

## Chapter 21

# Posterior Flap Hemipelvectomy

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### BACKGROUND

- Despite increasingly effective chemotherapy and advances in limb-sparing surgery around the pelvis and hip, 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.<sup>9–11</sup> An intimate knowledge of the pelvic anatomy (**FIG 1A,B**) and a systematic approach to the surgical procedure are required to minimize the intraoperative and postoperative morbidity associated with this demanding procedure.
- Early descriptions of the surgical technique of hemipelvectomy emphasized the importance of careful selection of patients and immediate replacement of blood loss.<sup>2,4,5,7,8,12–14,16–19,21,22</sup> Other, later technical descriptions of this procedure have been published.<sup>1,3,6,15</sup>
- 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<sup>16</sup> or interinnomino-abdominal<sup>20</sup> 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.
- Sugarbaker and Ackerman<sup>21</sup> and others have shown the utility of a myocutaneous pedicle flap based on 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 who require a well-vascularized flap for coverage.
- There are subtypes of the posterior flap hemipelvectomy. The term “classic hemipelvectomy” is used to refer to amputation of the pelvic ring via disarticulation of the pubic symphysis and the sacroiliac joint, division of the common iliac vessels, and closure with a posterior fasciocutaneous flap (**FIG 1C**).
- Classic hemipelvectomy is typically necessary for large 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 glu-

teus maximus, permitting creation of a vascularized myocutaneous posterior flap for wound closure. This term also describes 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 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 sacroiliac joint (**FIG 2**).
- 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. (Tumor suspected of extending into viscera or extremely large tumors filling the pelvic fossa can be approached through an intraperitoneal incision.)

### ANATOMY

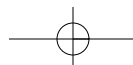
- The skeletal anatomy and contents of the pelvis are complex and difficult to visualize without direct experience. Major portions of the gastrointestinal tract, the urinary tract, the reproductive organs, and the neurovascular trunks to the extremities all coexist within the confines of the bony pelvis.
- Understanding the three-dimensional anatomy is essential to identifying and protecting these structures during a hemipelvectomy (see Fig 1A–C). 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 on sequential exposure and identification of these landmarks and structures.

#### Bony Anatomy

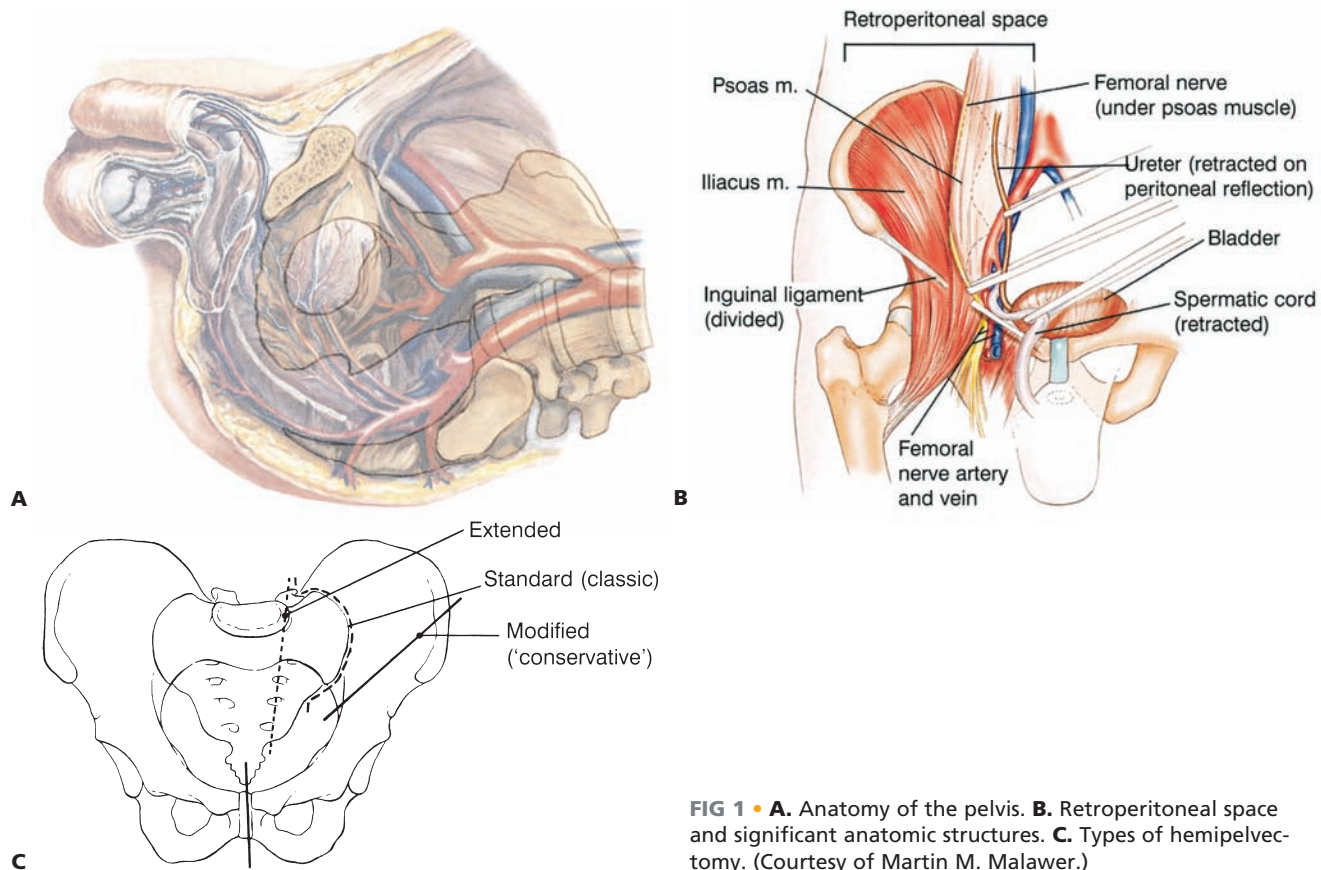
- The basic pelvic bony anatomy is best thought of as a ring running from the posterior sacrum to the anterior pubic symphysis. Major joints include the large, flat sacroiliac joints, the hip joints, and the pubic symphysis. The hip joint is easily located by motion of the extremity; the other joints are easily located and identified by palpation. Other easily palpable bony prominences include the iliac crest, the anterior superior iliac spine, 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 sacroiliac joint, the sciatic nerve and gluteal vessels are found under the sciatic notch, and 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



