



Penn Medicine

PENN ORTHOPAEDICS

FREE VASCULARIZED FIBULAR GRAFT SURGERY

PATIENT HANDBOOK





A MESSAGE FROM

L. SCOTT LEVIN, MD, FACS

Chair, Department of Orthopaedic Surgery



Thank you for your interest in free vascularized fibular graft (FVFG) surgery at Penn Orthopaedics. This booklet provides a wealth of information about FVFG, a microsurgical procedure pioneered in the 1970s by Dr. James Urbaniak at Duke Medical Center. I am proud now to bring this exacting and intricate surgical technique to Penn Medicine, home to the nation's first department of orthopaedic surgery. Penn Orthopaedics is currently the only medical center in the region offering free vascularized fibular graft surgery and other complex microsurgical operations.

The following pages contain information for prospective patients and their care providers regarding the condition the surgery was designed to treat—osteonecrosis of the femoral head—as well as pre- and post-operative questions frequently asked about this procedure.

Sincerely,

A handwritten signature in blue ink that reads "L. Scott Levin". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

L. Scott Levin, MD, FACS

Chair, Department of Orthopaedic Surgery
Paul B. Magnuson Professor of Orthopaedic Surgery
Professor of Surgery, Division of Plastic Surgery

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ABOUT OSTEONECROSIS

The majority of individuals requiring free vascularized fibular grafting surgery have a rare condition known as osteonecrosis (literally, bone death). To understand osteonecrosis, it is important to know that:

Osteonecrosis is a disease that destroys bone

Osteonecrosis is a condition in which the bone dies after losing its blood supply. The elements of healthy bone include cellular and soft tissue components that are nourished by a network of small blood vessels. When these vessels are damaged or blocked for any reason, osteonecrosis occurs. Osteonecrosis is progressive and will eventually cause collapse of the bone.

Osteonecrosis happens at or near joints

Osteonecrosis usually affects the bones at or near a joint. The most common site for osteonecrosis is the head of the femur, the part of the long bone at the thigh that fits into the hip. It is common for osteonecrosis to happen in both femurs at the same time. Less common sites for osteonecrosis include the elbow, wrist and knee.

Osteonecrosis primarily affects younger, active men for unknown reasons

Every year, between 10,000 to 20,000 Americans develop osteonecrosis; most are between the ages of 20 and 50 years, and most are men. The origin of osteonecrosis in this population is not completely understood, though a number of likely causes have been proposed. These include factors that promote excessive fat in the blood (blocking the tiny vessels in the bones) such as excessive use of alcohol and steroids, and Gaucher's disease; certain medications known to weaken bone; radiation; chemotherapy; dialysis; sickle cell anemia; and trauma. Despite these known risk factors the most common etiology is idiopathic or unknown.

Surgery is an effective treatment for osteonecrosis

Surgery to remove dead bone is the most effective treatment for the condition. For patients with mild-to-moderate osteonecrosis, options may include core decompression and bone grafting, a surgery that removes dead bone and replaces it with a live bone graft .

For patients with late stage osteonecrosis, total hip replacement (THR) is the standard treatment. THR eliminates the site of the osteonecrosis entirely, replacing the dead bone at the hip with an artificial ball and socket.

Penn Orthopaedics is now offering another option for the treatment of osteonecrosis, free vascularized fibular grafting or FVFG.



ABOUT FREE VASCULAR FIBULAR GRAFTING AT PENN

Penn Medicine is among the few medical centers nationwide to offer free vascularized fibular grafting

