

13

Adductor Muscle Group Excision

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OVERVIEW

The adductor muscle group is the second most common site for high- and low-grade soft-tissue sarcomas of the thigh. Liposarcoma is the most common tumor arising within this compartment. Although these tumors often become large prior to clinical detection, limb-sparing resection may be safely performed in 90–95% of patients with adductor tumors. Today, induction chemotherapy, radiation therapy, or both permit a safe compartmental or partial muscle group resection for even the largest tumors. Amputation (modified hemipelvectomy) is required if there is intrapelvic extension, superficial femoral artery and vein involvement, or sciatic notch extension and, in rare cases, palliation.

Preoperative staging studies must evaluate the sartorial canal, pelvic floor, medial hamstrings, ischium, psoas muscle, and hip joint. A limb-sparing procedure begins with dissection and preservation of the superficial femoral artery. The profundus femoris artery is ligated. The adductors are then detached from the femur and from its origin along the inferior and superior pubic rami and ischium. Preservation of the sciatic nerve is necessary. Surgical reconstruction of the defect is performed by transferring the sartorius muscle and the remaining medial hamstrings. Functional loss following resection is minimal.

INTRODUCTION

The adductor compartment is the second most common muscle group involved by soft-tissue sarcomas of the thigh. Tumors arising within the adductor compartment are often extremely large. As they enlarge they often displace the superficial femoral artery and profundus, involve the extrapelvic floor musculature (obturator fascia) and bone (superior and inferior pubic rami and ischium), and even extend extracompartmentally to the medial hamstrings and/or the psoas muscle and the adjacent hip joint. The anatomic characteristics often make resection extremely difficult.

Traditionally, large high-grade soft-tissue sarcomas of the proximal adductor group required an amputation one level above the pelvic ring, i.e., a modified hemipelvectomy. Today, a large majority of these patients may benefit from a limb-sparing procedure (muscle group resection). Wide excision of the involved compartment, followed by postoperative radiation therapy, yields local control rates of 90–95%. Preoperative radiation therapy and resection yield similar results; however, this approach is associated with a very high incidence of wound complications (20–25%). Alternatively, induction chemotherapy has been shown to markedly shrink regional sarcomas and permit resection.

We have examined more than 50 soft-tissue sarcomas following induction chemotherapy. The median tumor necrosis was greater than 90%. On the basis of these findings we conclude that radiation therapy and its associated long-term complications may be avoided if there is greater than 90% tumor necrosis and negative tumor margins. If radiation therapy is required, it is not begun until 3–6 weeks after the wound is completely healed.

ANATOMIC CONSIDERATIONS

The medial (adductor) compartment of the thigh consists of the adductor magnus, the brevis and longus, and the gracilis muscles. All arise from the pelvic floor and the medial aspect of the ipsilateral pelvic ring, symphysis pubis, inferior pubic ramus, ischium, and obturator fascia. They attach distally to the linea aspera and the medial aspect of the distal femur. The adductors are mainly innervated by the obturator artery and nerve. The profundus femoris artery passes through the adductor brevis and travels along the linea aspera. This compartment is best thought of as an inverted funnel – the base being the obturator ring and fascia, the lateral border being the femur and linea aspera, and the tip of the cone being the adductor hiatus (Figure 13.1).

Sartorial Canal

The sartorial canal extends from the femoral triangle to the adductor hiatus, which is an opening of the adductor magnus. The superficial femoral artery passes along the anterior and lateral margin of the entire compartment and forms the lateral border. Most adductor tumors displace the superficial femoral artery (SFA) and vein but rarely directly involve these structures. The profundus femoris artery is often involved and must be ligated as it passes through the adductor brevis.

Pelvic Floor

The bony structures of the pelvic floor are the closest margin for large sarcomas that arise within this muscle group. The obturator artery and nerve, which pass through the obturator fascia, are routinely ligated. Occasionally tumors arising from the pelvic ring require resection of the pelvic floor (Type III pelvic resection) if negative margins are to be obtained in conjunction with a formal adductor group resection. This combination of surgical procedures can be performed as a true limb-sparing procedure in lieu of a hemipelvectomy. Rarely, proximal adductor tumors may extend as a dumb-bell around the ischium into the ischiorectal fossa (space). The possibility of such extension must always be evaluated preoperatively.