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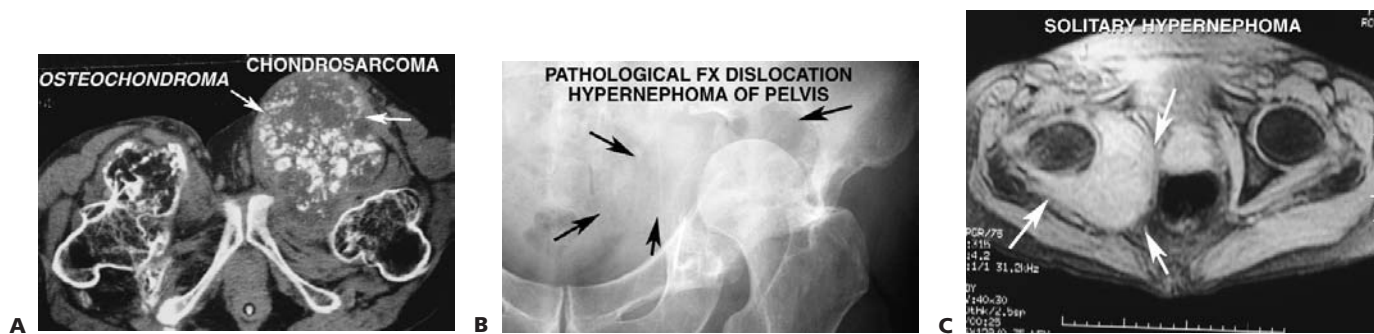


**FIG 1** • **A.** Anatomy of the pelvis. **B.** Retroperitoneal space and significant anatomic structures. **C.** Types of hemipelvectomy. (Courtesy of Martin M. Malawer.)

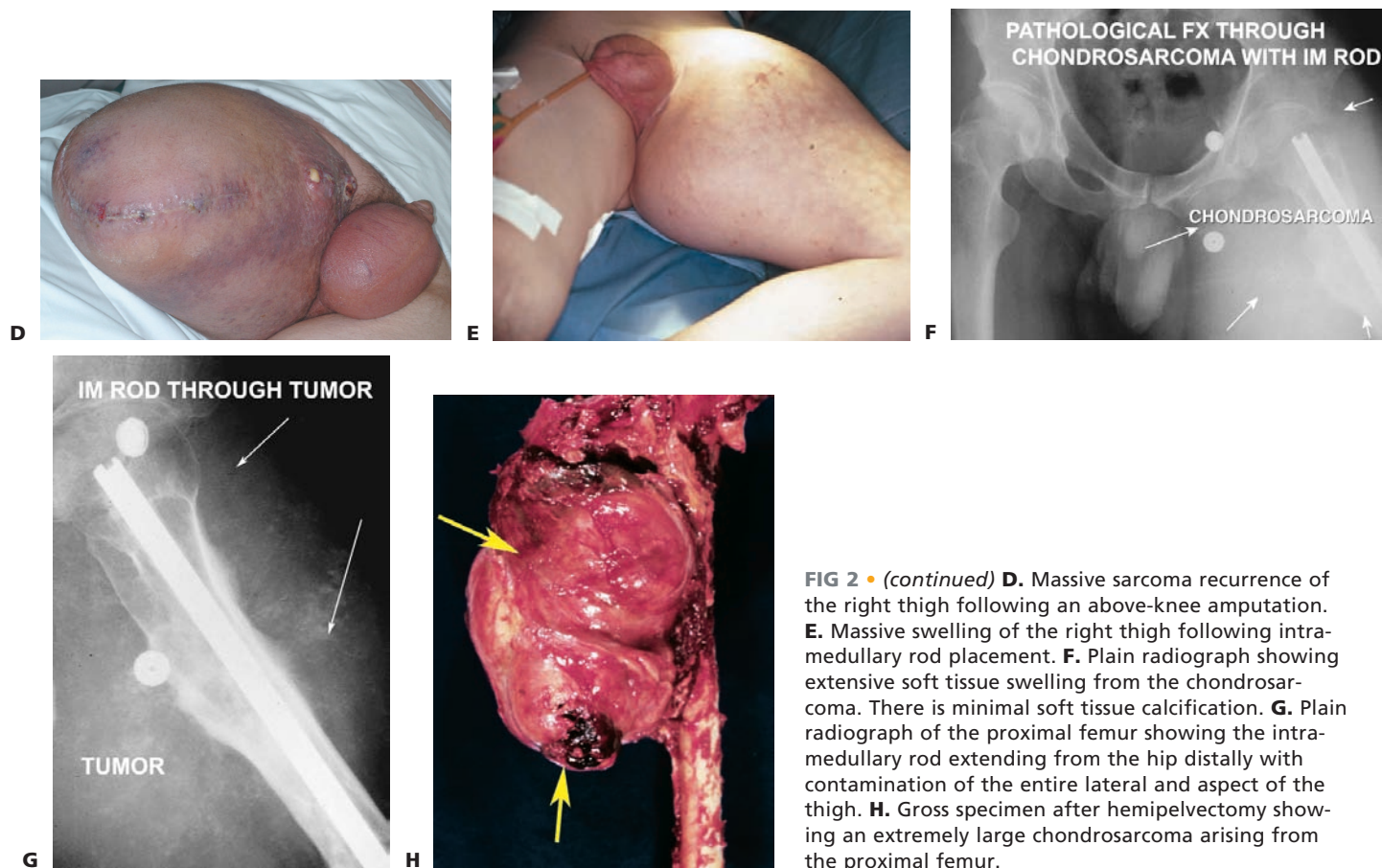
classification scheme, in which the level of ligation determines the type of amputation to be performed. As the abdominal aorta and vena cava descend into the pelvis they bifurcate, creating the common iliac arteries and veins. This bifurcation typically occurs at L4, with the lower bifurcation occurring 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 before performing a ligation (see Fig 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