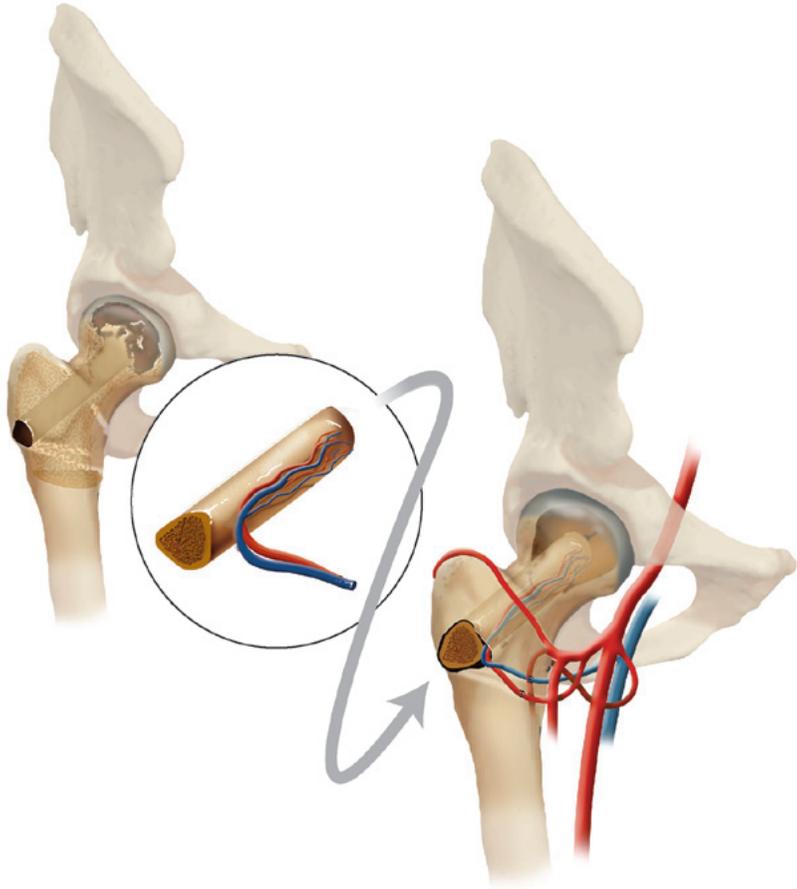
Free vascularized fibular grafting (FVFG) is a microsurgical procedure that replaces dead bone with viable, structurally sound, vascularized bone grafted from a patient's own fibula. A microscope is then used in the operating room to connect blood vessels at the native hip to the grafted bone. This process provides an immediate blood supply to the femoral head that sustains the bone, halting the progression of osteonecrosis.

Candidates for the procedure must be younger than 50 years

At Penn Medicine, FVFG surgery is available as an alternative to total hip replacement for patients suffering from osteonecrosis who are younger than 50 years of age. A number of other factors may also be used to assess candidacy for FVFG at Penn. To determine whether you are a surgical candidate for the procedure, you or your orthopaedic surgeon may contact Penn Orthopaedics at 215.662.3340. Following an evaluation at Penn, individuals found to be candidates for the free vascularized fibular graft procedure and their referring surgeons will be contacted.

FVFG is performed at Penn by surgeons trained in orthopaedics and microsurgery

The unique skill set required to perform FVFG surgery limits the number of hospitals that can offer the procedure. At Penn, L. Scott Levin, MD, FACS directs the FVFG surgical program. Chair of the Department of Orthopaedic Surgery at Penn, Dr Levin is the current president of the World Society of Reconstructive Microsurgery and the past president of both the American Society for Reconstructive Microsurgery and the American Society For Reconstructive Transplantation.



During FVFG surgery, a section of the fibula with attached artery and veins is harvested and transferred to the femoral head, which has been cored out to remove dead bone. The vessels in the fibular section are then microsurgically joined to vessels in the hip.

FVFG SURGERY AT PENN

Pre-Surgery Timeline

The preparation for surgery at Penn Orthopaedics begins in the weeks before the procedure. Some preparatory steps, including the discontinuation of certain supplements and medications, occur on a set schedule:

TWO WEEKS BEFORE SURGERY

The following supplements are discontinued (if applicable)

- Alpha-omega
- Fish oil
- Vitamin E

ONE WEEK BEFORE SURGERY

The following medications are discontinued (if applicable)

- Aspirin and aspirin products
- Anti-inflammatory medications (including ibuprofen)
- Anticoagulants (blood thinners)
- Immunosuppressants (methotrexate, CellCept®, Plaquenil®, etc.)

