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Anterior Flap Hemipelvectomy

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OVERVIEW

The anterior flap hemipelvectomy is a modified version of the classical posterior flap hemipelvectomy. Instead of utilizing the traditional posterior skin flap of the gluteal region, a myocutaneous flap from the anterior thigh is used to close the peritoneum following amputation through the sacroiliac joint and the pubic symphysis. This modification has permitted the treatment of difficult buttock and pelvic tumors where the posterior flap was involved and/or contaminated by tumor. This technique offers patients, initially thought to be incurable by standard technique, a good oncological procedure. The anterior myocutaneous flap consists of a portion or the entire quadriceps muscle group on its vascular pedicle, the superficial femoral artery. This flap covers the entire peritoneal surface and generally heals with minimal problems.

INTRODUCTION

Patients with extensive soft-tissue sarcomas of the buttock or bone sarcomas of the pelvis that extend posteriorly, once thought to be incurable by standard posterior flap hemipelvectomy, can often be treated with an anterior flap hemipelvectomy (Figure 19.1). The procedure, which originally entailed use of an anterior skin flap raised off of a portion of the superficial femoral vessels,[1] was later modified to include a full-thickness myocutaneous flap raised from the anterior thigh.[2,3] This procedure may also be indicated following failed attempts at limb-sparing surgery,[4] as well as for patients with nononcologic indications for amputation (e.g. uncontrollable sepsis from sacral or trochanteric osteomyelitis). The major advantage of anterior flap hemipelvectomy is the creation of a large vascularized myocutaneous flap that is ideal for closure of significant posterior defects. As much of the anterior thigh compartment may be saved as needed, depending on the size of the defect being closed. As always, careful patient selection is critical in ensuring that an acceptable outcome is achieved. For example, elderly patients and diabetics with silent atherosclerotic disease of femoral vessels must be carefully evaluated with preoperative angiography. The suitability of this procedure may also be limited by the anatomic location of the tumor.

CLINICAL CONSIDERATIONS

Sugarbaker[3,6] and others[1–5,7–9] have shown the utility of a myocutaneous pedicle flap based upon the femoral vessels and anterior compartment of the thigh for closure of the wound in patients with tumors involving the posterior buttock structures (Figure 19.2). This procedure has been termed an "anterior flap" hemipelvectomy to distinguish it from the more common "posterior flap" hemipelvectomy. Anterior flap hemipelvectomy is indicated for tumors involving the buttock that cannot be resected with a less radical procedure. Patients who have failed prior attempts at limb-sparing surgery, with or without radiation, or who have tumors that primarily involve the posterior thigh and sciatic nerve, are also candidates for this procedure (Figure 19.3). Nononcologic indications include selected paraplegics with uncontrollable chronic osteomyleitis of the pelvis and/or hip joint. The primary advantage of this procedure in all of the above cases is that the anterior flap raised from the thigh can be used to reconstruct an enormous posterior defect with little risk of flap necrosis. Patients who are expected to require substantial doses of radiation postoperatively should be considered for this procedure whenever possible, since the well-vascularized myocutaneous flap tolerates radiation well.

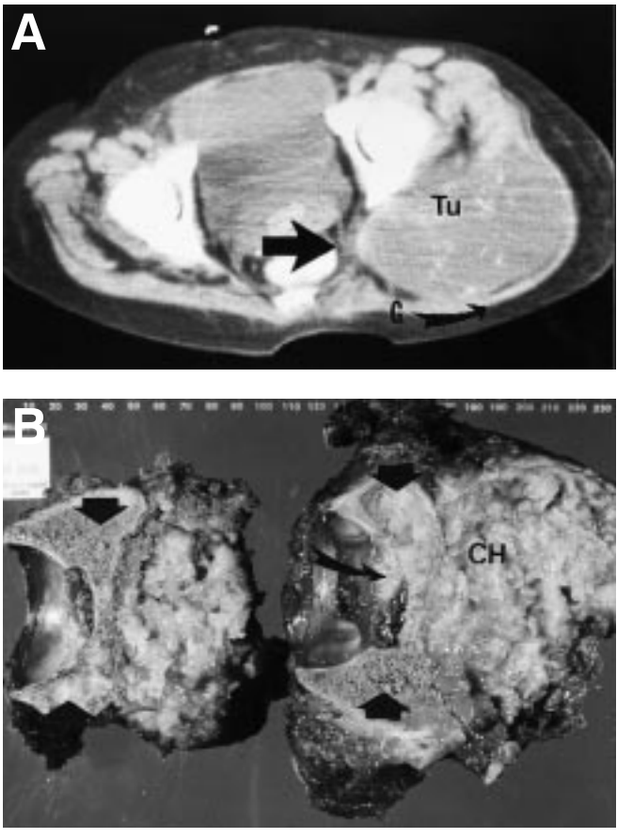
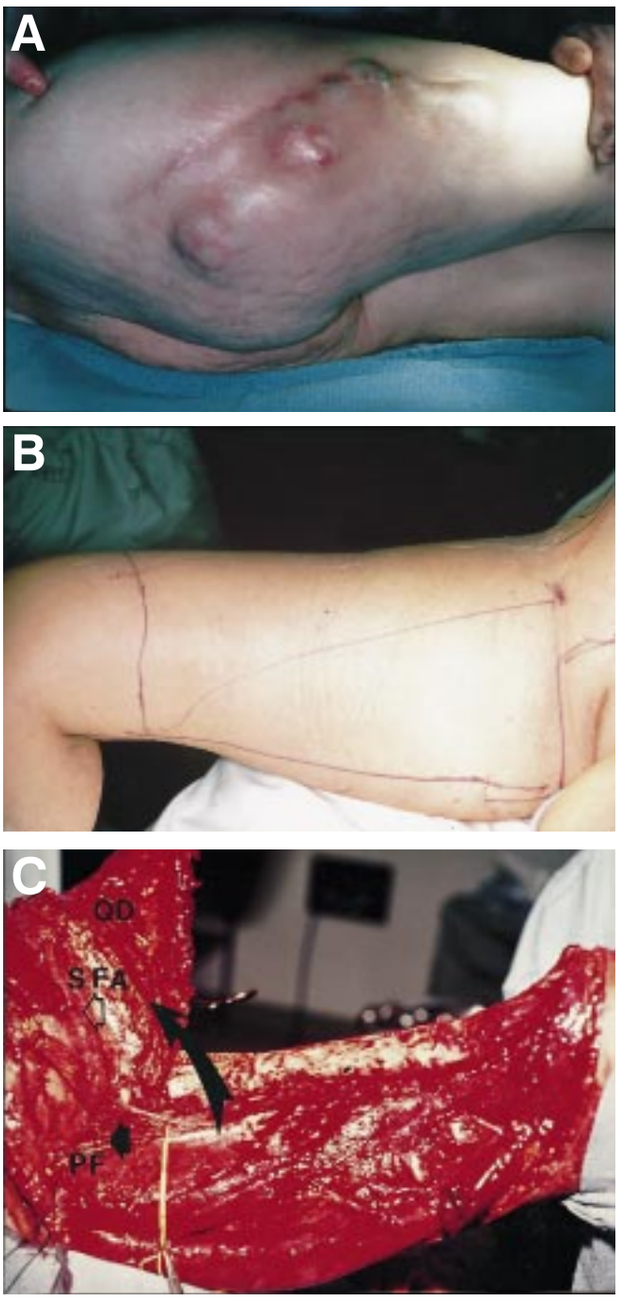