**FIG 2** • **A.** CT scan showing a large chondrosarcoma arising from the left proximal femur. Benign osteochondroma is on the ipsilateral femur. This patient had multiple hereditary osteochondromas. This is one of the more common indications for performing a hemipelvectomy. Chondrosarcoma is the most common malignant tumor of the pelvis. **B.** Pathological fracture (distal location) through an extremely large renal cell carcinoma of the left pelvis. There is a large soft tissue component extending almost to the midline. **C.** Solitary renal cell carcinoma metastasis of the right proximal femur extending into the pelvis. This MRI shows a large extrasosseous component with complete destruction of the periacetabular area, and with tumor filling the ischiorectal space. Solitary renal cell carcinoma metastasis is considered to be one of the few indications for radical amputation due to metastatic carcinoma. (continued)



**FIG 2 • (continued)** **D.** Massive sarcoma recurrence of the right thigh following an above-knee amputation. **E.** Massive swelling of the right thigh following intramedullary rod placement. **F.** Plain radiograph showing extensive soft tissue swelling from the chondrosarcoma. There is minimal soft tissue calcification. **G.** Plain radiograph of the proximal femur showing the intramedullary rod extending from the hip distally with contamination of the entire lateral and aspect of the thigh. **H.** Gross specimen after hemipelvectomy showing an extremely large chondrosarcoma arising from the proximal femur.

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 genitourinary tracts are present and exposed during a hemipelvectomy. These structures should be completely evaluated before surgery.
- The bladder and urethra, and the prostate in male patients, 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 women who have undergone hysterectomies. In female patients who have not undergone such surgery, these organs are found under and adjacent to the bladder. They can be easily and safely retracted out of the operative field.

- Most 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 before completing the amputation. Insertion of a rectal tube before 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 are prudent.

## INDICATIONS

### Unresponsive Sarcomas Involving Multiple Compartments

- The most common indication for hemipelvectomy is a non-metastatic sarcoma that fails to respond to neoadjuvant chemotherapy or radiation. In addition, patients with extremely large sarcomas 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 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.



### Contamination of Surrounding Structures

- Patients with extensive contamination of compartments from inappropriately placed biopsies 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 (Fig 2).
- Traditionally, such fractures have been treated with hemipelvectomy, although some institutions now attempt limb-sparing procedures after aggressive preoperative (neoadjuvant) treatment and spica immobilization.

### Nonviable Extremity Precluding Limb Salvage

- Elderly patients with significant peripheral vascular disease and patients with fungating, infected sarcomas that preclude limb-sparing surgery may be candidates for hemipelvectomy.
- 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 after aggressive surgical and medical treatment.
- Careful patient evaluation is necessary to rule out metastatic disease in such cases.
- Hemipelvectomy may also be required to control infection after limb-sparing procedures around the hip and pelvis.

### Palliation

- The use of radical amputation for palliation of patients with metastatic disease is rare. Palliative indications for hemipelvectomy include uncontrollable pain from tumor involvement of the lumbosacral plexus, sciatic, and femoral nerves.
- Patients with uncontrollable local disease from metastatic carcinoma who have failed to respond to 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 longstanding paralytic conditions. 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. In both circumstances, oncologic margins are not required, making the surgery easier to perform.