Other components of the preparation for surgery will be scheduled for a time in the days and weeks prior to surgery, including X-rays and MRI imaging to evaluate the extent of osteonecrosis. A physical examination and lab tests will be performed as part of the pre-admission work up.

Scheduling Surgery

Surgery will be scheduled after the results of the physical examination, laboratory tests and imaging have been evaluated by the operating surgeon. The scheduling secretary will contact patients to determine the date of surgery at Penn.

AFTER FVFG SURGERY AT PENN ORTHOPAEDICS

IN THE HOSPITAL

The total length of the hospital stay for FVFG surgery is usually three to four days, including the day of surgery. Discharge usually occurs on the third day following surgery; if the surgeon recommends a later discharge, the hospital stay may be longer.

A number of procedures have been established at Penn Orthopaedics to provide an optimal outcome in the immediate aftermath of FVFG surgery:

- Following FVFG surgery, anticoagulants (blood thinners) are administered to prevent blood clots and enhance blood flow to the graft.
- On the day after surgery, physical therapy is initiated to guide the patient in crutch-walking and muscle-strengthening exercises and the patient receives counseling on activities to limit during the recovery period.

AFTER DISCHARGE

Dressings

Patients should use the dressing material provided at the time of discharge from the hospital. Those patients who receive a plastic drain tube during surgery (typically accompanied by a clear plastic dressing where the drain exits the skin) should be aware that it is not unusual for small amounts of fluid to collect at this area. A log should be kept on the amount of drainage each day.

Wound Care

Surgical incisions should be kept clean and dry. Surgical dressing can be removed on the day following the return home. If any concerns arise about the appearance of the incisions, including drainage or redness at the incision site, the surgeon's office should be contacted immediately.

Showering may be resumed when there has been no drainage for at least 48 hours or at seven days post-surgery. Washing over the incision should be performed gently, with warm sudsy water, followed by rinsing with clear water, and a pat dry. Incisions may be left open to the air or re-covered with clean, dry dressing. Wet dressings should be removed and the incisions cleaned before a dry dressing is reapplied.

Creams or ointments should not be applied to the incision until Steri-Strips are removed between 10 and 14 days following surgery.



RECOVERY FROM FVFG SURGERY

PHYSICAL AFTER-EFFECTS OF SURGERY

A number of physical effects are to be anticipated following FVFG surgery. These include:

Swelling

Postoperative swelling at or close to the surgical site is common following a free vascularized fibular graft procedure. As activity levels increase, swelling will occur below the area of surgery, as well, in the lower leg and foot. Swelling is usually greatest at the end of the day.

Elevating the operated leg three to four times a day for 20 minute intervals will help reduce swelling. This may occur in bed, with the leg resting on pillows. If swelling is persistent and pain does not decrease with elevation, the surgeon or primary care physician should be contacted immediately.

Constipation

Constipation is common following surgery as a result of decreased activity and fluid intake and the use of narcotic pain medications. A stool softener is administered to patients following FVFG surgery, and should be taken as directed. Dietary measures, particularly a diet high in fiber and roughage will help reduce constipation. Attention to fluid intake to ensure adequate hydration is also important. If necessary, a mild laxative may be used.

Fever

Low-grade fever is a common after effect of major surgery, and may last up to ten days. Persistent fever above 101.5°F with pain, irritation of the incision, urinary burning or a productive cough should result in a call to the surgeon's office.

Bone Fragility

In the short-term, FVFG surgery results in substantial weakening of the surface of the femoral head and the femur, which is 80% weaker following surgery.

WEIGHT-BEARING DURING RECOVERY

Individuals who have had FVFG surgery should understand the concept of weight-bearing and the importance of the proper use of crutches during recovery.

