighten (a fixed flexion contracture). Following the surgery, if a patient spends prolonged periods in bed with a pillow under the knee that prevents the knee from straightening completely, the risk of a fixed flexion contracture (FFC) is greatly increased. Another source of an FFC occurs when the knee is filled with blood (a hematoma). Also, a lack of appropriate therapy can contribute to the problem. Despite intensive therapy and the

absence of any demonstrable problem, spontaneous stiffness of the knee may occur. A contributing factor to its occurrence is a failure to undergo intensive physical therapy after the surgical procedure. This problem (arthrofibrosis) may be difficult or impossible to fully correct. If arthrofibrosis of the knee with less than 90° of flexion is documented at a period of eight weeks after the surgery, a manipulation of the knee under general anesthesia is usually recommended.

Occasionally after a knee replacement, the kneecap (patella) possesses a tendency to partly or completely displace, usually to the outside of the knee. The problem is most likely to arise in a short, obese woman, or in someone who possesses unusually lax joints (loose jointedness). Another problem after a knee replacement occurs when the knee begins to lock spontaneously and intermittently. The most likely source of the complication is when a small fragment of bone cement or a bone chip becomes interposed in the knee joint.

Whenever a manmade device is utilized in the body, the potential for a premature “wearing out”, breakage or loosening arises, a problem shared with the use of all other manmade devices, such as a car, television or a computer. Where a patient is of a younger chronological age, and thereby possesses a longer life expectancy, this consideration becomes a greater concern. If such a problem does arise, a surgical revision may be needed to address the situation. After a total knee replacement in a young adult, eventually some type of surgical repair or revision procedure is highly likely to be necessary. Certain activities such as jogging, combative sports and falls from a height, immeasurably increase the likelihood for a premature failure. For this reason, after a knee replacement, these activities are discouraged in a life-long way.

Special Circumstances

If a patient has a prolonged exposure to potent, pain-killing medications (codeine, opioids) or recreational drugs and occasionally other agents prior to a total knee replacement, the response of the body to various therapeutic agents that control postoperative pain can be markedly altered. This factor may apply even if the patient had a prolonged abstinent period between exposure to the drugs and the time of the surgical period. In this event, the post-operative pain may be difficult to control, and the relief of post-operative pain may not be nearly as complete. The essential postoperative therapeutic exercises may be accompanied by considerable pain so that the activities cannot be as effectively performed. The ultimate clinical outcome may be markedly compromised and inferior to the normal outcome. If such a situation could apply to you, a preoperative discussion with Dr. Mears is strongly recommended.

Prior to a knee replacement, a patient's family members or friends may recognize features of a mild dementia in the patient. Dr. Mears and his team should be made aware of this situation. After the surgical procedure, in the presence of a strange hospital environment, the exposure to anesthetic agents and other medications, the behavioral changes are likely to become much more marked, including confusion and mood changes. In turn, the patient's ability to perform the therapy may be impaired so that the ultimate clinical outcome is heavily compromised. If these possible problems are recognized prior to the surgery, some preventive measures may be undertaken. After the surgery, with the assistance of the Social Services Department, our therapists can recommend that you be transferred to a skilled nursing center or an in-patient rehabilitation facility for additional intensive therapy. This situation is most likely to arise for patients more than 80 years of age, or in the presence of multiple medical problems, including multiple arthritic and impaired joints or dementia.

Special arrangements may be organized to optimize the environment for the early convalescent period.

For additional information about the procedure, or to arrange for an appointment, call or email Michelle Phillips (tel. 412-661-5500 or michellephillips@gpoa.com)