## IMAGING AND OTHER STAGING STUDIES

- Complete imaging and staging of the patient are essential for proper patient selection and preoperative planning. Routine

preoperative staging studies of the patient should include a computed tomography (CT) scan of the chest and a 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 Radiographs

- Radiographs remain the gold standard for the detection and diagnosis of bone sarcomas. Evaluation of patients with suspected pelvic and hip or 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 the iliac and obturator oblique views described by Judet, as well as inlet and outlet views. Given the complexity of pelvic anatomy, cross-sectional images are vital.

### CT and Magnetic Resonance Imaging

- 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, intravenous, and rectal contrast media can greatly improve the ability of CT scanning to image the visceral organs of the pelvis.
- CT is extremely useful in evaluating the sacroiliac joint, the sciatic notch, and the symphysis pubis.
- MRI often provides a better image of the soft tissue and the intramedullary extent of sarcoma. 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 may require both imaging modalities.

### 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 atherosclerotic disease of the femoral vessels that could jeopardize the success of the flap.
- If a modified hemipelvectomy is being considered, angiography reveals the level of the common iliac bifurcation. Patients undergoing palliative amputation may benefit from preoperative embolization to reduce intraoperative bleeding.

### 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 by sigmoidoscopy and cystoscopy may be essential in selected patients. Pelvic venography should be performed if there is any clinical suspicion of venous obstruction (ie, distal edema). Venous tumor thrombi often occur with large pelvic chondrosarcomas. Tumor thrombi should be removed during surgery.

### Biopsy

- The biopsy of tumors around the pelvis and proximal femur must be extremely well planned to avoid contaminating the

posterior flap, which is the most common type of hemipelvectomy performed. The orthopedic oncologist who will be performing the amputation should be present during the biopsy procedure to ensure that a proper and appropriately placed biopsy is performed (**FIG 3**).

## SURGICAL MANAGEMENT

### Positioning

■ The patient is placed in a modified semisupine 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.

### Approach

■ 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 and abduction of the hip then allows the surgeon to divide the muscles and ligaments of the pelvic floor and complete the amputation.



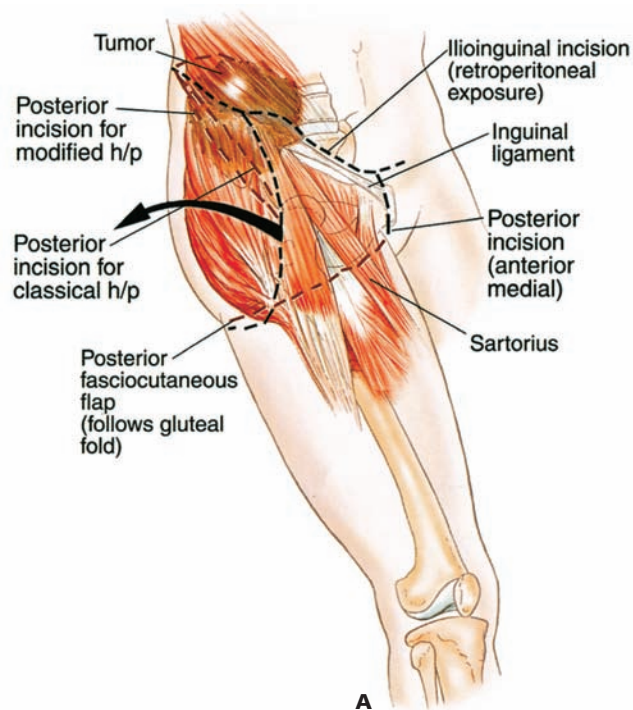
**FIG 3** • The biopsy of tumors around the pelvis and proximal femur must be extremely well planned to avoid contaminating the posterior flap, which is the most common type of hemipelvectomy performed. The posterior flap of the hemipelvectomy includes either the subcutaneous flap over the gluteus maximus or, if a modified posterior flap hemipelvectomy is performed, the above as well as the underlying gluteus maximus muscle.