Please note that following FVFG surgery at Penn Orthopaedics:

- Weight-bearing is prohibited during the first 12 weeks post-surgery.
- Partial weight-bearing as defined by the surgeon is permitted during the next 12 weeks.

The progression to full, unassisted weight-bearing depends upon a number of factors, including stage of avascular necrosis; whether both hips are affected; follow-up x-rays; and symptoms.



RECOVERY TIMELINE

AFTER 1 WEEK

Showering (if no drainage at incision site for the preceding 48 hours)

AFTER 4 WEEKS

Bathing

AFTER 3 TO 6 MONTHS

Walking without crutches

Partial weight-bearing as determined by surgeon

AFTER 2 WEEKS

Travelling outside the home

First post-operative visit

AFTER 6 WEEKS

Second post-operative office visit

Non weight-bearing

Return to driving

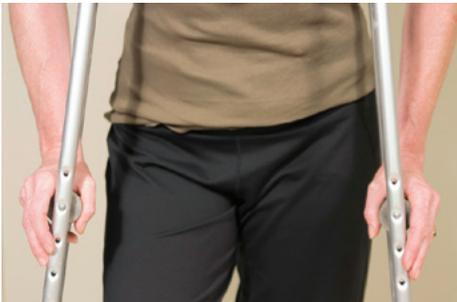
CRUTCH USE IN WEIGHT-BEARING AND RECOVERY

The Correct use of Crutches

Crutches are an essential part of the post-surgical experience because they help patients stay within the limits placed on weight-bearing by their surgeons. Any weight above these limits can cause collapse of the femoral head.

Improper use of crutches can be uncomfortable and hazardous. The following guidelines have been designed to ensure optimal crutch use during the post-surgical recovery period.

- Crutch length is critical to comfort and safety. The proper crutch length is established by placing the crutch three inches below the armpit, or axilla, when the user is standing at full height.
- When properly adjusted, the bottom of the crutch should be two inches to the side and six inches in front of the foot.
- The handle at mid-crutch should not permit the elbow to flex beyond 30°.
- To avoid damage to the nerves and blood vessels of the shoulder, the axillary bar should not be used as the primary support during crutch use; body weight should be supported by the hands at mid-crutch.



Crutch Use Precautions

Proper care of crutches and precautions in the home are encouraged to prevent slips and falls during crutch use.

- Throw rugs should be put away until crutches are no longer being used in the home.
- Rubber crutch tips should be checked for gravel or other debris when entering the home to avoid slips.
- Crutch tips should be inspected and replaced before the gripping pattern wears away or the concave surface flattens. Tips with cracks or splits on the side should also be replaced.
- Caution should be taken whenever moving from one floor surface to another in the home (i.e., tile to carpet).
- Crutches should not be discontinued until the surgeon determines that it is safe to do so.

Other Options for Walking

For some individuals, walkers and/or wheelchairs offer greater stability in the home. The progression with weight-bearing remains the same with walkers. Wheelchairs at work or around the home are often preferred after having surgery on the second hip.

Canes may be used as an assist when full weight-bearing has been achieved. Although it may seem counterintuitive, the cane should be held in the hand opposite the operated leg. The cane and operated leg should move together; it is very important that the handle be comfortable.

FOLLOW-UP AT PENN ORTHOPAEDICS

At Penn Orthopaedics, follow-up office visits are scheduled at the time of discharge from the hospital and at subsequent office visits.

All free vascularized fibular graft patients require lifetime x-ray surveillance. Following FVFG surgery at Penn, AP pelvis and frog leg lateral x-rays will be obtained at six weeks, three months, six months, one year, and every year thereafter.

Follow-up with Referring Orthopaedic Surgeons

If follow-up visits are performed by a referring orthopaedic surgeon, weight-bearing instructions and gait training should be scheduled at six weeks. AP pelvis and frog leg lateral x-rays are obtained at three months, six months, and yearly. After the six-month visit, the surgeon should send a summary letter and x-rays to Penn Orthopaedics for review. It is the practice at Penn Orthopaedics to review all x-rays and to correspond by letter with the referring surgeon and patient as soon as possible.