Figure 19.1 (**A**) Large extraosseous chondrosarcoma of the buttocks (Tu) with a thin rim of gluteus maximus muscle remaining (G) showing early intrapelvic extension through the sciatic notch (large arrow). This is a typical mechanism of tumor extension into the pelvis and usually indicates the need for a hemipelvectomy. (**B**) Partial sectioning of a gross specimen following a hemipelvectomy. Chondrosarcoma can be seen (small and curved arrows) extending below the ilium into the sciatic notch and involving the adjacent sciatic nerve. Tumor involvement of the sciatic notch almost invariably involves the gluteal vessels as well as the exiting sciatic nerve. This patient was treated with an anterior flap hemipelvectomy.

Because of the vascular nature of this flap, the surgical wound heals rapidly in the vast majority of patients. Accordingly, the 10–30% risk of ischemic necrosis associated with posterior flap hemipelvectomy is not seen with an anterior flap procedure. Likewise, the risk of subsequent infection in the postoperative period is markedly reduced. Great care must be taken not to dissect or shear the subcutaneous tissue and skin overlying the quadriceps during the creation of the flap, because this will compromise the cutaneous circulation.

Rehabilitative considerations and the risk of phantom pain are similar to those associated with other types



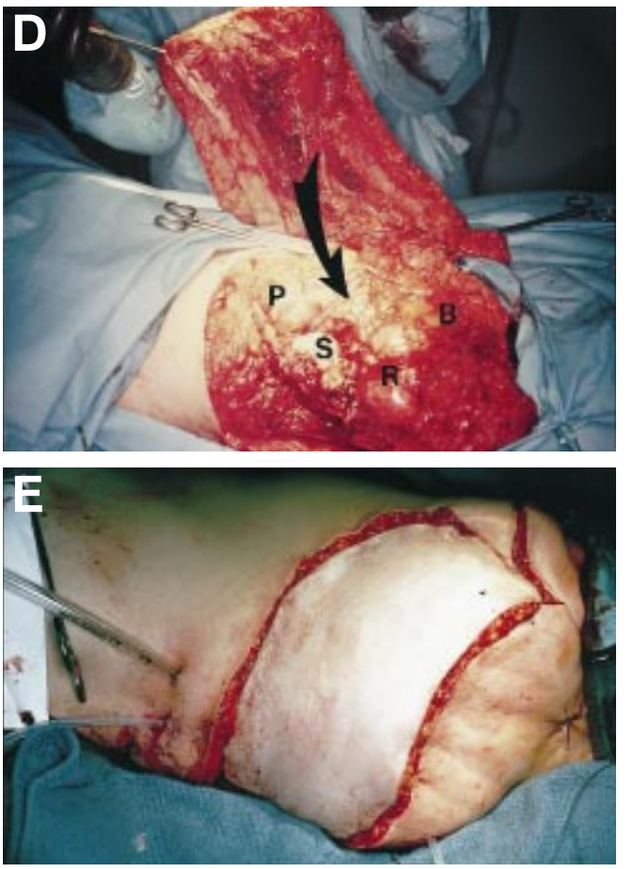


Figure 19.2 Clinical and intraoperative photographs of a patient with a large buttock sarcoma fungating through the posterior flap. This patient was treated by an anterior myocutaneous hemipelvectomy per Sugarbaker *et al*. (**A**) Clinical photograph demonstrating multiple nodules in the buttock arising from a local recurrence of a high-grade chondrosarcoma. Note the previous posterolateral incision. (**B**) Intraoperative photograph of the thigh marking out the large anterior myocutaneous flap. The diagonal line represents the sartorial canal in which the femoral vessels are located below. The dissection is performed inferior to the sartorius so that the feeding branches to the quadriceps muscle that come out medially are not disturbed. (**C**) Intraoperative photograph demonstrating the large anterior myocutaneous flap (quadriceps group, QD) has been elevated off of the quadriceps muscle. The vessel loop shows the profundus vessel (PF) that is now ready to be ligated to permit the flap to be elevated above the pelvis. The superficial femoral artery (SFA, open arrow) remains on the quadriceps muscle as the major pedicle (large arrow). (**D**) Intraoperative photograph following amputation and ligation of the profundus vessel and complete elevation of the anterior myocutaneous flap (P, peritoneum; S, sacrum; R, rectum; B, bladder). (**E**) Intraoperative photographs show the flap has been rotated to close over the large defect. Note the flap can be positioned in many directions. It is important that the underlying iliac and external artery and veins are not twisted when the flap is set into the defect.

of hemipelvectomies. Because of the rapid healing seen with this type of flap, prosthetic fitting may be performed earlier. The cushioning effect of the quadriceps muscle may significantly reduce tenderness along the cut edge of the sacrum.