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

## ANTERIOR RETROPERITONEAL APPROACH THROUGH THE ILIOINGUINAL INCISION

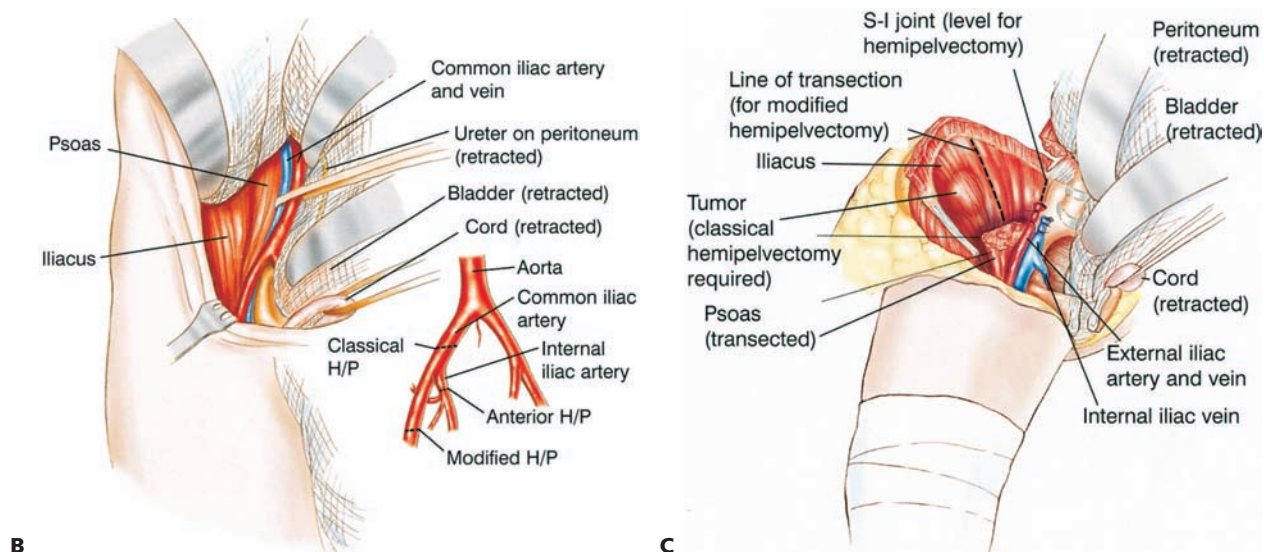
- Through this incision (**TECH FIG 1A**), the retroperitoneal space is explored by detaching the abdominal wall musculature from above the ilioinguinal ligament and off the iliac crest (**TECH FIG 1B**). For large tumors of the ilium the retroperitoneal space is entered laterally, where there is more free retroperitoneal fat. The peritoneum is then reflected off the tumor mass and the retroperitoneal space is developed. The ureter remains on the peritoneal reflection. 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. All structures are transected or mobilized anteriorly before proceeding to the next steps. It is crucial to identify all of the vascular struc-

**TECH FIG 1 • A.** Ilioinguinal retroperitoneal incision and approach. 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 in contrast to the typical lateral position frequently used by other authors. (*continued*)



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## TECHNIQUES



**TECH FIG 1 • (continued) B.** The retroperitoneal space is easily entered by detaching the abdominal wall musculature from above the ilioinguinal ligament and off the iliac crest. The peritoneum is then reflected off the tumor mass, and the retroperitoneal space is developed. It is crucial to identify all of the vascular structures initially to prevent any mistakes in ligation. **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.

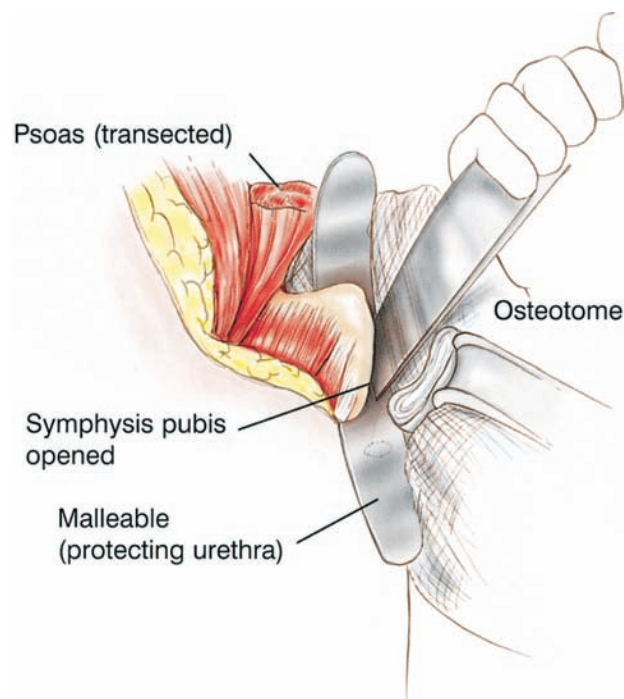
tures initially to prevent any mistakes in ligation. The levels of transection and ligation of the iliac vessel, along with its two major branches (internal and external iliac vessels), are illustrated in the inset to Technique Figure 1B. A classic hemipelvectomy requires ligation of the common iliac artery and vein. A modified hemipelvectomy requires preservation of the hypogastric artery and

specifically the first branch, the superior gluteal artery (**TECH FIG 1C**). The external iliac artery and vein are ligated. The anterior hemipelvectomy requires the external iliac artery to be intact; it 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.

## 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 retracted 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 malleable retractor (**TECH FIG 2**). A foley catheter is 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.

