20

Posterior Flap Hemipelvectomy

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OVERVIEW

In spite of increasingly effective chemotherapy and advances in limb-sparing surgery around the pelvis and hip (see Chapter 10), hindquarter amputation (hemipelvectomy) often remains the optimal surgical treatment for primary tumors of the upper thigh, hip, or pelvis. Hemipelvectomy may also be life-saving for patients with massive pelvic trauma or uncontrollable sepsis of the lower extremity, and it can provide significant palliation of uncontrollable metastatic lesions of the extremity.[1–3] An intimate knowledge of the pelvic anatomy (Figures 20.1A,B) and a systematic approach to the surgical procedure are required to minimize the intraoperative and postoperative morbidity associated with this demanding procedure.

The patient is placed in a modified semi-supine position. Incision of the abdominal wall and retroperitoneal dissection of the iliac vessels are performed first. The common iliac, external iliac, or internal iliac (hypogastric) vessels are selectively ligated according to the type of hemipelvectomy to be performed. Exposure of the pubis, bladder neck, and urethra permits sectioning of the symphysis pubis. The iliac wing, sacroiliac joint, or sacrum is then exposed and divided to complete the amputation. Division of the lumbosacral plexus at the level of the sacrum or pelvis is accomplished at the same time. A fasciocutaneous or a myocutaneous flap (involving the gluteus maximus for posterior flaps or the anterior compartment of the thigh for anterior flaps) is then completed. Flexion and adduction/abduction of the hip then allows the surgeon to divide the muscles and ligaments of the pelvic floor and complete the amputation. The wound is closed by rotating and suturing the prepared myocutaneous flap to the abdominal wall and flank. Maximizing the patient's functional outcome requires the combined skills of an experienced multidisciplinary team of physical, occupational, and rehabilitative therapists.

INTRODUCTION

Early descriptions of the surgical technique of hemipelvectomy emphasized the importance of careful selection of patients and immediate replacement of blood loss.[4–18] Other, later technical descriptions of this procedure have been published.[19–25] Recent reports of series of hemipelvectomy patients have shown this procedure to have a low mortality rate and to offer an acceptable survival in carefully selected patients.[25,26] Quality-of-life studies suggest that long-term morbidity in patients who have undergone this radical amputation is not greater than that experienced by patients who have undergone other cancer treatments.[27]

CLASSIFICATION

Current terminology for major amputations through the pelvis is overly simplistic and consequently confusing. The terms "hindquarter" amputation and "hemipelvectomy" are often used interchangeably to refer to any amputation performed through the pelvis. Older terms used to describe this same procedure include interpelviabdominal[4] or interinnomino-abdominal[5] amputation to describe this same procedure. The advent of limb-sparing pelvic resections has necessitated a distinction between internal and external hemipelvectomy, depending on whether preservation of the ipsilateral limb is performed. Confusion caused by the term "internal hemipelvectomy" can be avoided by use of a standardized classification for pelvic resection (see Chapter 26).

Sugarbaker[28,29] and others[30–36] 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 tumor involving the posterior buttock structures. 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 that involve the buttock and for selected patients in whom a well-vascularized flap is required for coverage.

There are subtypes of the posterior flap hemipelvectomy (Figure 20.1C). The term "classic hemipelvectomy" is used to refer to amputation of the pelvic ring via disarticulation of the pubic symphysis and the sacroiliac joint (SI), division of the common iliac vessels, and closure with a posterior fasciocutaneous flap. Classic hemipelvectomy is typically necessary for large

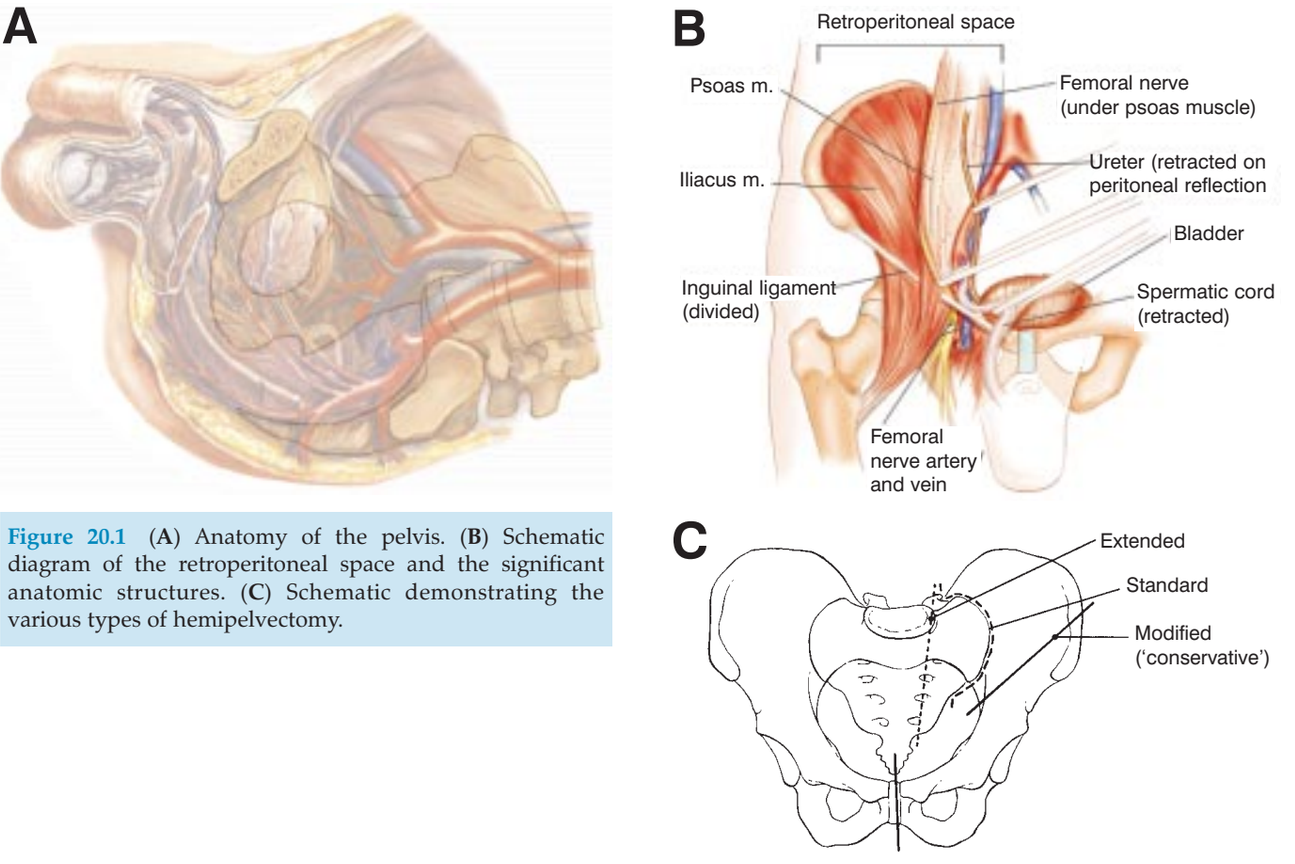


Figure 20.1 (**A**) Anatomy of the pelvis. (**B**) Schematic diagram of the retroperitoneal space and the significant anatomic structures. (**C**) Schematic demonstrating the various types of hemipelvectomy.

tumors that arise within the pelvis. "Modified hemipelvectomy" refers to a procedure that preserves the hypogastric (internal iliac) vessels and the inferior gluteal vessels supplying the gluteus maximus, permitting creation of a vascularized myocutaneous posterior flap for wound closure. This term also describes any and all variations from the classic operation, including resection through the iliac wing or contralateral pubic rami. Modified hemipelvectomy is most commonly performed for tumors involving the thigh and/or hip, when a limb-sparing alternative is contraindicated. "Extended hemipelvectomy" refers to a resection of the hemipelvis through the sacral alar and neural foramina, thereby extending the margin for tumors that approach or involve the SI joint.