Medial Hamstrings and Ischium

The medial hamstrings also take their origin from the ischium. There is no intermuscular septum separating the adductor group from the posterior hamstrings proximally; therefore, extracompartmental extension often occurs between the adductor muscles and the medial hamstrings as these tumors enlarge proximally. Adequate resection may require partial medial hamstring resection.

Sciatic Nerve

The sciatic nerve belongs to the posterior compartment musculature, but as it passes from the buttock to the posterior thigh it is in close apposition to the ischium. Thus, large tumors of the adductor muscles arising near the ischium routinely displace the sciatic nerve as well as extending extracompartmentally. The sciatic nerve must be explored and preserved at the time of surgery. It is usually displaced but is rarely infiltrated by a sarcoma.

The iliopsoas muscle attaches to the lesser trochanter and covers the medial aspect of the hip joint. It is not a

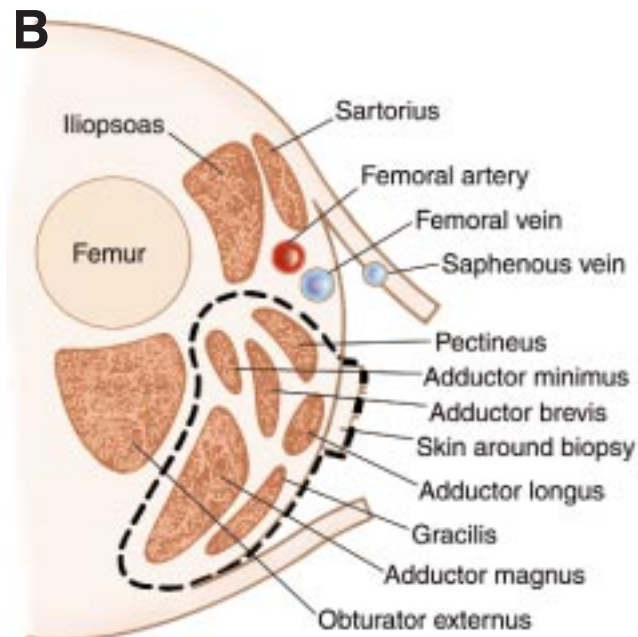


Figure 13.1 (A) Clinical photograph of a patient with an extremely large liposarcoma of the adductor group. Note the distended veins that indicate compression of the deep superficial femoral vein and profundus. Evaluation of patients with large adductor sarcomas must include the intrapelvic area, groin, popliteal space, and the superficial femoral artery. Despite the large size of this lesion this patient underwent a wide resection of the adductor muscle group. (B) Cross-sectional anatomy of the adductor group is outlined. The sartorial canal is opened.

component of the adductor group. Tumors of the adductor brevis and longus may involve the iliopsoas muscle and hip as they enlarge. The iliopsoas and hip capsule must be closely evaluated and removed at the time of resection if involved by tumor.

STAGING STUDIES

Computerized Axial Tomography (CAT)/Magnetic Resonance Imaging (MRI)

CAT and MRI are the most useful studies for determining tumor extent (Figures 13.1 and 13.2). Careful evaluation can determine whether a portion of the adductor compartment or the entire compartment must be resected. Both studies are useful to determine bony or soft-tissue extension into the ischioanal space, obturator foramen, psoas, and hip capsule, as well as involvement of the proximal medial hamstrings. The sciatic nerve can usually be visualized with these studies.

Bone Scan

Three-phase bone scans of the pelvis and thigh are used to determine pelvic, ischial, and femoral involvement. Increased uptake of bony structures is a contraindication for a traditional compartmental resection, but may indicate whether a combined bony procedure can be performed in order to avoid an amputation.