UNIQUE ANATOMIC CONSIDERATIONS

The surgeon must be familiar with the pelvic anatomy as well as the thigh musculature and femoral vessels. The anatomic key to this procedure is the major

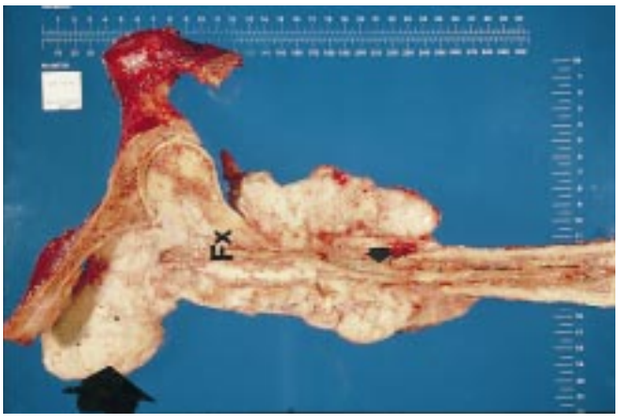


Figure 19.3 Gross specimen following an anterior flap hemipelvectomy. Note there is a large extraosseous tumor mass in the buttock region as well as in the adductor region. This patient had been treated by an IM rod mistakenly for a benign lesion. The rod has been removed and the tumor tract can be seen. In addition there is a pathologic fracture present (F). Small arrow shows the intramedullary tract. This is one of the more common indications for anterior flap hemipelvectomies; that is, mistaking posterior IM rodding of primary malignancies.

vascular pedicle of the pelvis and extremity (Figure 19.2C). Oncologic considerations for tumor involvement of the bone or soft tissues in the pelvis are identical to those discussed in the chapter on posterior flap hemipelvectomy.

The external iliac vessels leave the pelvis and cross through the femoral triangle, where they become the common femoral vessels. A single branch supplying the iliac crest may be encountered along the medial aspect of the external iliac vessel just below the inguinal ligament. The superficial femoral vessels travel underneath the sartorius muscle along most of the length of the thigh; they pass through the adductor hiatus and become the popliteal vessels behind the knee. The major branch in the femoral triangle is the profunda femoris, which arises from the posterior aspect of the superficial femoral vessel and passes deep to the posterior surface of the femur. Ligation of the profunda femoris is required to elevate the anterior flap. The common femoral and superficial femoral vessels are preserved.

The (four) quadriceps muscles, the adductor muscles, and the sartorius muscle all have a vascular supply that arises from pedicles off of the superficial femoral artery. Perforating branches from the profundus are present in the vastus lateralis and may be encountered as they pass through the intramuscular septum. The entire anterior and medial compartments can be elevated off of the femur by dividing the quadriceps tendon above the patella and peeling the full- thickness myocutaneous flap off of the anterior femoral periosteum. To prevent hemorrhage, care must be taken to properly ligate all perforating vessels, as well as the superficial femoral vessels, at the level of the adductor hiatus.

Division of the skin at the inguinal canal and skeletonization of the external iliac vessels permit the entire flap to be rotated as necessary to cover the defect created by the amputation. Use of this flap for closure results in improved cosmesis and facilitates fitting of a prosthesis for an improved functional result. In addition, this flap permits radiation therapy to the remaining pelvis without any wound complications. The nature of the flap available for closure permits greater posterior resection than that possible during a traditional posterior flap hemipelvectomy. The entire buttock compartment (i.e. the gluteal muscles, sciatic nerve, sacrospinous ligaments and sacral alar) can be safely removed.

IMAGING/STAGING STUDIES

In addition to the routine radiographic evaluation of the pelvis (x-rays, CT/MRI scans and bone scans) necessary to determine the suitability of a hemipelvectomy, angiography of the femoral vessels should be considered essential for patients undergoing anterior flap hemipelvectomy. The variable nature of the profunda femoris, as well as the frequent presence of silent atherosclerosis of the superficial femoral artery in elderly patients or in patients with a history of smoking, can greatly affect the outcome of this procedure. In addition, visualization of the pelvic vessels can help to ensure that they are not involved with the tumor.

CT and MRI are required to determine if the tumor involves the sacrum or the vertebra. Spinal involvement is a contraindication to this procedure.

SURGICAL GUIDELINES

1. Positioning the patient (lateral).
2. Ilioinguinal dissection and pelvic exploration.
3. Dissection and ligation of the internal (hypogastric) iliac vessels.
4. Elevation of anterior thigh flap with external iliac/superficial femoral artery.
5. Ligation of profunda femoris.
6. Osteotomy of pubic symphysis and sacroiliac joint (or sacral alar).
7. Division of pelvic floor muscles.
8. Closure via flap rotation.

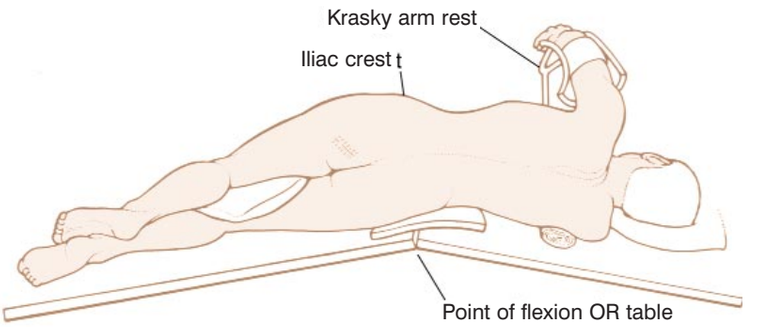


Figure 19.4 Position. Preoperative preparations include correction of blood deficits and a complete bowel preparation. In females the vagina is also prepared. Venous and arterial lines are secured, and a drainage catheter is placed in the bladder. After being placed supine on the operating table, the patient is rolled into the lateral position with the iliac crest at the flexion point of the table. As the patient is positioned, a cushion is placed beneath the right iliac crest and greater trochanter to prevent pressure necrosis of the skin. Padding beneath the right axilla is used to allow full excursion of the chest wall and as prophylaxis against injury to the brachial plexus. The left arm is placed on a Krasky arm rest. An elastic wrapping or a support stocking is used to prevent blood pooling in the right lower extremity. The operating room table is flexed to open the angle between the crest of the ilium and the lumbar vertebra. The anus is sutured shut. The left lower extremity is prepared and draped free with the skin exposed circumferentially from the knee to the iliac crest.

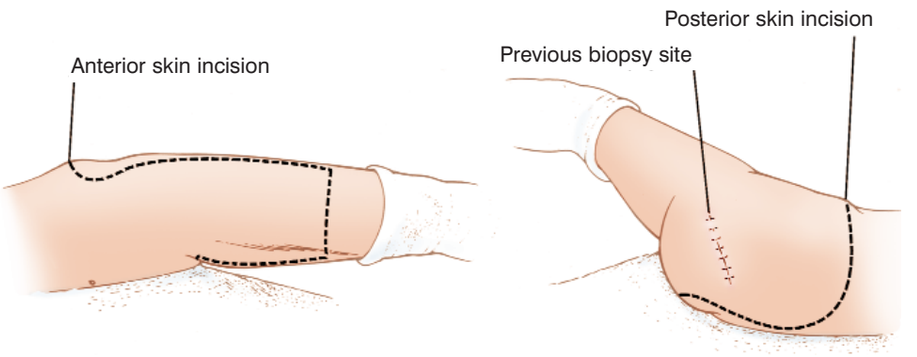


Figure 19.5 Incision. It is critical to determine before the operation that the myocutaneous flap created from the tissue overlying the quadriceps muscle will cover the operative defect created in the buttock. The location of the proposed incision is mapped out with a marking pen and the width and length of the flap compared with the anticipated defect in the buttock. Once it is ascertained that the flap is adequate to cover the defect, the remainder of the incision is determined. First, draw the location of the incision medial to the tumor at or near the midline posteriorly above the anus. Superiorly and laterally the incision should parallel the wing of the ilium to the anterior superior iliac spine. It then continues distally along the midpoint of the lateral aspect of the thigh to the junction of the lower and middle thirds of the thigh.