**TECH FIG 2 •** 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.

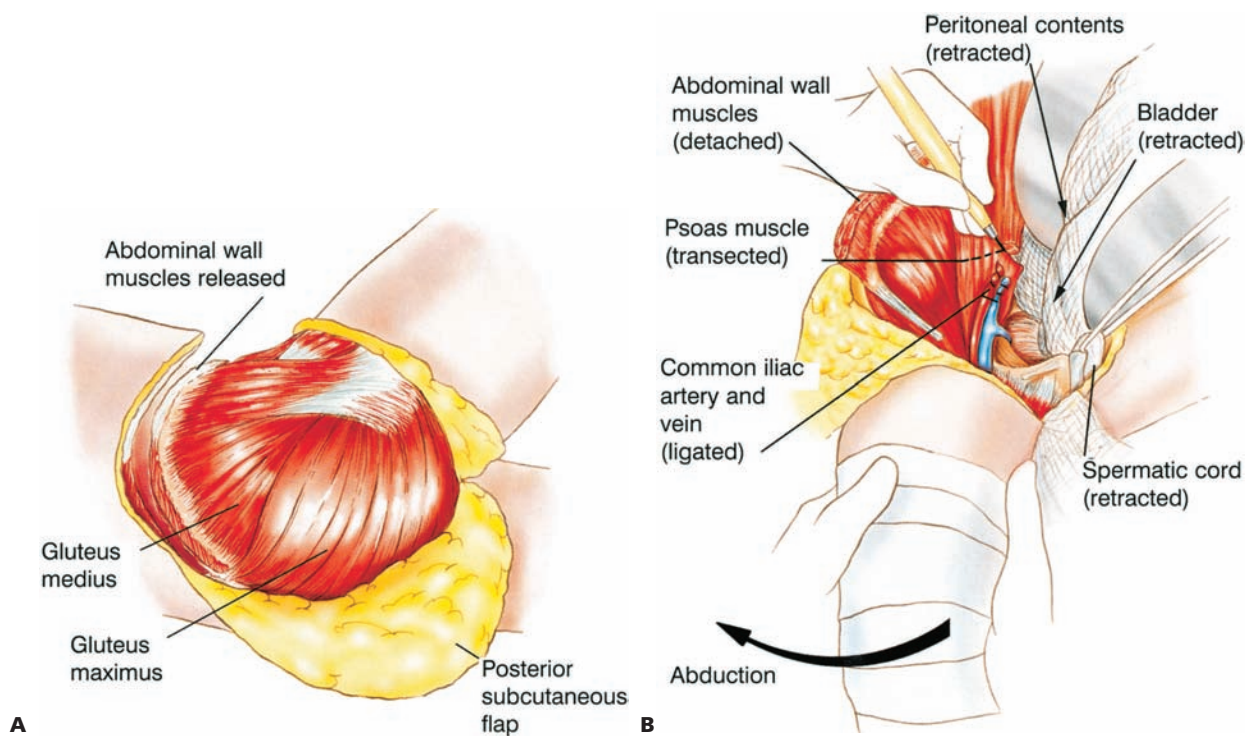




## POSTERIOR FLAP RETROGLUTEAL AREA EXPLORATION

- The third component of the procedure is the posterior fasciocutaneous or subcutaneous flap that is mobilized along the iliotibial band and the greater trochanter toward the sacroiliac joint. A classic hemipelvectomy involves the removal of all gluteal structures, and only the subcutaneous flap remains (**TECH FIG 3**). A classic hemipelvectomy consists of a disarticulation of the

sacroiliac joint, therefore requiring all of the abdominal muscles to be released up to the paraspinal muscles. The iliolumbar ligament is a good surgical landmark: it inserts onto the ilium posteriorly just above the superior aspect of the sacroiliac joint. This is especially useful in obese patients in whom the sacroiliac joint cannot easily be palpated.

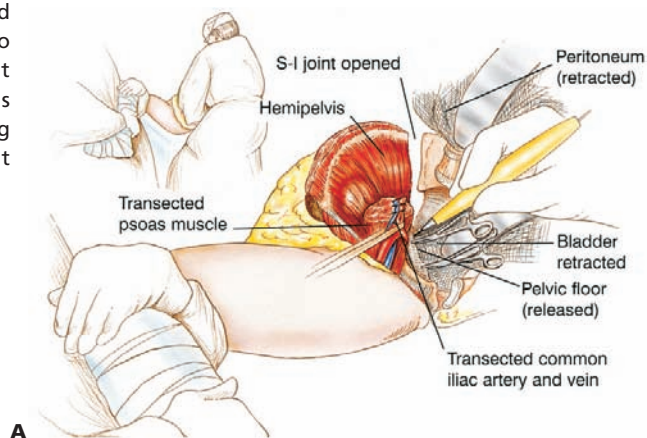


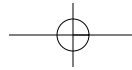
**TECH FIG 3** • **A**. The abdominal wall musculature is released from the crest of the ilium with a 1–2 cm cuff of muscle remaining along the ilium. **B**. The psoas muscle has a tendency to bleed postoperatively and should therefore be oversewn. Depending on the type of hemipelvectomy to be performed (classical or modified), the level of the abdominal wall musculature release and the level of the posterior osteotomy will vary.