Biplane Angiography

It is essential to evaluate the relationship of the SFA and profundus femoris artery to the tumor mass (Figure 13.3). The profundus is often ligated when one is performing an adductor muscle group resection. It is important to ascertain whether the superficial femoral artery is patent, especially in older patients. In such individuals the SFA may be completely occluded because of peripheral vascular disease. In such a case,

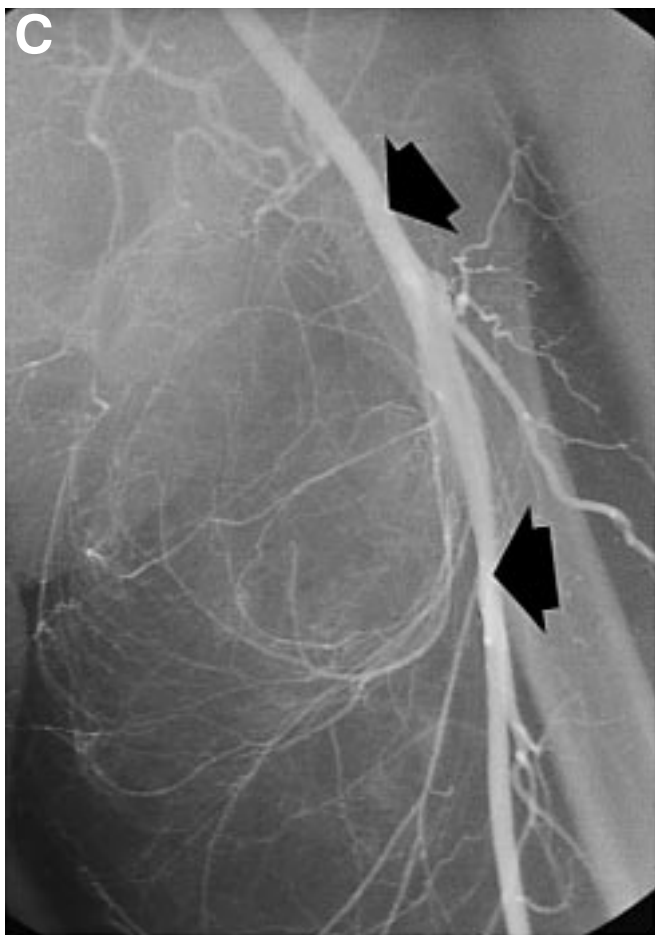
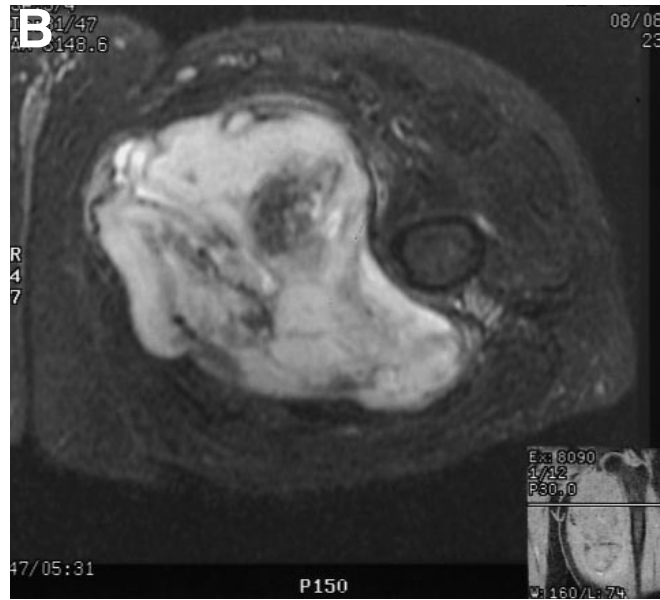


Figure 13.2 Staging studies for large adductor group tumors. (A) Coronal T1 weighted MRI scan of the thigh. Note the large mass (arrows) involving the entire adductor muscle group that is approaching the obturator fascia (pelvic floor) and the hip joint. Note that there is no intrapelvic extension. (B) Axial T2 weighted MRI scan showing large adductor group tumor involving the adductor muscles and displacing the medial gastrocnemius muscle and the superficial femoral artery. There is also extension to and displacement of the gluteal muscles. Large adductor tumors of the proximal thigh often extend into the retrogluteal or hamstring compartments. Low-grade tumors are generally resected with negative margins. (C) Angiography is routinely performed for all adductor group tumors. The superficial femoral artery is often displaced (large black arrows) but almost never involved directly by tumor due to the thick fascial border of the sartorial canal. The profundus vessel is routinely ligated during the dissection as it passes below the adductor brevis (see text).

only the profundus artery supplies the lower extremity and it must be preserved. Alternatively, a vascular bypass graft can be performed prior to tumor resection. Ligation of the profundus artery without a patent SFA will lead to a nonviable extremity.