The medial incision courses 2–3 cm lateral to the anus, then anteriorly in the gluteal crease toward the pubic tubercle. It then continues along the midpoint of the thigh to the junction of the lower and middle thirds of the thigh. The two longitudinal incisions extending along the lateral and medial aspects of the thigh are connected by a transverse incision over the anterior aspect of the thigh. The location of this transverse incision determines the length of the myocutaneous flap. Hence it should be ascertained that the transverse incision is positioned so the tip of the flap will extend to the level of the iliac crest.

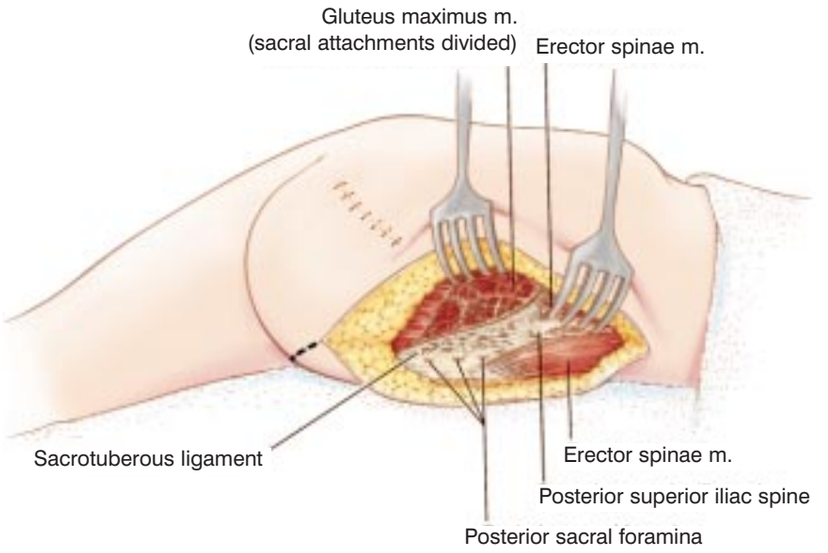


Figure 19.6 Posterior incision to determine operability. In excision of buttock tumors the medial margin of the tumor is usually the closest one to the line of excision. Therefore the dissection should commence medial to the tumor to allow the surgeon to assess operability before completion of the amputation is required. The initial incision is made superficial to the sacrum in the midline, through fascia to the midsacral spines. A cuff of skin 2–3 cm in length should be preserved around the anus. The sacral attachments of the gluteus maximus and erector spinae muscles are divided from their origins between the midsacral spines and the dorsal sacral foramina. Biopsies from the medial margin of resection are secured. By removing the outer table from the sacrum, biopsies from sacral nerves may also be obtained if indicated. If by cryostat sectioning and histologic examination these biopsies are negative, the amputation may proceed.

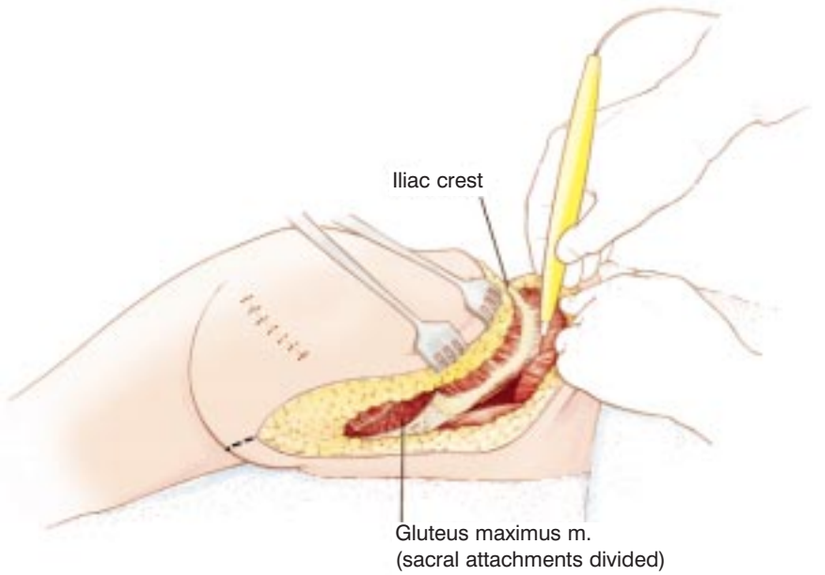


Figure 19.7 Release of back muscles from the iliac crest. Abdominal and back muscles that arise on the sacrum and the iliac crest are incised in the plane of attachment of muscle to bone to minimize blood loss. The muscles to be severed include the external oblique, erector spinae, latissimus dorsi, and quadratus lumborum.

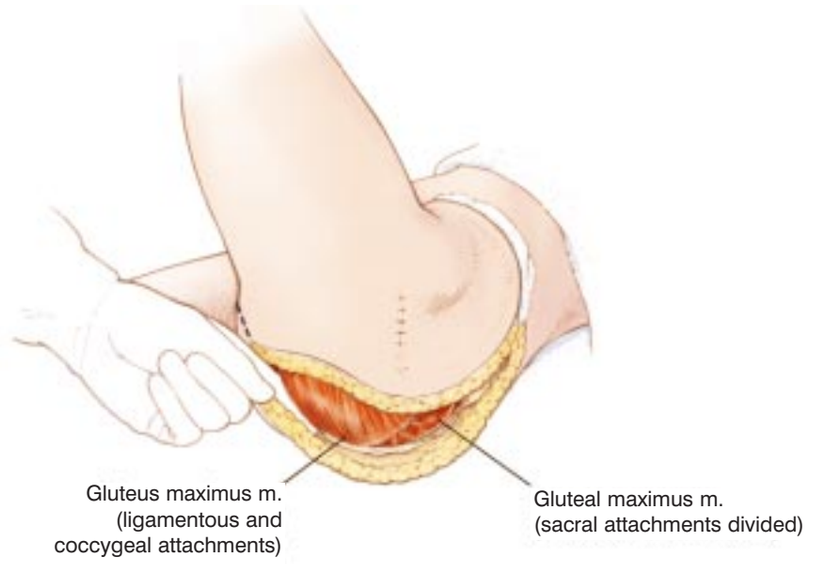


Figure 19.8 Posterior dissection in the ischiorectal space. The extremity is flexed at the hip to place the tissues in the area of the gluteal crease under tension. The perianal incision is extended toward the pubic tubercle along the gluteal crease. The deep dissection is continued lateral to the rectum into the ischiorectal fossa. The remaining origins of the gluteus maximus muscle are now severed from the coccyx and sacrotuberous ligament.