Regardless of the type of flap created for closure, the term "compound hemipelvectomy" is used to describe resection of contiguous visceral structures such as bladder, rectum, prostate, or uterus. (Patients suspected of having tumor extending into viscera, or an extremely large tumor filling the pelvic fossa, can be approached through an intraperitoneal incision.)

INDICATIONS

The advent of limb-sparing procedures combined with effective chemotherapy and/or radiation therapy has greatly reduced the need to perform radical amputations of the lower extremity. Increasing experience with less radical resections of the pelvis (see Chapter 10) and new techniques of reconstruction following removal of the acetabulum and hip joint have further reduced the number of patients requiring a hemipelvectomy. The adoption of vascular grafts and advances in rotational flaps and microvascular free flaps extended the indications for limb-sparing surgery. Finally, recognition that deficits from femoral or sciatic nerve resection may be overcome by patient education and bracing of the knee or ankle has further increased the number of patients that can undergo a limb-sparing procedure. Nonetheless, some patients will still require a hemipelvectomy (Figures 20.2–20.4).

Indications for Hemipelvectomy

Unresponsive Sarcomas Involving Multiple Compartments

The most common indication for hemipelvectomy is a nonmetastatic sarcoma that fails to respond to neoadjuvant chemotherapy and/or radiation. In addition, patients with extremely large sarcomas (Figure 20.5) involving multiple compartments of the thigh may require an immediate amputation to avoid tumor fungation, hemorrhage, and secondary infection. In each case the type of hemipelvectomy performed in these circumstances is dictated by the anatomic location of the tumor and the expected defect to be created by the resection. For example, a posterior tumor involving the buttock and sciatic nerve that cannot be resected by a buttockectomy can be removed and closed with a vascularized pedicle anterior flap hemipelvectomy.

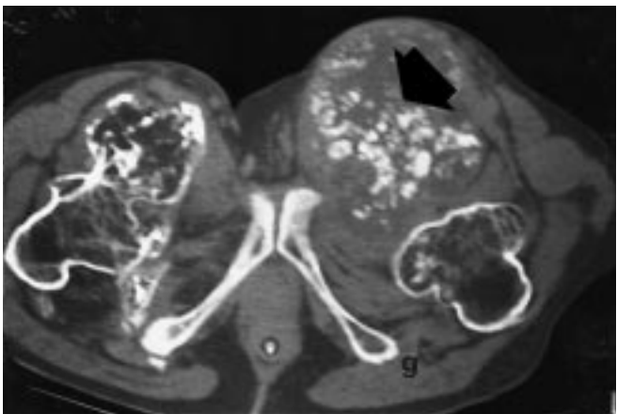


Figure 20.2 CT scan showing a large secondary chondrosarcoma (arrow) arising from the left proximal femur in a patient with multiple hereditary osteochondromatosis. Note the gluteus maximus (G) was completely free of tumor. This patient was a perfect candidate for a modified posterior flap hemipelvectomy.

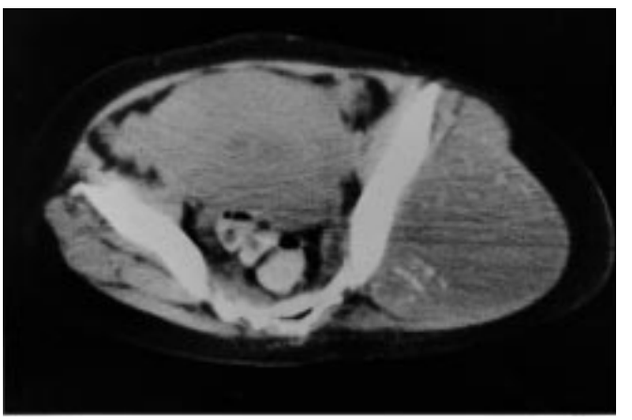


Figure 20.3 CT scan showing a large chondrosarcoma arising from the iliac wing approaching the sacroiliac joint involving the gluteus maximus muscles. This patient is not a candidate for a posterior flap hemipelvectomy and required an anterior flap hemipelvectomy for adequate margins to be obtained posteriorly.

Figure 20.4 MRI scan of an osteosarcoma stage IIB involving the entire wing of the ilium with extension to the superacetabular area. This patient underwent a classical hemipelvectomy.

Figure 20.5 (**A**) CT scan of an extremely large leiomyosarcoma of the pelvis and adductor region. (**B**) Tumor destruction of the pelvic floor as well as the symphysis pubis and involvement of the hip joint.

Contamination of Surrounding Structures

Patients with extensive contamination of compartments from inappropriately placed biopsies and/or from unplanned intralesional resections of sarcomas around the pelvis, hip, and proximal thigh are candidates for hemipelvectomy. In addition, pathologic fractures of the proximal femur often contaminate unexpectedly large volumes of tissue. Traditionally, such fractures have been treated with hemipelvectomy, although some institutions now attempt limb- sparing procedures following aggressive preoperative (neoadjuvant) treatment and spica immobilization.

Nonviable Extremity Precluding Limb Salvage

Elderly patients with significant peripheral vascular disease, or patients with fungating, infected sarcomas that preclude limb-sparing surgery, may be candidates for hemipelvectomy (Figure 20.6). Conversely, very young and skeletally immature children with primary sarcomas who are not suitable candidates for limb-sparing procedures because of the inevitable problem of limb-length discrepancy may be treated with hemipelvectomy. Typically, the youngest patients adapt most completely to their missing limb and lead extremely active lives. Psychological counseling for the parents and family is essential under such circumstances.

Failure of Previous Resection

Hemipelvectomy is indicated as a final salvage procedure for patients with local recurrence in the thigh or buttock following aggressive surgical and medical treatment. Careful patient evaluation is necessary to rule out the presence of metastatic disease in such cases. Hemipelvectomy may also be required for the control of infection following limb-sparing procedures around the hip and pelvis.

Palliation

The use of radical amputation for palliation of patients with metastatic disease is rare.[37–39] Palliative indications for hemipelvectomy include uncontrollable pain from tumor involvement of the lumbosacral plexus, sciatic,

Figure 20.6 Clinical photograph of a patient who had undergone a hip disarticulation after a failed aortal–femoral bypass graft with secondary infection and flap necrosis. This is one of the most common clinical nononcology indications for a hemipelvectomy. The patients with failed vascular grafts at a higher level are often septic at the time of surgery and require emergent surgery.

and femoral nerves. Patients with uncontrollable local disease from metastatic carcinoma who have failed all conventional treatments, including radiation and chemotherapy, may also benefit from amputation. Realistic expectations and psychological support for the patient and family are essential in such cases.

Nononcologic Indications

Modified or anterior flap hemipelvectomy may be required for uncontrolled decubiti and osteomyelitis of the hip and pelvis in patients with long-standing paralytic conditions.[9] Both function and emotional well-being often improve rapidly after the source of chronic sepsis has been surgically removed. For patients with partial pelvic amputation and open hemorrhaging fractures of the pelvis, emergency hemipelvectomy may be life-saving.[40] In both circumstances, oncologic margins are not required, making the surgery easier to perform.

CLINICAL CONSIDERATIONS

Minimizing of the morbidity and mortality associated with hemipelvectomy requires careful physical and psychological preparation of the patient. Patients receiving preoperative chemotherapy or radiation therapy require time to recover from their neutropenia and anemia. Use of supportive growth factors such as erythropoietin and GCSF may be of significant benefit. Replacement of red cell mass by blood transfusion and correction of bleeding abnormalities are essential to reduce the risk of intraoperative mortality. In addition, patients with poor nutrition secondary to disease and the nausea and vomiting induced by chemotherapy may require hyperalimentation before and after surgery to reduce problems with wound healing.

To reduce the risk of postoperative infection, bowel preparation should be performed for all patients. Perioperative antibiotic coverage for aerobic skin flora and anaerobic bowel flora is required. Postoperative care to prevent hematomas and seromas includes the use of large-bore suction drains and pressure dressings using Ace wraps. A Foley catheter and a nasogastric tube are used to prevent abdominal distension that, in turn, reduces pressure on the skin closure. Skin sutures or staples should be retained for 3–4 weeks to minimize the risk of wound dehiscence.