## 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 (**TECH FIG 4**).

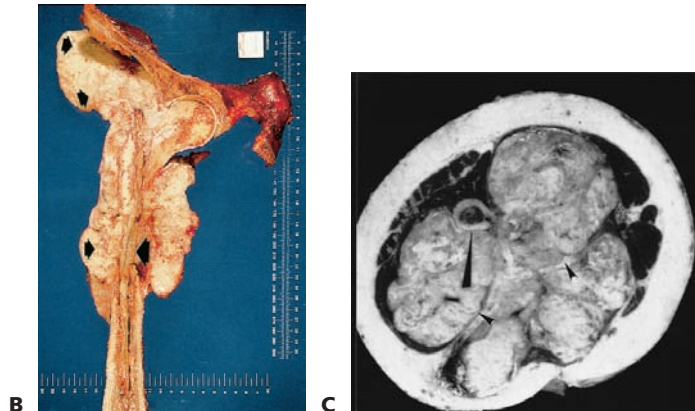
**TECH FIG 4** • **A**. Completion of amputation and release of pelvic floor muscles. The final steps of the amputation involve the release of the sacroiliac joint and the remaining pelvic sling muscles attaching to the ilium and pelvic floor. (*continued*)





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### TECHNIQUES



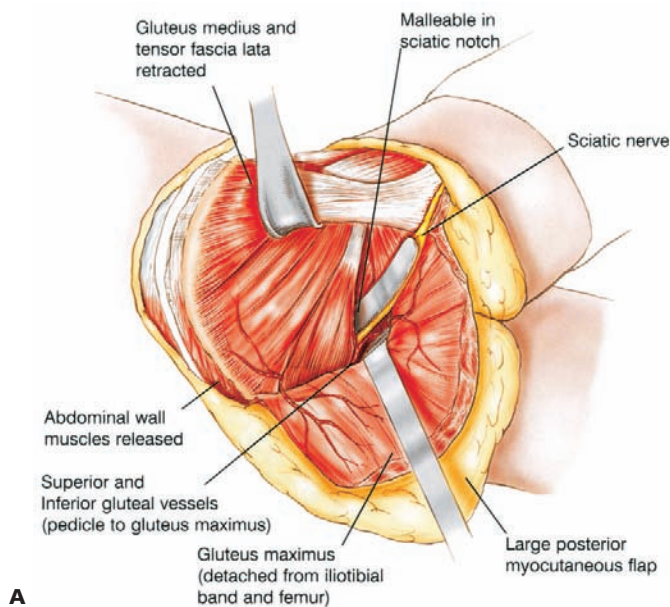
**TECH FIG 4 • (Continued) B.** Gross specimen following hemipelvectomy for multiple recurrences of metastatic renal cell carcinoma. Small arrows indicate recurrent tumor; large arrows indicate intramedullary tract site. **C.** This tumor has crossed several anatomical boundaries and involves the anterior, posterior, and medial compartments of the thigh. Large arrow indicates the location of the femur; small arrows indicate intervascular septa. (Courtesy of Martin M. Malawer.)

### COMPLETION OF THE AMPUTATION WITH SACROILIAC DISARTICULATION

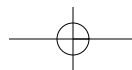
- The amputation is completed by transecting the sacroiliac joint with a large osteotome while retracting the peritoneal contents and avoiding the previously transected iliac vessels. The surgical assistant stands on the same side of the table as the surgeon and flexes and abducts the lower extremity to expose the pelvic floor muscles for the surgeon. A sponge on a stick is used to push the rectum off the pelvic sling muscles in the inferior portion of the wound. If a left-sided hemipelvectomy is performed, great care must be taken to mobilize the rectum to avoid injuring 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. The sacroiliac joint is not opened previously due to the potential for bleeding from injury to the perisacral veins.
- If a posterior modified hemipelvectomy is performed,

the wing of the ilium is transected from the sciatic notch to the midportion of the ilium. The hypogastric artery is preserved and the external iliac artery is ligated. The choice between a classic hemipelvectomy and a modified posterior flap hemipelvectomy is made preoperatively. In general, modified hemipelvectomies are performed for thigh and groin lesions, whereas classic hemipelvectomies are performed for true pelvic tumors of the muscle or bony structures (**TECH FIG 5A**).

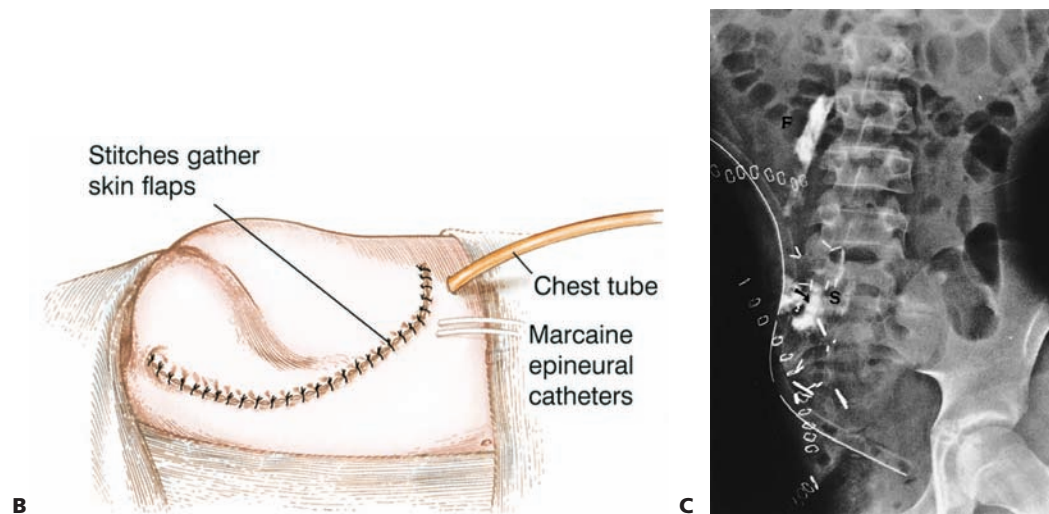
- A modified hemipelvectomy preserves a portion of the wing of the ilium and the underlying gluteus maximus muscle and its major pedicle, the inferior gluteal vessels. Therefore, an osteotomy is performed through the wing of the ilium starting at the sciatic notch. The iliocapsular muscle is transected internally and the abductor muscles are transected longitudinally (posteriorly). All of the muscles located anteriorly in the pelvis are transected at this step.