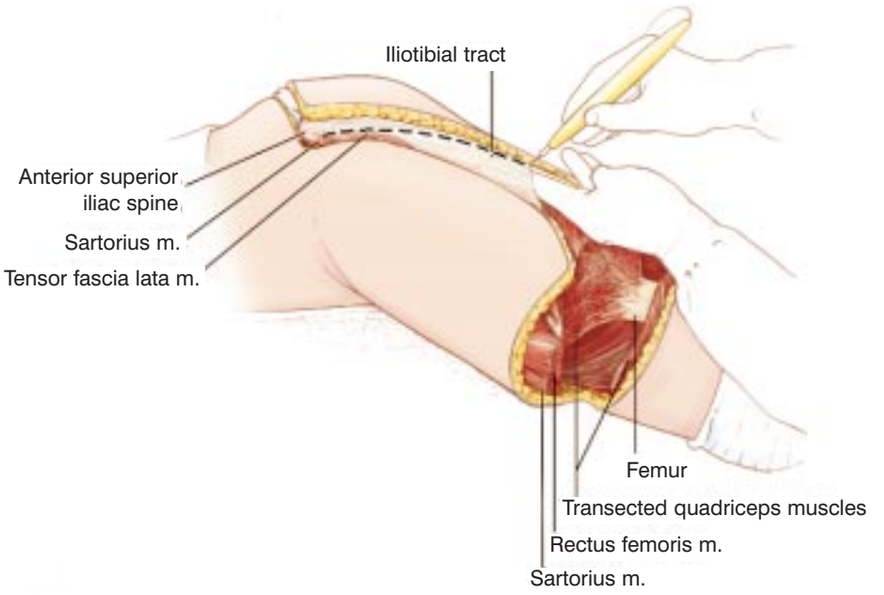


Figure 19.9 Lateral incision of the myocutaneous flap. The surgeon now moves from the posterior to the anterior aspect of the patient. The anterior incision at the junction of the middle and lower thirds of the thigh is made and continued down to the femur, transecting the entire quadriceps muscle. Laterally, this incision is continued superiorly toward the greater trochanter to the anterior superior iliac spine, the tensor fascia lata muscle is separated from its investing fascia so that it is included with the specimen.

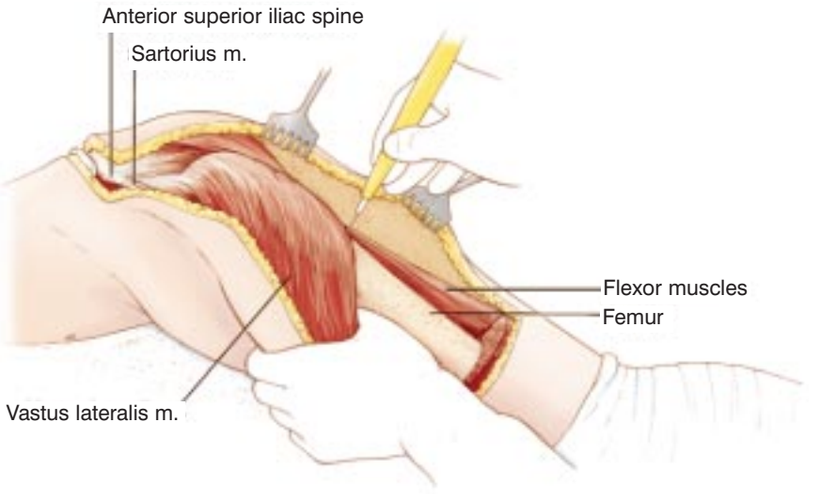


Figure 19.10 Release of the vastus lateralis from the femur. The fascial covering of the vastus lateralis of the quadriceps femoris muscle is dissected free of the flexor muscles and traced to its insertion on the femur. Then the vastus lateralis is severed from the femur using electrocautery. In performing the dissection from this point on, care must be taken not to separate muscle bundles of the myocutaneous flap from the overlying skin and subcutaneous tissue.

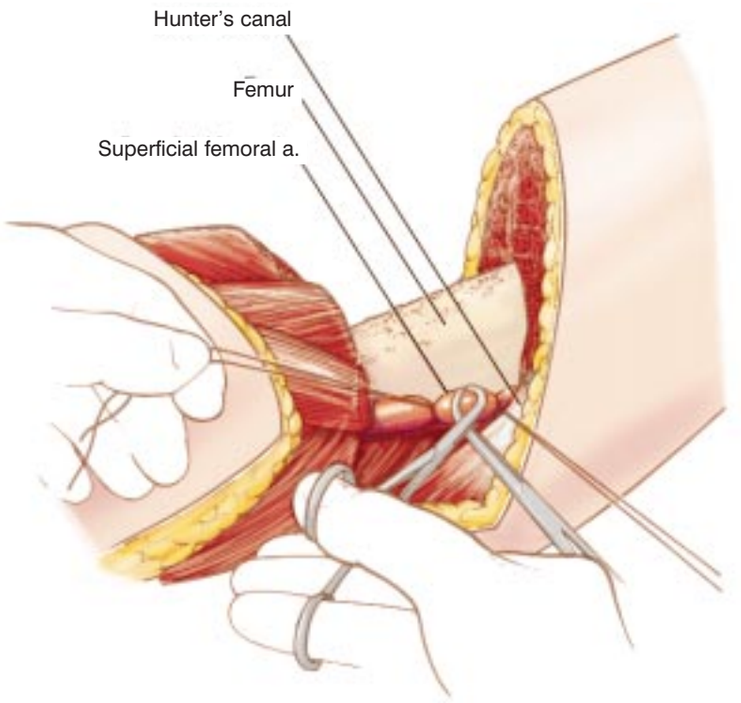


Figure 19.11 Transection of superficial femoral artery. The medial skin incision is from the area of Hunter's canal to the pubic tubercle. The superficial femoral vessels are located at their point of entry into the abductor muscles, and are ligated and divided at this level. These vessels course along the deep margin of the myocutaneous flap, and in the subsequent dissection they are traced superiorly to the inguinal ligament. Multiple small branches from the superficial femoral vessels to the abductor muscles must be clamped, divided, and ligated.