BIOPSY

All biopsy sites should be in line with the anticipated incision for surgical resection. In general, the incision should be parallel to the inferior border of the sartorial canal (Figure 13.1B). A large medial flap based posteriorly is required for the definitive resection. Thus, the biopsy site should be longitudinal and parallel to

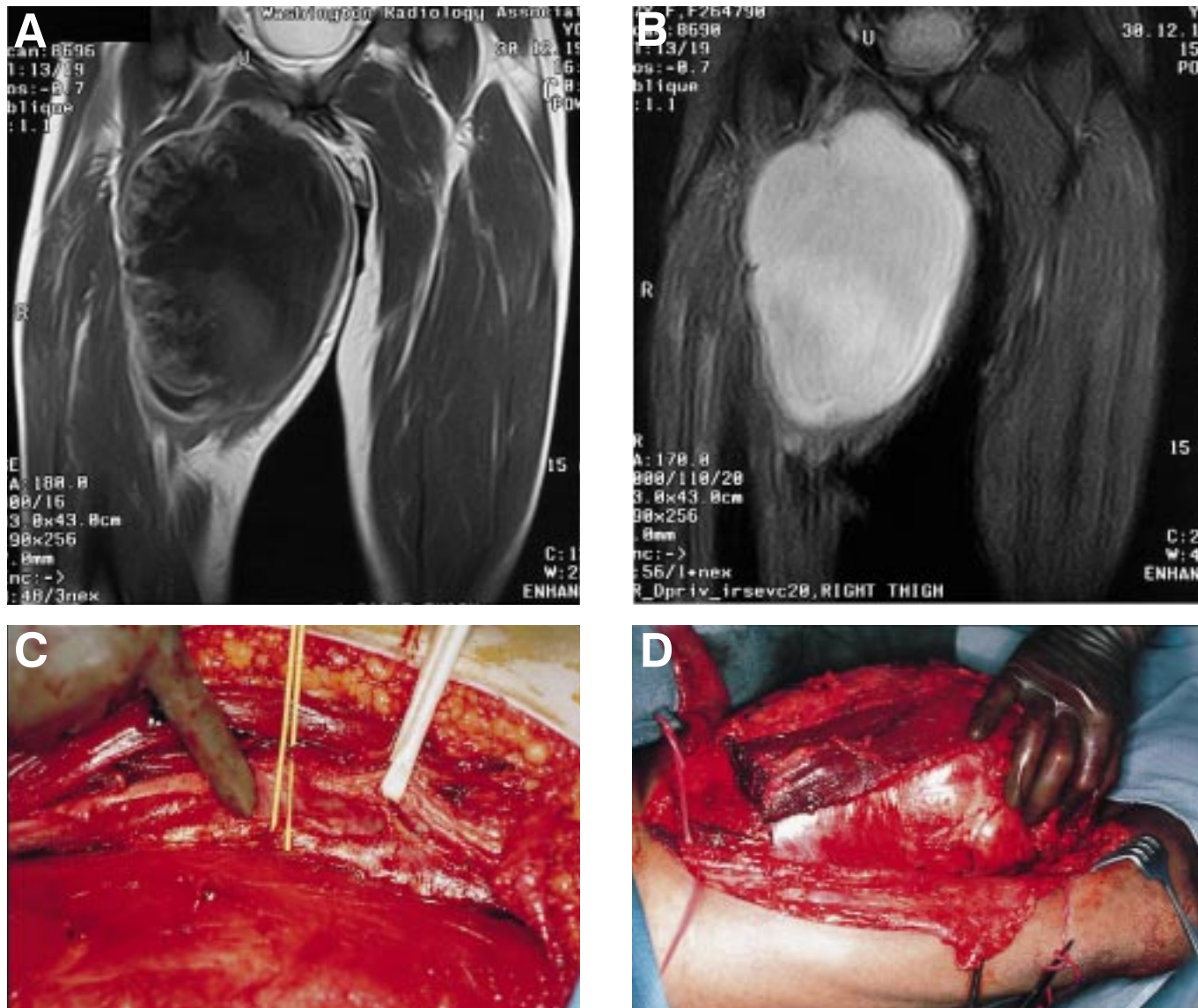


Figure 13.3 (A) Large adductor tumor not involving the pelvic fossa or the hip joint showing significant hemorrhage necrosis. This occurred following induction chemotherapy. (B) T2 weighted MRI scan showing no evidence of intrapelvic extension. The tumor is located proximally to the thigh with displacement of the superficial femoral artery. (C) Intraoperative photograph demonstrating the exploration and dissection of the entire length of the entire superficial femoral artery from the femoral triangle to the adductor hiatus. The profundus is ligated and the adductor muscles are released from their origin on the distal femur. (D) Intraoperative photograph demonstrating the mobilization of the adductor tumor within the adductor muscle group covered by normal muscle that has been distended as well as the deep fascia of the sartorial canal that is utilized as a border between the tumor and the superficial femoral artery. This is a constant finding that permits safe resection of most adductor tumors. The final step of the surgical procedure is the release of the adductors off of the femur and the obturator fascia (see text).

the sartorial canal. Multiple core biopsies may be taken through a single puncture wound. The biopsy should avoid contaminating the sartorial canal, popliteal space, hip area, pelvic floor, sciatic nerve, and posterior compartment. Diagnostic tissue can easily be obtained from

large tumors in this area. Fine-needle aspiration is usually not utilized for soft-tissue sarcomas. An open incisional biopsy is rarely required. If one has been performed, the biopsy site and all contaminated tissue must be removed en-bloc when the tumor is resected.

INDICATIONS AND CONTRAINDICATIONS TO LIMB-SPARING SURGERY

Approximately 90–100% of most high-grade soft-tissue sarcomas and almost all low-grade sarcomas of the adductor group can be safely resected. Today, amputation is rarely required. There are, however, several contraindications to limb-sparing surgery. In general, a combination of several contraindications is required, most of which are related to extremely large tumors. We recommend induction chemotherapy and repeat staging studies prior to a definitive decision regarding amputation.