Patients undergoing hemipelvectomy face a unique combination of psychological stress related to the loss of limb and potential loss of life from the underlying disease. Ongoing psychological support for the patient and family is essential. Rehabilitation of the patient begins at the time of the staging studies. The entire health-care team must develop and maintain an honest relationship with the patient and the family and include them in the decision-making process. Trust and understanding can be enhanced by having the patient meet others who have undergone this procedure, and helping the patient accept the amputation and set realistic goals.

Although hemipelvectomy has traditionally been associated with extensive blood loss, strict adherence to the techniques described here can result in an estimated blood loss (EBL) of 500–2000 ml. Use of growth factors such as erythropoietin and nonhemologic plasma expanders has allowed us to perform this amputation without blood transfusion on a Jehovah's Witness patient. Meyers *et al*. have also reported

successful hemipelvectomy under these circumstances.[41] However, for patients in whom the tumor encases or involves the major vessels, extensive bleeding should be anticipated. Extensive blood loss and replacement in excess of one to two times the patient's circulatory volume may create life-threatening coagulopathies and pulmonary complications.

Another serious postoperative complication is wound necrosis. Ligation of the common iliac vessels during a classic posterior flap hemipelvectomy deprives the flap of its major blood supply; 10–50% of patients may develop clinically significant ischemia. Pressure from prolonged laying or sitting on the flap may result in ischemic necrosis. Early identification of necrosis and surgical revision is recommended as being essential to minimize additional complications. Meticulous attention to preserving the fasciocutaneous vessels and a portion of the gluteus maximus can reduce the incidence of ischemic necrosis.

All patients undergoing hemipelvectomy have significant risk factors for infection, such as tumor-related catabolism, chronic malnutrition, and chemotherapy-induced anemia and neutropenia. As a result it is not surprising that infection may be seen in approximately 15% of patients. Additional factors that increase the risk of infection include immunosuppression from surgical stress, transfusions, and pschyological depression. Steps to reduce the incidence of infection should include the use of preoperative bowel prepping, use of a purse-string suture to close the anus during surgery, broad-spectrum perioperative antibiotic coverage, and the use of large-bore closed suction drains to prevent retroperitoneal hematomas. Infection may significantly retard wound healing; aggressive surgical debridement and prolonged dressing changes are often necessary.

Intraoperative retraction of the peritoneum and use of postoperative narcotics contribute to the development of an ileus that may last for a week or more. Routine placement of a nasogastric tube and avoidance of oral feeding are required to prevent nausea, vomiting, aspiration, abdominal distension, and possible wound complications. Early intravenous nutritional supplementation should be considered.

Division of the sacral plexus may result in loss of innervation of the ipsilateral bladder and penis, resulting in bladder atony and impotence. These problems are often transient and often resolve within 1–3 months as the contralateral innervation becomes dominant. An indwelling Foley catheter should be maintained until the patient becomes mobile, and post-void residuals should be measured once the catheter is removed.

All amputees experience phantom limb sensation. Patient education, aggressive medical treatment, and rigorous physical rehabilitation play a role in minimizing the impact of these sensations. Injection and infusion of local anesthetics into the lumbosacral plexus and stumps of the sciatic and femoral nerves may significantly reduce actual pain and phantom sensation in the immediate postoperative period (see Chapter 24).

A prosthesis should be offered to all patients, even though all of them may not use it. If a segment of ilium has been preserved, a suspension belt may be used. Elderly and overweight patients may become wheelchair-dependent following this procedure because of the increased workload required to ambulate. Some children and adults find that a prosthesis slows their ability to ambulate with crutches. The prosthesis enables the wearer to stand for prolonged periods of time without supports and frees both hands for other activities (see Figure 20.19, in Rehabilitation Section of this Chapter).

UNIQUE ANATOMIC CONSIDERATIONS

The skeletal anatomy and contents of the pelvis are complex and difficult to visualize without direct experience. Major portions of the gastrointestinal tract, the urinary tract, the reproductive organs, and the neurovascular trunks to the extremities all coexist within the confines of the bony pelvis. Understanding the three-dimensional anatomy is essential to identifying and protecting these structures during a hemipelvectomy (Figure 20.1). It is also important to recognize that the normal anatomy may be distorted by the tumor. Reference to easily palpable and visual landmarks helps identify critical structures. The surgical approach to a hemipelvectomy is based upon sequential exposure and identification of these landmarks and structures.

Bony Anatomy

The basic pelvic bony anatomy is best thought of as a ring, running from the posterior sacrum to the anterior pubic symphysis. Major joints include the large, flat sacroiliac joints, the hip joints and the pubic symphysis. The hip joint is easily located by motion of the extremity, while the other joints are easily located and identified by palpation. Other easily palpable bony prominences include the iliac crest, the anterior superior iliac spine (ASIS), the ischial tuberosity, and the greater trochanter of the femur. These landmarks are essential in creating rational skin incisions during the procedure. Likewise, identification of internal bony landmarks helps localize adjacent structures. The lumbosacral plexus is found by palpating the SI joint, the sciatic nerve and gluteal vessels are found under

the sciatic notch, the urethra is found under the arch of the pubic symphysis.

Vascular Anatomy

Ligation of the correct pelvic vessels is crucial to a successful amputation. The importance of this fact is indicated by the classification scheme, in which the level of ligation determines the type of amputation to be performed. As the abdominal aorta and vena cava descend into the pelvis they bifurcate, creating the common iliac arteries and veins. This bifurcation typically occurs at L4, with the lower bifurcation occurring at S1. The left-sided aorta and the iliac and external iliac arteries remain anterior to the major veins throughout the pelvis. The internal iliac artery (hypogastric artery) bifurcates from the posterior surface of the common iliac artery as it travels down toward the sciatic notch. Tumor masses within the pelvis can distort this anatomy, making it mandatory to visualize and isolate each of the vessels prior to performing a ligation (see Figure 20.1A).

The internal iliac (hypogastric) vessels supply the pelvic floor, rectum, bladder, and prostate, as well as the gluteal muscles. Ligation of this vessel will not jeopardize the internal structures because of contralateral blood flow and rich anastomotic vessels; however, it will significantly devascularize the gluteus maximus muscle. Classic hemipelvectomy, in which these branches are divided, has a substantial rate of wound complications as a direct result.

Pelvic Viscera

In addition to the critical vascular structures, major organs of the gastrointestinal and genital–urinary tracts are present and exposed during a hemipelvectomy. These structures should be completely evaluated prior to surgery.

The bladder and urethra, and the prostate in males, are located above and under the pubic symphysis. Placement of a Foley catheter with a large inflated balloon makes these structures easier to palpate during surgery. Care must be taken not to injure the urethra during division of the symphysis. In addition, the venous plexus surrounding the prostate can be a significant source of bleeding that can be difficult to control even with good visualization of the organ. The ureters are at risk of injury as they cross over the iliac vessels, from lateral to medial. The peristaltic motion of the ureters helps to identify these structures.

In female patients the ovaries, fallopian tubes, uterus, cervix, and vagina require identification and protection. Care in taking a complete history of the patient will identify those women who have undergone hysterectomies. In women who have not undergone such surgery, these structures are found under and adjacent to the bladder. They can be easily and safely retracted out of the operative field.

The majority of the gastrointestinal tract is protected by the peritoneum and is gently retracted out of the operative field. Of particular concern is the sigmoid colon, which must be protected during left-sided amputations. The colon and rectum must also be identified and protected during the division of the sling muscles prior to completion of the amputation. Insertion of a rectal tube prior to surgery helps to identify both these structures and to decompress them. Because of the possibility of bacterial contamination from these structures, preoperative bowel preparation and the use of appropriate antibiotics is prudent.