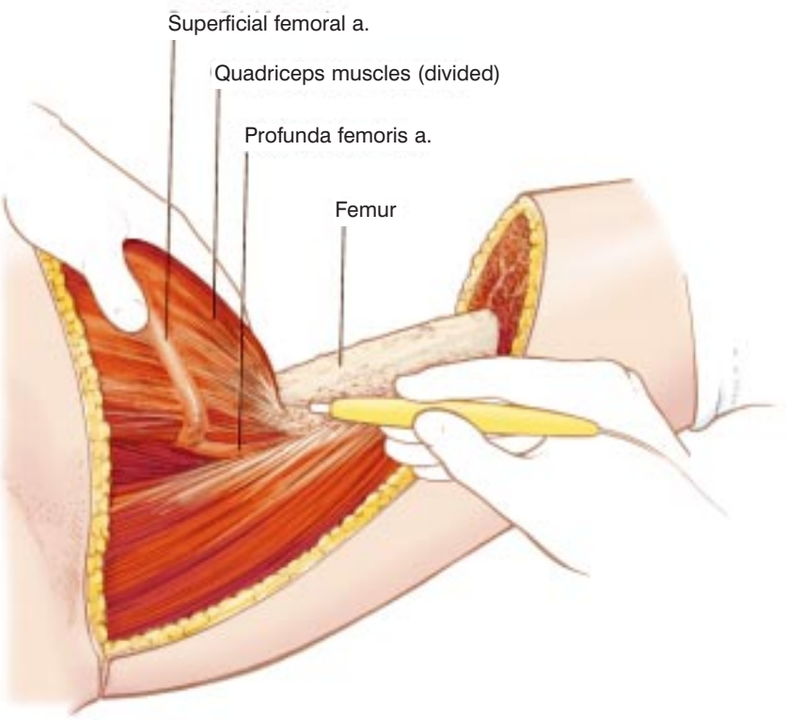


Figure 19.12 Release of the quadriceps muscle from the femur. Vigorous upward traction on the myocutaneous flap allows the origins of the vastus intermedius and the vastus medialis to be severed from the femur. As the release of the myocutaneous flap continues up toward the pelvis, the profunda femoris vessels are identified. These vessels are ligated and divided at their origin from the common femoral artery.

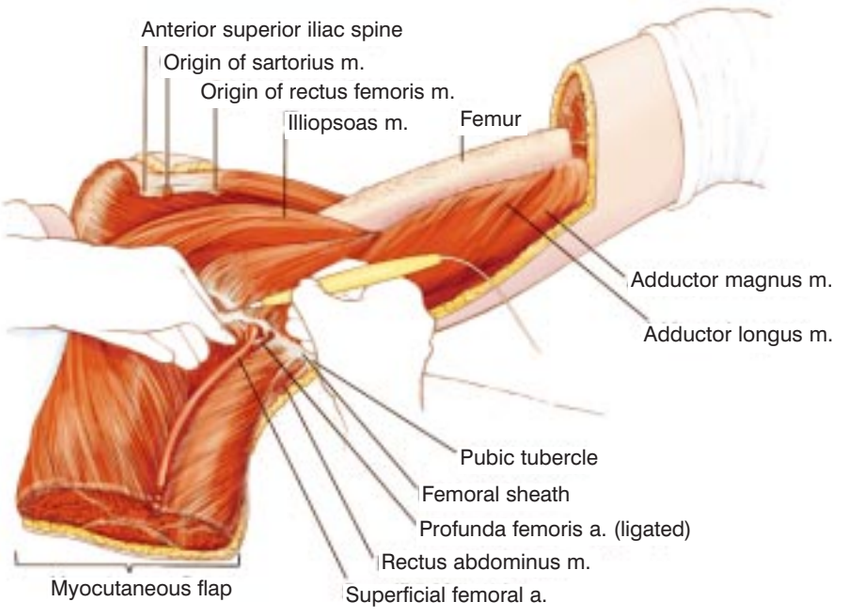


Figure 19.13 Release of the myocutaneous flap from the pelvis. The myocutaneous flap is freed from its pelvic attachments by the following procedure: the abdominal muscles and fascia are severed from the iliac crest; the sartorius muscle is transected at its origin on the anterior superior iliac spine; the rectus femoris is transected at its origin on the anterior inferior iliac spine; the femoral sheath overlying the hip joint is divided; and the left rectus abdominus muscle is released from the pubic bone. By retracting the myocutaneous flap medially, full access to the pelvis is achieved. Blunt dissection along the femoral nerve allows rapid dissection into the pelvis to expose the vessels and nerves to be transected in the subsequent phases of the procedure.

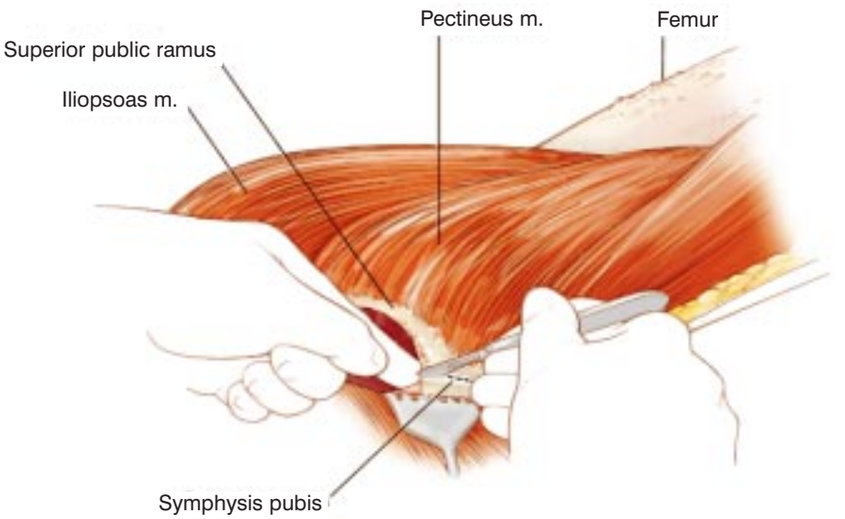


Figure 19.14 Division of the symphysis pubis. To divide the symphysis pubis, the bladder and urethra are protected and a scalpel is used to locate and divide the cartilaginous joint.