SECOND SURGERY

For individuals with osteonecrosis in both hips, surgery may be performed on the second hip within 3 months of the first surgery. Adding swimming, aquatic exercises, and/or stationary biking three times a week in the weeks preceding the second surgery can prove beneficial as a preparation for surgery on the second side.



FREQUENTLY ASKED QUESTIONS

QUESTIONS ABOUT FVFG SURGERY

1. What is the advantage of having a free vascularized fibular graft?

The advantage of FVFG surgery is that it uses an individual's own tissue to correct a condition that would likely require an artificial joint. Because the graft is not from a donor, there is no fear of rejection and no need for immunosuppression. In addition, because free vascularized fibular grafting replaces dead bone at the hip with viable, structurally sound, vascularized bone from the fibula, the procedure can halt the progression of osteonecrosis and restore the bone to its previous state of health.

2. Is FVFG an experimental procedure?

FVFG surgery has been performed in the United States since the 1970s and is not considered an experimental or investigational procedure.

3. How long can the decision regarding FVFG surgery be delayed?

Osteonecrosis will usually progress within 20 months of initiation, and has been observed as early as one month after diagnosis.

4. If I have osteonecrosis in both hips, can both be operated on at the same time?

In general, after performing one vascularized fibular graft and the unoperated hip is symptomatic then the second hip surgery is three months later.

5. How long does the surgery take?

The surgical procedure alone lasts approximately four hours. Patients are under anesthesia for approximately five hours.

6. What happens to the fibula after the graft is removed?

Fortunately, the fibula bears minimal weight. Its primary purpose is to act as a strut for muscle attachment. During FVFG surgery, the middle portion of the bone is removed leaving the top and bottom to the bone without change. There is no change in the appearance of the lower leg except for the incision on the outside of the leg.

QUESTIONS ABOUT THE HOSPITAL EXPERIENCE

1. What is the process to get admitted for surgery at Penn Medicine?

On the day prior to surgery, patients will need to confirm pre-surgery arrival time by calling a phone number provided by the hospital for this purpose. On the day of surgery, patients will be admitted through the operating room.

2. Are visitors permitted?

Family members (limited to two) may accompany the patient to the preoperative holding area and will then be instructed to wait in the family waiting area. The surgeon will speak to family members after the procedure.

3. What should patients bring to the hospital?

Patients may bring personal items and toiletries, as well as pajamas to wear a day or two after surgery. Generally, a hospital gown is preferred immediately after surgery. A pair of comfortable flat shoes is also recommended. Some personal prescription medications may be brought from home, but will be administered in the hospital by staff members. Large amounts of money and jewelry should be left at home. No jewelry is permitted in the operating room.

QUESTIONS ABOUT POST-SURGERY

1. How often must someone who has had FVFG surgery return to Penn for follow-up?”

Individuals having FVFG surgery at Penn are asked to return one year after surgery. Local or referring physicians may perform examinations at six weeks, three months, and six months. In addition, after visiting Penn one year after surgery, the individual can go to their local physician for annual examinations.

2. What kind of physical therapy is required following FVFG surgery?

Physical therapy is only necessary while in the hospital. Beginning at 6 weeks post-surgery, swimming and stationary bicycling are highly recommended.

3. What medications are required postoperatively?

Anticoagulants, aspirin and Lovenox are given postoperatively. Lovenox is administered while in the hospital. Aspirin is taken for six weeks postoperatively. Prophylactic antibiotics are given for FVFG surgery before and 24 hours following surgery.

If needed, pain medicine may be continued for one to two weeks following surgery. After discontinuing the prescribed pain medicine, acetaminophen (Tylenol) is recommended for pain control. Patients unable to take acetaminophen may use other over-the-counter pain medicines.

Routine medications will not resume until approval by the patient’s surgeon. Medicines for immunosuppression (methotrexate or CellCept®) or medicines that may increase bleeding (including NSAIDs and aspirin) are included in this group. Additional variations in the postoperative medication schedule will be discussed at discharge and are dependent on individual clinical history.