PREOPERATIVE IMAGING/STAGING STUDIES

Complete imaging and staging of the patient are essential to proper patient selection and preoperative planning. Routine preoperative staging studies of the patient should include computerized tomography (CT) scan of the chest and total body bone scan to detect metastatic disease. Images of the liver and abdomen may be indicated for patients with certain tumors, such as myxoid liposarcomas. that can present with unusual sites of metastases.

Standard X-Rays

X-rays remain the gold standard for the detection and diagnosis of bone sarcomas. Evaluation of patients with suspected pelvic and hip/thigh tumors should always include a standard anteroposterior (AP) pelvis view that extends from the top of the iliac crests to below the pubic symphysis. Additional views of the pelvis may be helpful, including iliac and obturator oblique views described by Judet;[42] as well as inlet and outlet views. Given the complexity of pelvic anatomy, cross-sectional images are vital (Figure 20.7).

CT and MRI

CT and magnetic resonance imaging (MRI) both provide the ability to image pelvic anatomy in cross-sectional planes; MRI provides better images in the sagittal and coronal planes. Use of oral, IV and rectal contrast media can greatly facilitate the ability of CT scan to image visceral organs of the pelvis. CT is extremely useful in the evaluation of the sacroiliac joint, the sciatic notch, and the symphysis pubis. MRI often provides a better image of the soft tissue and

Figure 20.7 Three different patients with extrapelvic tumors that required hemipelvectomies. (**A**) Plain radiograph shows a pathological fracture through an osteosarcoma of the proximal femur. This patient was treated by a classical posterior flap hemipelvectomy. (**B**) CT scan demonstrating an intramedullary rod placed into the femur with large contamination. The IM rod was performed for a pathological fracture thought to be a benign fracture. The underlying diagnosis of a lymphoma was discovered postoperatively. The tumor has extruded into all of the muscle compartments. This patient was treated by a posterior flap hemipelvectomy. (**C**) Angiogram of a multiple recurrent groin and hip sarcoma after several attempts of resection. Note the large tumor blush from the superficial femoral and profundus vessels as well as the previously resected portion of the proximal femur. This patient was treated by a posterior flap hemipelvectomy.

intramedullary extent of sarcoma (see Figure 20.4). The retroperitoneal lymph nodes can be evaluated with either technique. Because of the complementary nature of the information provided by these scans, a complete evaluation of a given patient may require the use of both imaging modalities (Figures 20.7B and 20.8).

Angiography

Preoperative angiography of the pelvis is extremely useful in delineating the relationship of the iliac branches to the tumor. Older patients undergoing anterior flap hemipelvectomy may have silent

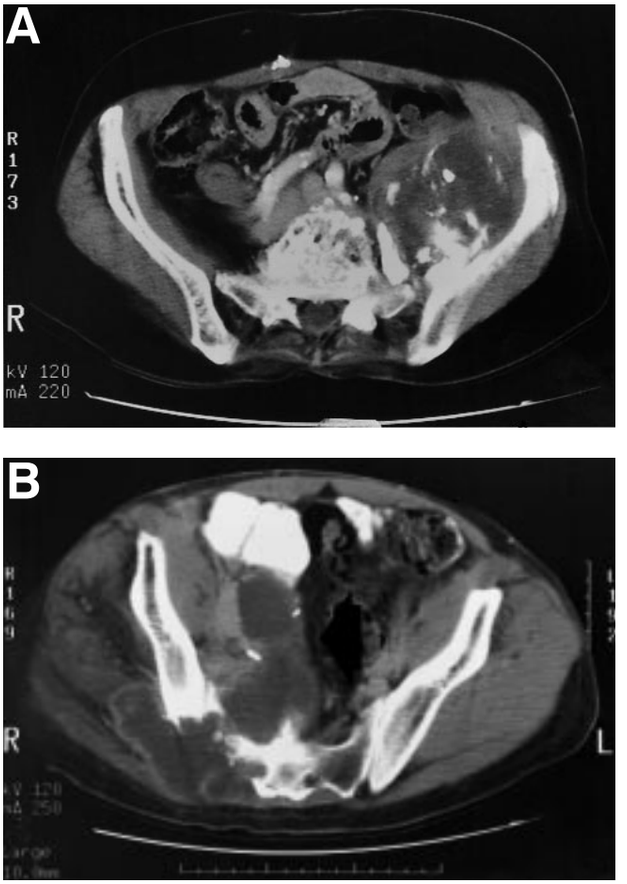


Figure 20.8 CT scans of two different patients demonstrating the inoperability of large sarcomas around the pelvis that may involve the sacrum. (**A**) CT scan of a radiation-induced osteosarcoma of the left ilium that crosses the sacroiliac joint and involves S1 and L5. Note the large intrapelvic component with S-I joint involvement and destruction. (**B**) CT scan of an extremely large chondrosarcoma arising from the right posterior wing of the ilium and sacroiliac joint with marked involvement of the sacrum with a huge intrapelvic extension crossing the midline (arrow). Note the hemaclips that denoted the area of an open biopsy and exploration. There is marked tumor necrosis following postoperative radiation therapy. This patient was inoperable due to the local extension of the tumor intrapelvically and intraspinally.

atherosclerotic disease of the femoral vessels that could jeopardize the success of the flap. For patients in whom a modified hemipelvectomy is considered, angiography reveals the level of the common iliac bifurcation. Patients undergoing palliative amputation may benefit from preoperative embolization to reduce intraoperative bleeding (see Figure 20.7C).

Venography and Other Tests

Complete evaluation of the visceral structures of the pelvis may require additional studies. Dedicated radiographic evaluation using contrast materials of the colon, rectum, bladder, urethra, and uterus is useful if tumor involvement is suspected. Direct visual inspection via sigmoidoscopy and cystoscopy may be essential in selected patients. Pelvic venography should be performed if there is any clinial suspicion of venous obstruction, i.e. distal edema. Venous tumor thrombi often occur with large pelvic chondrosarcomas. Tumor thrombi should be removed during the operative procedure.

SURGICAL GUIDELINES

The classical posterior flap hemipelvectomy can be visualized as consisting of five major surgical components.

1. *Anterior retroperitoneal approach through the ilioinguinal incision*. Through this incision the retroperitoneal space is explored. The iliac arteries or hypogastric vessels are ligated and transected, the psoas muscle and the femoral nerve are transected, and the abdominal wall is released from the iliac crest from the symphysis pubis to the posterior superior iliac spine. *Note*: all structures are transected or mobilized anteriorly before proceeding on to the next steps of the operative procedure.
2. *Perineal incision*. The second major step is the perineal incision. This incision extends from the symphysis pubis down to the ischium along the inferior pubic ramus. The ischiorectal space is exposed along the inferior pubic ramus to the symphysis pubis. The symphysis pubis is disarticulated. The bladder is protected with a large malleable. The urethra is protected similarly.
3. *Posterior flap retrogluteal area exploration*. The third component of the procedure is the posterior fasciocutaneous or subcutaneous flap that is mobilized along the iliotibial band and the greater trochanter towards the sacroiliac joint. A classical hemipelvectomy involves the removal of all gluteal structures and only the subcutaneous flap remains.
4. *Detachment of pelvic floor musculature*. This maneuver is performed with the hip abducted and flexed, with the surgeon standing between the two extremities, facing the pelvis. While the assistant abducts the extremity, the pelvic floor musculature is stretched and ligated through Kelly clamps, beginning at the pubic ramus and ending at the sacroiliac joint.
5. *Completion of the amputation with sacroiliac disarticulation*. The amputation is completed by transecting

the sacroiliac joint with a large osteotome while retracting the peritoneal contents and avoiding the previously transected iliac vessels.

Closure of the flap is then performed over large 28-gauge chest tubes with suction drainage. Marcaine epineural catheters are utilized for continuous pain relief postoperatively. Two catheters are used: one is placed into the lumbosacral plexus and the other is inserted into the femoral nerve.