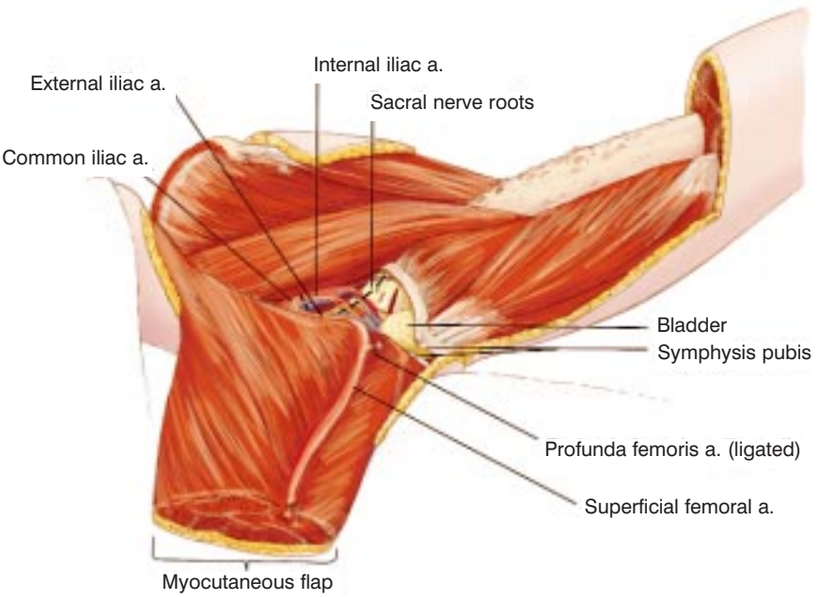


Figure 19.15 Transection of internal iliac vessels and branches. The internal iliac artery and vein are divided at their point of origin from the common iliac vessels. Multiple visceral branches of the internal iliac vessels are divided in their course superficial to the sacral nerve roots. Strong medial traction on the viscera will help expose these vessels. When this phase of the dissection is completed, the nerve roots should be clearly visualized throughout their course in the pelvis.

It should be noted that the common iliac lymph nodes remain with the patient in this procedure, in contrast to a standard hemipelvectomy, in which they are removed.

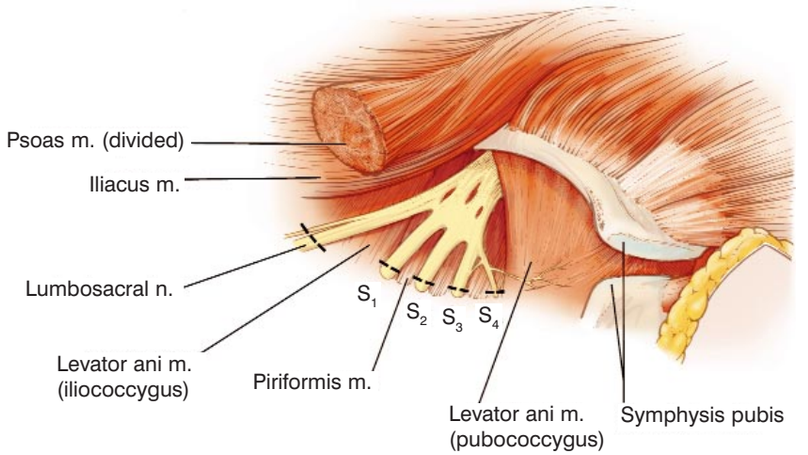


Figure 19.16 Division of the psoas muscle and nerve roots. The psoas muscle is divided near its junction with the iliacus muscle. The obturator nerve deep to the muscle is also divided. Care is taken to preserve the femoral nerve coursing into the myocutaneous flap. The lumbosacral and sacral nerve roots are ligated and divided close to the ventral sacral foramina.

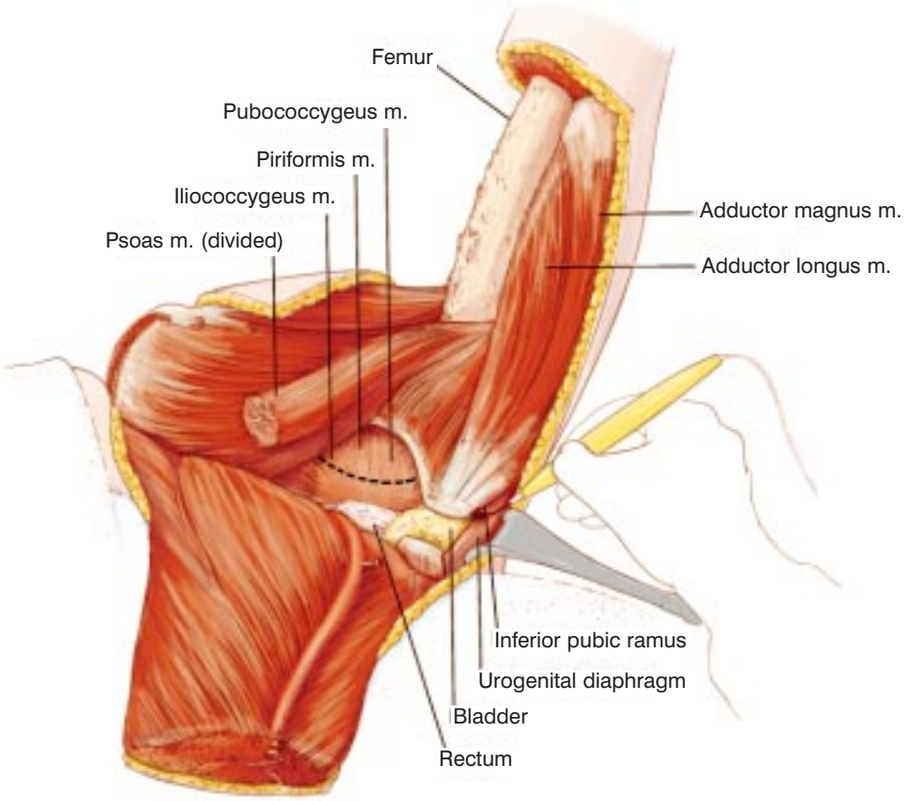


Figure 19.17 Division of the pelvic diaphragm. The leg is elevated to place under tension the individual muscles that constitute the pelvic diaphragm. Take care to protect the urethra, bladder, and rectum. The urogenital diaphragm, levator and piriformis muscles are divided. These muscles are transected near their pelvic attachments.