QUESTIONS ABOUT RECOVERY

1. How long does it take to recover from FVFG surgery?

The recovery period for any surgery depends on the individual. Some patients having FVFG feel a return to health and strength within a week of surgery; for others, recovery may take four to six weeks following surgery.

2. Are any special devices required in the home during recovery?

Patients will need crutches or a walker as determined by a physical therapist on an individual basis. Patients who already have crutches or a walker may bring these to the hospital on the day of surgery where they will be assessed by a physical therapist for safety. Optional durable goods for home use include a wheelchair, an elevated toilet seat, handrails around the toilet, and a tub seat. The discharge planner will assist patients with any special needs.



PERFORMING MICROSURGICAL FREE VASCULARIZED FIBULAR GRAFT SURGERY AT PENN MEDICINE

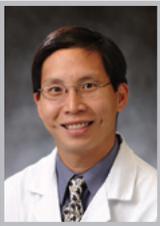
Faculty Team

The country's first department of orthopaedic surgery and a national leader in National Institutes of Health (NIH) funding, Penn Orthopaedics offers advanced, personally-tailored care and the latest treatment options for a variety of injuries and disorders within ten orthopaedic subspecialties. In addition to orthopaedic procedures, the collective skills of Penn's orthopaedic specialists include microsurgery, nerve and tendon transfer and reconstructive transplantation.



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PATIENT STORY

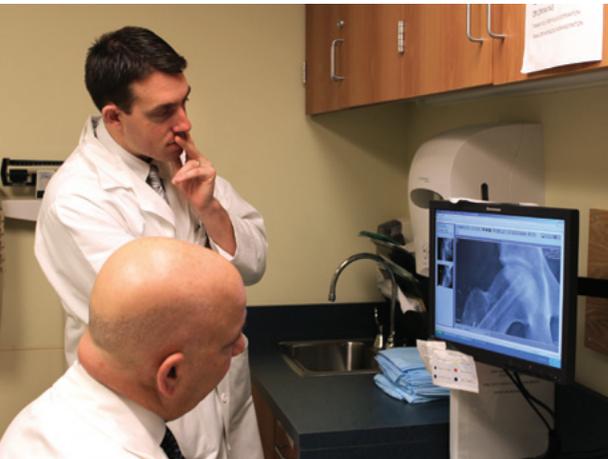
Adam, a 26 year old Penn Medicine patient, started experiencing hip pain in his final days as a law school student. With the bar exam just months away, he pushed the pain out of his mind and focused on his studies. Sometime later, as the pain got worse and walking became difficult, Adam sought help from an orthopaedic specialist. Upon his visit, X-rays and an MRI confirmed Adam was suffering from bilateral osteonecrosis, also known as avascular necrosis.

“By the time I saw a specialist, I was walking with a limp,” he said. “My MRI showed the necrosis in both of my hips had advanced beyond the point where the typical therapeutic procedures would help so I started looking into my options. I didn’t want to get artificial joints that would wear out in 15 to 20 years, but my options were limited. Then, I heard about FVFG.”

Adam underwent FVFG surgery on his right hip and then followed that with his left hip 7 months later. After a period on crutches, he began weight-bearing exercises and the process of gaining strength. “Dr. Levin and Dr. Lee were great. They were very open about the procedure,” Adam said. Despite the lengthy recovery, particularly when compared to the six weeks it typically takes

patients to recover from a total hip replacement, Levin says in the long-run the FVFG procedure will be worth it.

“His own hip regenerated with a fresh blood supply, eliminating the need for total hip replacement procedures,” Levin said. “Had he chosen hip replacement with artificial joints, his initial recovery time would have been shorter, but it’s likely he would have needed multiple hip replacement revisions over the course of his life to replace the worn out joints.”



L. Scott Levin, MD, FACS (bottom left) reviews post-operative FVFG images at Penn Orthopaedics with his fellow.



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