If a posterior modified hemipelvectomy is performed, the wing of the ilium is transected from the sciatic notch to the mid-portion of the ilium. The hypogastric artery is preserved and the external iliac artery is ligated. The decision between a classical hemipelvectomy and a modified posterior flap hemipelvectomy is made preoperatively. In general, modified hemipelvectomies are performed for thigh and groin lesions, whereas classical hemipelvectomies are performed for true pelvic tumors of the muscle or bony structures.

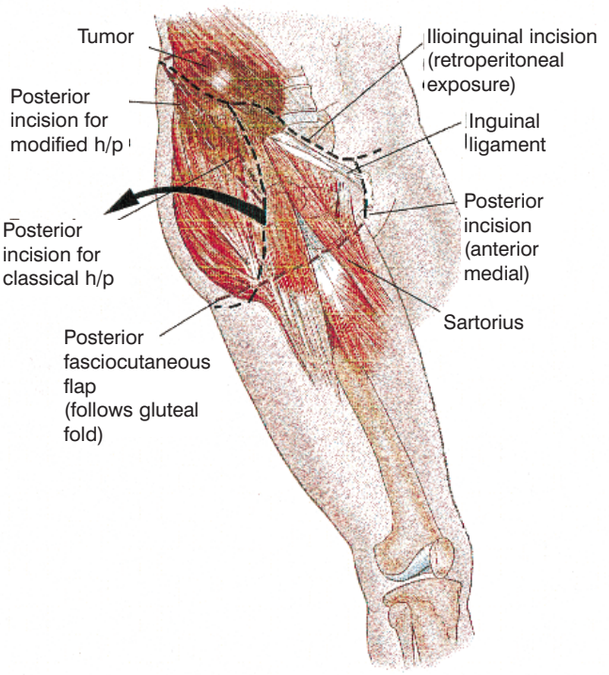


Figure 20.9 Incision and position. The patient is placed on the operating table in a semisupine position. This permits anterior retroperitoneal surgery under an anterior approach. The perineal incision can then be performed with the hip abducted and flexed. The posterior gluteal incision is performed with the patient in a semilateral position with the table rotated to the opposite side. This position is preferred in contrast to the typical lateral position frequently used by other authors. The incision consists of three components: anterior ilioinguinal approach extending from the symphysis pubis along the ilioinguinal ligament and then along the iliac crest to the posterior superior sacroiliac joint. The perineal incision is made from the symphysis pubis and along the inferior pubic ramus to the ischium. The third part of the incision is the posterior incision that is made from the mid-portion of the anterior incision coursing down toward the greater trochanter and to the skinfold of the gluteus maximus muscle. This incision crosses the skinfold and proceeds posteriorly toward the ischium. This incision allows the retrogluteal flap to be made.

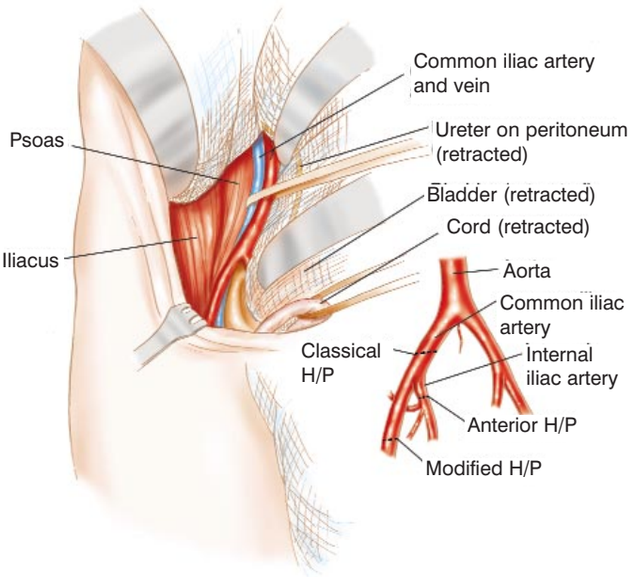


Figure 20.10 Ilioinguinal retroperitoneal incision and approach. The retroperitoneal space is easily entered by detaching the abdominal wall musculature from above the ilioinguinal ligament and off of the iliac crest. For large tumors of the ilium the retroperitoneal space is entered laterally where there is more free retroperitoneal fat. The peritoneum is then reflected off of the tumor mass and the retroperitoneal space is developed. The ureter remains on the peritoneal reflection. The common iliac artery and vein are identified, as well as the internal (hypogastric artery and vein) and the external iliac arteries and veins. It is crucial to identify all of the vascular structures initially to prevent any mistakes in ligation. *Insert:* The levels of transection and ligation of the iliac vessel, along with its two major branches (internal and external iliac vessels) are illustrated. A classical hemipelvectomy requires ligation of the common iliac artery and vein. The modified hemipelvectomy requires preservation of the hypogastric artery and specifically the first branch, the superior gluteal artery. The external iliac artery and vein are ligated. The anterior hemipelvectomy requires the external iliac artery to be intact, which is the main pedicle to the quadriceps muscle. Therefore, the hypogastric artery is ligated at its takeoff from the common iliac artery. The external iliac artery is not ligated.

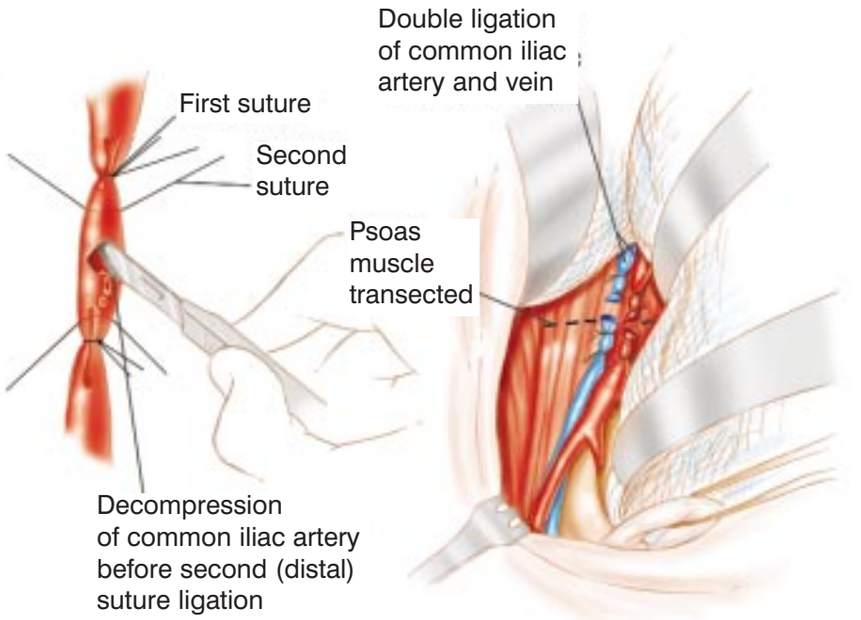
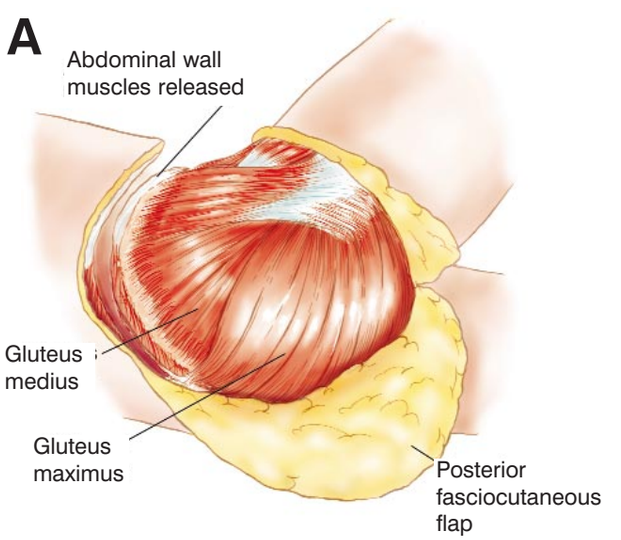


Figure 20.11 Transection of common iliac artery and vein. The peritoneum and its contents are retracted towards the midline with large retractors and the peritoneum is packed off with warm lap sponges. Both the artery and vein are double ligated and transected and oversewn with 3-O silk sutures. It is extremely important to identify the vascular anatomy correctly before ligating any vessels. In obese patients presenting with large pelvic tumors it may be difficult to identify the vessels. A surgical maneuver that the senior author recommends is to initially transect the psoas muscle proximally through Kelly clamps and then oversew the muscle with chromic sutures. This permits easy exposure of the common iliac vessels and the hypogastric vessels on the medial brim of the pelvis. *Insert*: Technique of major pelvic vessel ligation and transection. Arteries should be doubly ligated and transected. The second set of sutures are not tied until the vessel is decompressed with a knife. Any clots or artherosclerotic plaques should be removed prior to the second suture. This is oversewn with a 3-O silk ligature. Similarly, large veins are doubly ligated and transected.