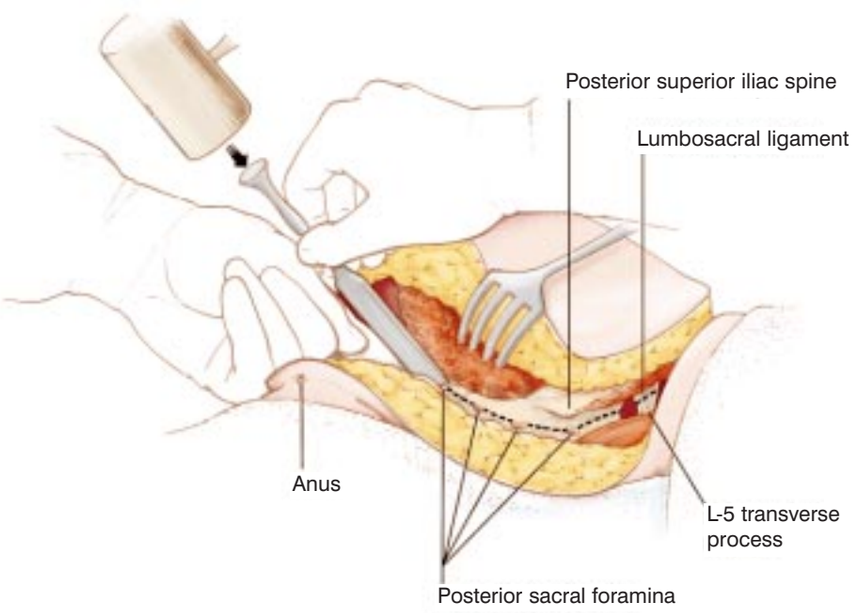


Figure 19.18 Division of the sacrum. The surgeon should again change orientation and move back to the posterior aspect of the patient. Using an osteotome and commencing at the tip of the coccyx, the coccyx and sacrum are divided in a plane that bisects the sacral foramina. Initially, the course of the osteotome should parallel the midsacral spines. The surgeon, being posterior to the patient, reaches around the coccyx with the left hand to locate the S-5 neural foramina from within the sacrum. This is at the junction of the sacrum and the coccyx. By holding the osteotome with the right hand, the direction for bone transection can be precisely determined. The assistant drives the osteotome through the bone with the mallet. At the upper portion of the sacrum, care must be taken not to fracture inadvertently through the bone. The lumbosacral ligament is divided to release the specimen

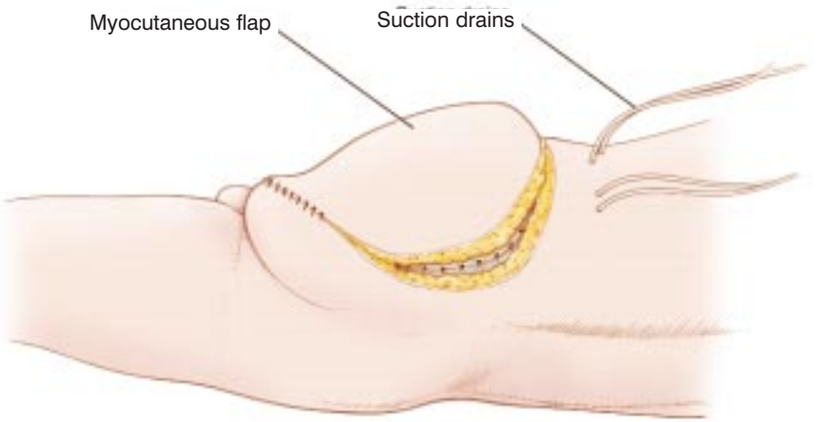


Figure 19.19 Closure. The operative site and myocutaneous flap are copiously irrigated and bleeding points are secured. The myocutaneous flap is folded posteriorly into the operative defect over two sets of suction drains. The fascia of the quadriceps femoris is sutured to the musculature of the anterior abdominal wall, to the back muscle, to the sacrum, and to the muscles of the pelvic diaphragm. The skin is closed with interrupted sutures.

If the patient is hemodynamically stable, ambulation may begin on the first postoperative day. The Foley catheter is removed at 1 week, and the suction drains are removed when the serous drainage is substantially reduced.

DISCUSSION

Patients with extensive soft-tissue sarcomas in the buttock, or patients with osteosarcoma of the pelvis extending posteriorly, have previously been thought incurable by amputation. Hemipelvectomy procedures formerly described required a flap of buttock skin to cover the surgical defect. Anterior flap hemipelvectomy allows sacrifice of the entire buttock and all the overlying skin and soft tissue to the midline. Even patients who have a tumor-contaminated buttock to the midline may have a potentially curative procedure.[10,11]

If at all possible, tumors in this area, especially those of low histologic grade, should be treated with an excision of the gluteus maximus muscle (buttockectomy). However, if tumor extends through the gluteus maximus muscle to involve the gluteus medius or minimus, if tumor encases the sciatic nerve or if tumor is directly adjacent to the pelvic bones, a radical amputation utilizing an anterior myocutaneous flap is indicated.

Early postoperative complications with this procedure have not occurred to date. The serious problem of skin flap ischemia seen in nearly one-quarter of patients undergoing a standard posterior flap hemipelvectomy has not been observed. The numerous muscular branches of the superficial femoral vessels to the quadriceps mechanism provide excellent blood supply to the preserved quadriceps muscles and to overlying skin and subcutaneous tissue. Care should be taken during the dissection not to shear overlying skin and subcutaneous tissue from the muscle mass; if this occurs, skin blood supply will be compromised.

The potential for rehabilitation with this procedure is excellent. The patients who are free of disease use a prosthesis regularly. Patients walk with the prosthesis without the use of crutches or cane. The large mass of quadriceps muscle provides a cushion of viable tissue on the sacrum on which a prosthesis may comfortably rest without traumatizing the overlying skin. Figure 19.3 shows the tissue mass created by the transplanted muscle that can be used to bear the weight required with use of a prosthesis.

The most bothersome long-term postoperative problem with this procedure (as with a standard hemipelvectomy) is phantom limb pain. Approximately 20% of patients currently surviving have severe phantom limb pain requiring narcotic analgesics on a daily basis. However, this incidence of phantom limb pain is not noticeably different from that seen with standard hemipelvectomy.

Occasionally, tumor tissue or heavily irradiated skin overlying the superficial femoral artery may require sacrifice of the skin pedicle. In this instance the island myocutaneous flap should be utilized.

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