**TECH FIG 5 • A.** 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 and the inferior gluteal vessels. (continued)







**TECH FIG 5 • (Continued) B.** Skin closure. A large 28-gauge chest tube is utilized for drainage. **C.** Postoperative radiograph of an extended hemipelvectomy (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. *F*, femoral nerve; *S*, sciatic nerve; *arrow* indicates Renografin (contrast) in sciatic sheath. (Courtesy of Martin M. Malawer.)

The sacroiliac joint is also identified anteriorly and the vessels are mobilized off the sacroiliac joint in preparation for the sacroiliac disarticulation that is the final step of the operative procedure.

- Closure of the flap is then performed over large 28-gauge chest tubes with suction drainage (**TECH FIG 5B**).
- Marcaine epineural catheters are used for continuous pain relief postoperatively (**TECH FIG 5C**). Two catheters are used: one is inserted into the lumbosacral plexus and the other into the femoral nerve.
- The wound is closed by rotating and suturing the prepared myocutaneous flap to the abdominal wall and flank.

## PEARLS AND PITFALLS

Preoperative	<ul style="list-style-type: none"> <li>■ Minimizing 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 granulocyte colony-stimulating factor may be of significant benefit. Replacing red cell mass by blood transfusion and correcting bleeding abnormalities are essential to reduce the risk of intraoperative mortality.</li> <li>■ 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.</li> </ul>
Intraoperative	<ul style="list-style-type: none"> <li>■ To reduce the risk of postoperative infection, bowel preparation should be performed for all patients.</li> <li>■ Perioperative antibiotic coverage for aerobic skin flora and anaerobic bowel flora is required.</li> <li>■ If 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.</li> <li>■ 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.</li> </ul>
Postoperative	<ul style="list-style-type: none"> <li>■ 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 distention; this reduces pressure on the skin closure. Skin sutures or staples should be retained for 3 to 4 weeks to minimize the risk of wound dehiscence.</li> <li>■ Routine placement of a nasogastric tube and avoidance of oral feeding are required to prevent nausea, vomiting, aspiration, abdominal distention, and wound complications. Early intravenous nutritional supplementation should be considered.</li> <li>■ 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.</li> </ul>

- 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 to 3 months as the contralateral innervation becomes dominant. An indwelling Foley catheter should be maintained until the patient becomes mobile, and postvoid residuals should be measured once the catheter is removed.
- A prosthesis should be offered to all patients, even though not all of them may use it. If a segment of ilium has been preserved, a suspension belt may be used.

## POSTOPERATIVE CARE

- The patient should understand that phantom limb sensations are to be expected and that they can be treated with analgesics. The discomfort will lessen over time.
- 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 may move the patient rapidly to his or her goals. A positive approach is amplified by contact with other patients who have 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.

## OUTCOMES

- Most patients can ambulate after appropriate rehabilitation and use of hemipelvectomy prostheses.
- Most patients who survive their disease will go on to enjoy a high quality of life and participate in a multitude of recreational activities (**FIG 4**).
- Recent reports of series of hemipelvectomy patients have shown that this procedure has a low mortality rate and offers an acceptable survival in carefully selected patients.
- 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.

- Elderly and overweight patients may become wheelchair-dependent after 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. However, a prosthesis enables the wearer to stand for prolonged periods of time without supports and frees both hands for other activities.

## COMPLICATIONS

- All patients undergoing hemipelvectomy will have considerable phantom limb sensation. It may be a more disruptive long-term problem to the patient than the loss of the limb itself. 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.
- 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% to 50% of patients develop clinically significant ischemia. Pressure from prolonged lying or sitting on the flap may result in ischemic necrosis. Early identification of necrosis

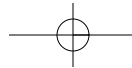


A



B

**FIG 4** • **A.** Photograph of a patient 5 years after a hemipelvectomy playing golf, using the golf cart as a brace. **B.** Plain radiograph showing one of the longest follow-ups (23 years) after modified posterior flap hemipelvectomy. This patient still ambulates well with a hemipelvectomy prosthesis. The remaining portion of the left ilium provides an area for the hemipelvectomy prosthesis to rest against.



and surgical revision is 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 is seen in about 15% of patients. Other factors that increase the risk of infection include immunosuppression from surgical stress, transfusions, and psychological depression. Steps to reduce the incidence of infection should include the use of preoperative bowel preparation, 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 débridement and prolonged dressing changes are often necessary.

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