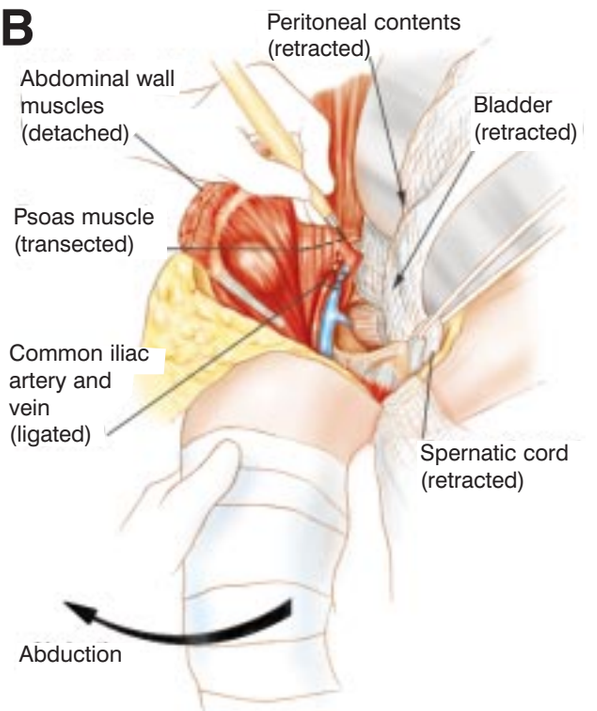


Figure 20.12 *(see following page).*

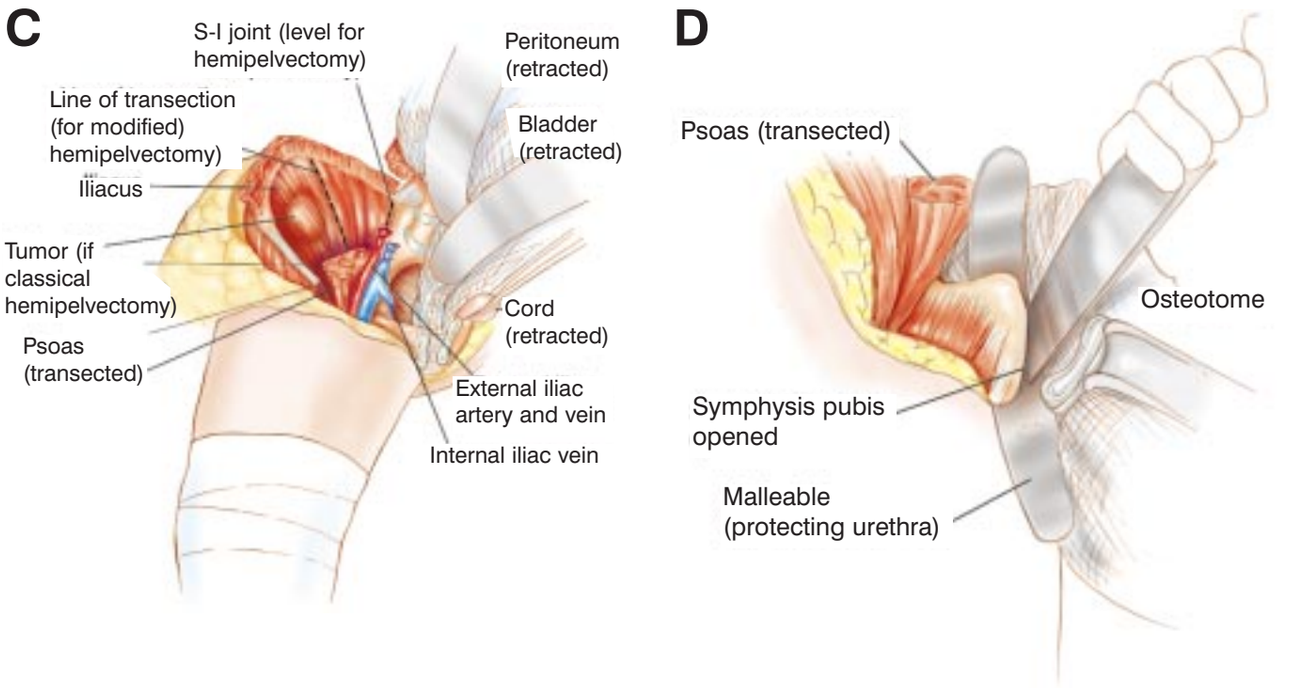


Figure 20.12 Anterior approach and release of psoas and abdominal wall musculature. Through the anterior incision, most of the surgery for a hemipelvectomy should be performed before the perineal and posterior components. (**A**) The abdominal wall musculature is released from the crest of the ilium with a 1–2 cm cuff of muscle remaining along the ilium. (**B**) The psoas muscle has a tendency to bleed postoperatively and should therefore be oversewn. Depending on the type of hemipelvectomy to be performed (classical or modified), the level of the abdominal wall musculature release and the level of the posterior osteotomy will vary. Classical hemipelvectomy consists of a disarticulation of the sacroiliac joint, therefore requiring all of the abdominal musculature to be released up to the paraspinal muscles. The iliolumbar ligament is a good surgical landmark, inserting onto the ilium posteriorly just above the superior aspect of the sacroiliac joint. This is especially useful in obese patients in which the sacroiliac joint cannot easily be palpated. (**C**) A modified hemipelvectomy is an amputation preserving a portion of the wing of the ilium and the underlying gluteus maximus muscle and its major pedicle the inferior gluteal vessels. Therefore, an osteotomy is performed through the wing of the ilium starting at the sciatic notch. The iliacus muscle is transected internally and the abductor muscles are transected longitudinally (posteriorly). Note that all of the muscles located anteriorly in the pelvis are transected at this step. The sacroiliac joint is also identified anteriorly and the vessels are mobilized off of the sacroiliac joint in preparation for the sacroiliac disarticulation that is the final step of the operative procedure. (**D**) The perineal incision is then begun prior to abducting or flexing the affected extremity. The symphysis pubis is opened with a small osteotome or a cutting cautery. It is necessary to retract the bladder with a malleable retractor and an additional small malleable retractor is placed beneath the symphysis pubis notch to protect the urethra. The urethra is easily palpable and protected with a Foley catheter in place. For large tumors of the pelvic floor the urethra may be around the pseudocapsule of the tumor. Therefore, great care must be taken not to enter the tumor or the pericapsular structures of the prostate.

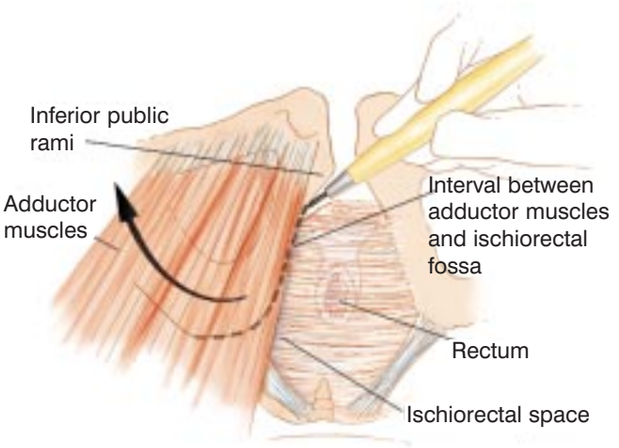
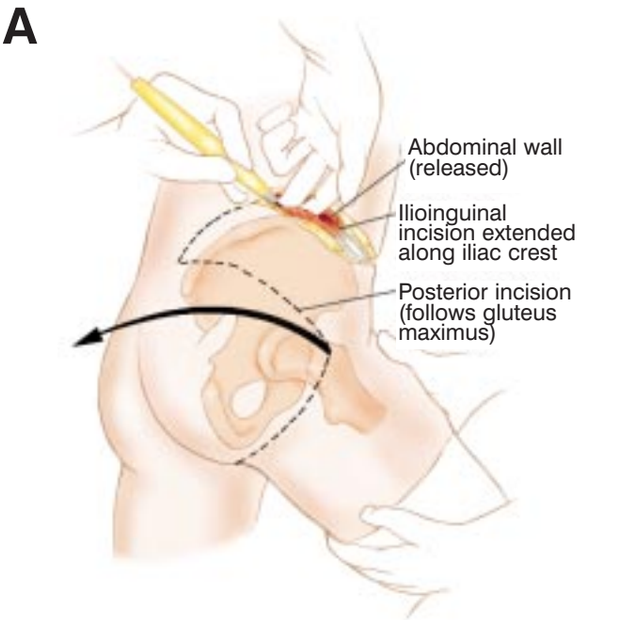


Figure 20.13 *(left)* Perineal incision. This is the second major step in performing a hemipelvectomy. With the affected extremity flexed and abducted, the surgeon stands between the two legs in order to visualize the pelvic structures. A cutting cautery is utilized to cut along the inferior pubic ramus, taking care not to drift into the adductor muscles. The ischiorectal space is easily entered at this point and is packed off. The incision then extends from the ischium to the symphysis pubis. No attempt to release the pelvic floor musculature is made at this time.



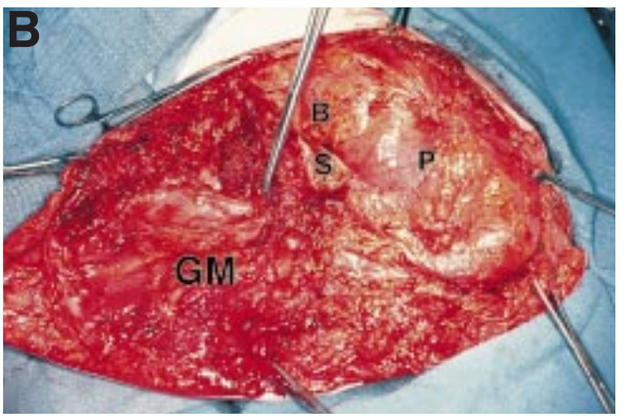


Figure 20.14 Posterior flap development. (**A**) If the abdominal wall musculature has not been completely released, it is released at this point. The patient is then rotated into a lateral position and the assistant from the other side of the table flexes and adducts the extremity to expose the gluteal area to the surgeon. A posterior flap (classical hemipelvectomy) begins at the superior aspect of the sacroiliac joint and extends along the iliotibial band to the greater trochanter, and then passes posteriorly along the gluteus maximus skinfold. A true classical hemipelvectomy utilizes only a subcutaneous flap. If there is no tumor in the gluteal muscles, or if a modified hemipelvectomy is performed, then a thick fasciocutaneous flap can be utilized. This is important since it can decrease the amount of postoperative flap necrosis. (**B**) Intraoperative photograph showing the peritoneum (P), bladder (B), sacrum (S), and a large posterior subcutaneous flap utilized for a classical posterior flap hemipelvectomy. The right angle clamp on the pedicle to the gluteus maximus muscle (GM). (**C**) The partial closure of the posterior myocutaneous flap (P) over the retroperitoneal surface (B).

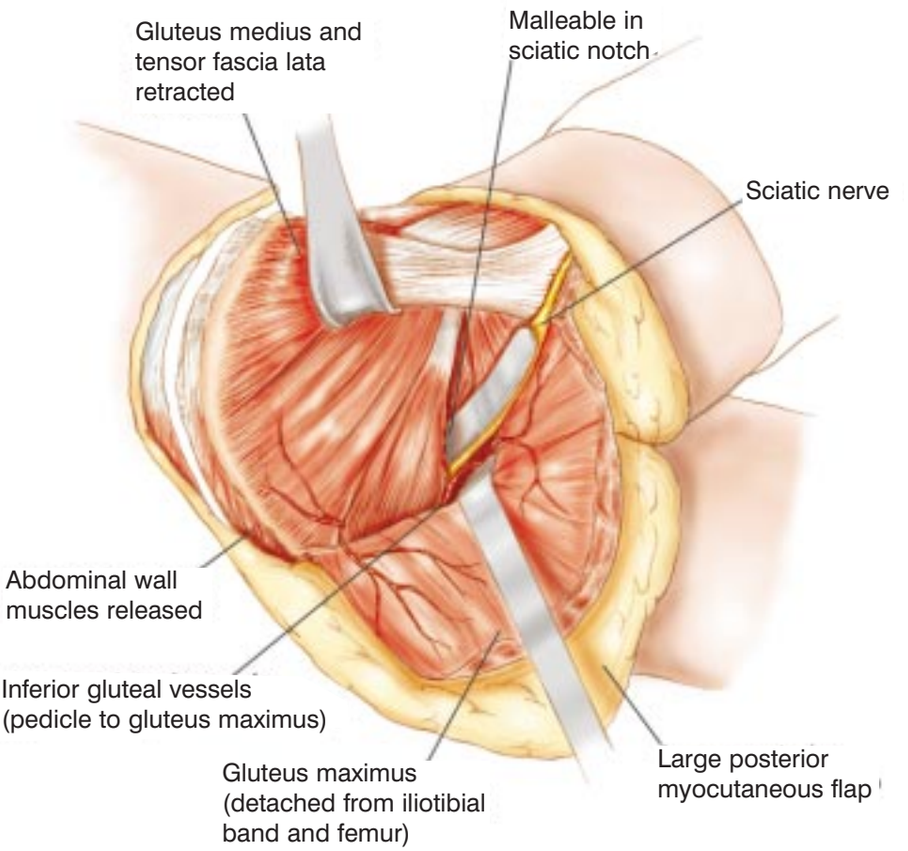


Figure 20.15 Variation of a posterior flap for a modified posterior flap hemipelvectomy. A modified posterior flap hemipelvectomy is an amputation through the wing of the ilium with preservation of the gluteus maximus and its major pedicle, the inferior gluteus vessels. A malleable retractor is placed through the sciatic notch to protect the iliac and the inferior gluteal vessels. The abductors are then transected from the sciatic notch to the mid-portion of the ilium, externally, with a cutting cautery. This is the line of the osteotomy. The iliacus muscle, which corresponds to this incision internally, is similarly trsansected. If it has not already been performed, the iliacus muscle is then transected through Kelly clamps. The ilium is then osteotomized with either a high-speed burr or an oscillating saw. If an osteotome is utilized, the surgeon must be extremely careful that the tip of the osteotome does not injure the major vessels or the pedicle to the gluteus maximus.

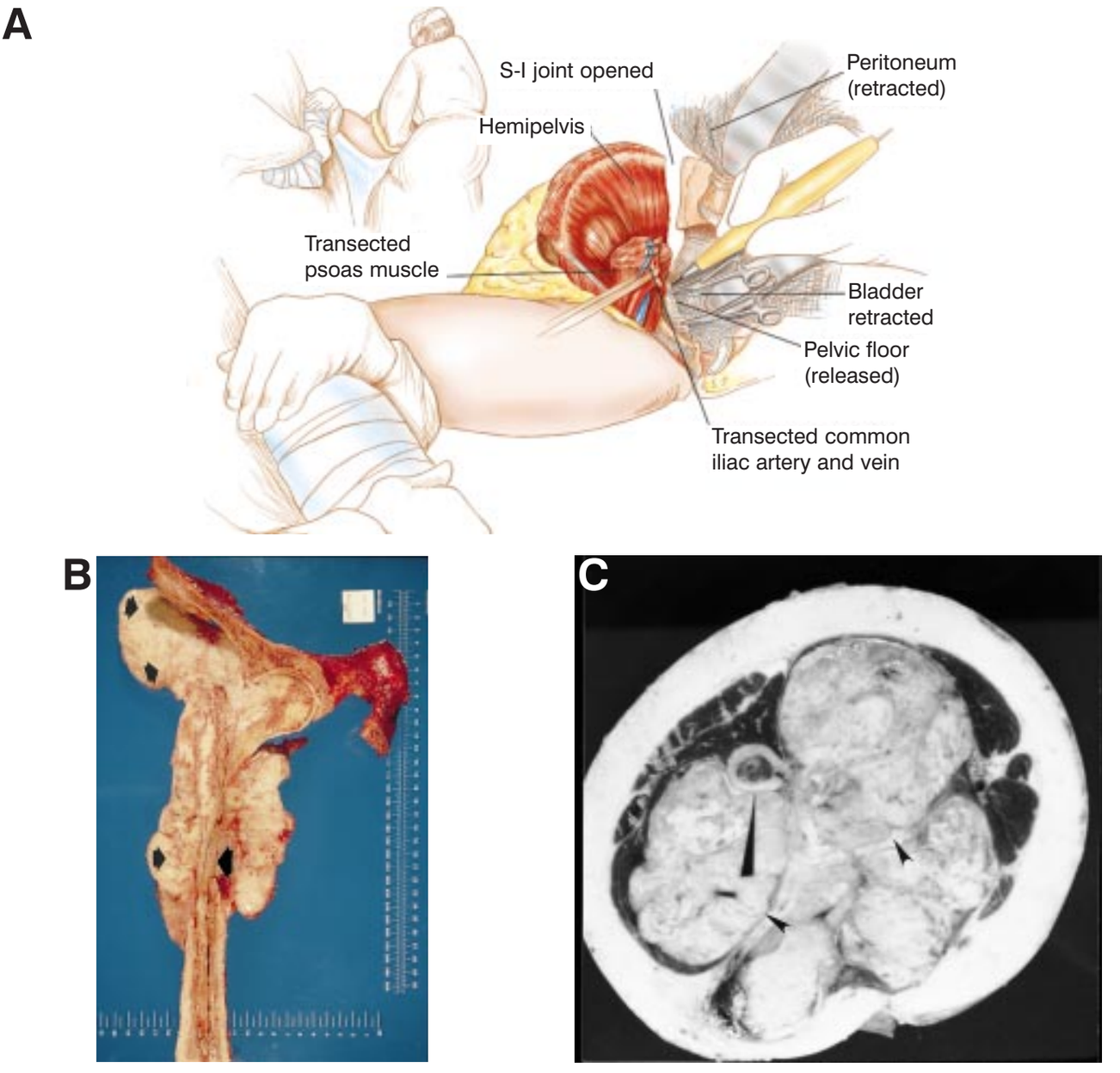


Figure 20.16 (**A**) Completion of amputation and release of pelvic floor muscles. The final step of the amputation is the release of the sacroiliac joint and the remaining pelvic sling muscles attaching to the ilium and pelvic floor. The surgical assistant stands on the same side of the table as the surgeon and flexes and abducts the lower extremity to expose the pelvic floor muscles for the surgeon. A sponge on a stick is utilized to push the rectum off of the pelvic sling muscles in the inferior portion of the wound. Note, if a left-sided hemipelvectomy is performed, great care must be taken to mobilize the rectum to avoid injury to it. The sling muscles are clamped with Kelly clamps and transected. The anterior capsule of the sacroiliac joint and occasionally some of the sacrolumbar trunks are the only remaining structures that must be opened and released. Note that the sacroiliac joint is not opened previously due to the potential of bleeding from injury to the perisacral veins. (**B**) Photograph of a gross specimen following a palliative hemipelvectomy following multiple recurrences for metastatic renal cell carcinima. A posterior flap hemipelvectomy was performed (small arrows = recurrent tumor, large arrow = intramedullary tract site). (**C**) Gross specimen following a modified posterior hemipelvectomy for a huge high-grade leiomyosarcoma of the proximal and mid-portion of the thigh. The large arrow denotes the location of the femur. This tumor has crossed several anatomical boundaries (small arrows indicate intervascular septums) to involve the anterior, posterior, and medial compartments of the thigh. Multiple compartmental involvement of the thigh almost always requires the need for a pelvic amputation.

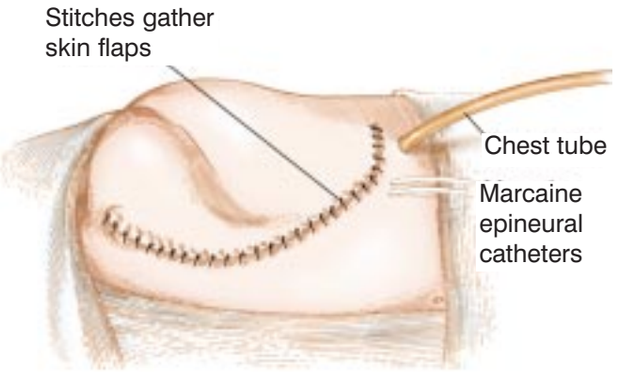


Figure 20.17 Skin closure. A large 28-gauge chest tube is utilized for drainage.

Figure 20.18 Postoperative radiograph of an extended hemipelvectomy (note the sacral alar is absent) with contrast injection of the marcaine catheters that were placed perineurally along the femoral nerve sheath as well as the lumbar sacral plexus. This has been our standard method of postoperative pain control. Perineural marcaine catheters can reduce the need for morphone by approximately 80–90%. They are left in place for 3–5 days. F = femoral nerve; S = sciatic nerve; arrow indicates renografin (contrast) in sciatic sheath.

REHABILITATION AND EMOTIONAL SUPPORT

The cancer patient faces unique psychological problems with hemipelvectomy. Not only is there a threat to the loss of a lower limb and hemipelvis, but also there is a threat to life itself. Rehabilitation of the patient undergoing this major amputation begins at the time of the staging studies. The entire health-care team must develop an honest relationship with the patient and include him or her in the early stages of decision-making. Building upon trust and understanding, the patient will be better able to accept the amputation and set realistic goals.

All patients undergoing hemipelvectomy will experience considerable phantom limb sensation. This may be a major problem with the hemipelvectomy. As a matter of fact, it may end up being a more disruptive long-term problem to the patient than the loss of the limb itself. The patient should understand that phantom limb sensations are to be expected and that they can be treated with analgesics. It should be emphasized that the discomfort will lessen over time.

The patients who report severe disabling pain are often those who find it most difficult to adapt to surgery and to the malignant process.

Although successful rehabilitation depends to a great extent on the patient's attitude, the physiatrist can help tremendously in these efforts. A *positive attitude* toward functional recovery augmented by early postoperative ambulation (Figure 20.19) may move the patient rapidly to his or her goals. A positive approach is amplified by contact with other patients who have successfully met some of the rehabilitation challenges. This can provide an immeasurable psychological boost to the patient. The oncologist, rehabilitation therapist, and others involved in the postoperative care must coordinate their efforts carefully. There may be conflicting demands on the patient's time. There may be a different interpretation by the patient and family of the same clinical information presented by several different caregivers. The entire team must not only be coordinated but must be positive about the complete rehabilitation that can be achieved following hemipelvectomy.

Figure 20.19 A modern hemipelvectomy prosthesis with a special outer covering to simulate the patient's own skin texture. Note the heavy pelvic band. Weight is transmitted to the ischium as well as around the ribcage. Approximately two-thirds of patients (in the younger age group) having a hemipelvectomy will utilize a hemipelvectomy prosthesis.

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