Contraindications to limb-sparing surgery include the following:

1. *Major neurovascular involvement.* Direct tumor involvement of the superficial femoral artery within the sartorial canal may occur in rare cases. A vascular graft may be considered, to salvage the extremity.
2. *Pelvic floor involvement.* Tumor extension to the pelvic floor, obturator foramen, and, especially, the ischio-rectal fossa makes resection difficult.
3. *Extensive extracompartmental extension.* Tumor extension to the hip joint, groin, and/or posterior compartment often eliminates a limb-sparing option in patients with extremely large tumors.
4. *Palliation.* Palliation for local recurrence following radiation therapy or failed limb-sparing surgery usually requires a hemipelvectomy, especially in a patient with infection, hemorrhage, or fungation.

SURGICAL GUIDELINES

The surgical guidelines and techniques of complete or partial adductor muscle group resections are summarized:

1. The SFA and vein are initially explored within the sartorial canal, from the femoral triangle to the adductor hiatus. The vessels must be free of tumor. If the tumor extends into the popliteal space the popliteal artery and vein are explored and preserved.
2. Large posteromedial flaps are elevated to expose all resection planes. The resection planes must leave a wide margin and a normal muscle cuff in all directions around the tumor. Portions of the medial hamstrings may have to be removed if the tumor extends proximally.
3. The sciatic nerve is explored early and must be free of tumor and preserved.
4. The pelvic floor and ischium are explored. If involved by tumor, they must be resected either intra- or extrapelvically.
5. The sartorius muscle is preserved and rotated distally to close over the exposed femoral vessels prior to skin closure. The medial hamstrings are rotated anteriorly to cover the femur and popliteal space.
6. A 28-gauge chest tube is utilized to drain the surgical dead space in order to avoid postoperative hematomas. An abduction brace is used for 3–4 weeks postoperatively to prevent abduction and secondary wound dehiscence, especially for the perineal portion of the incision.

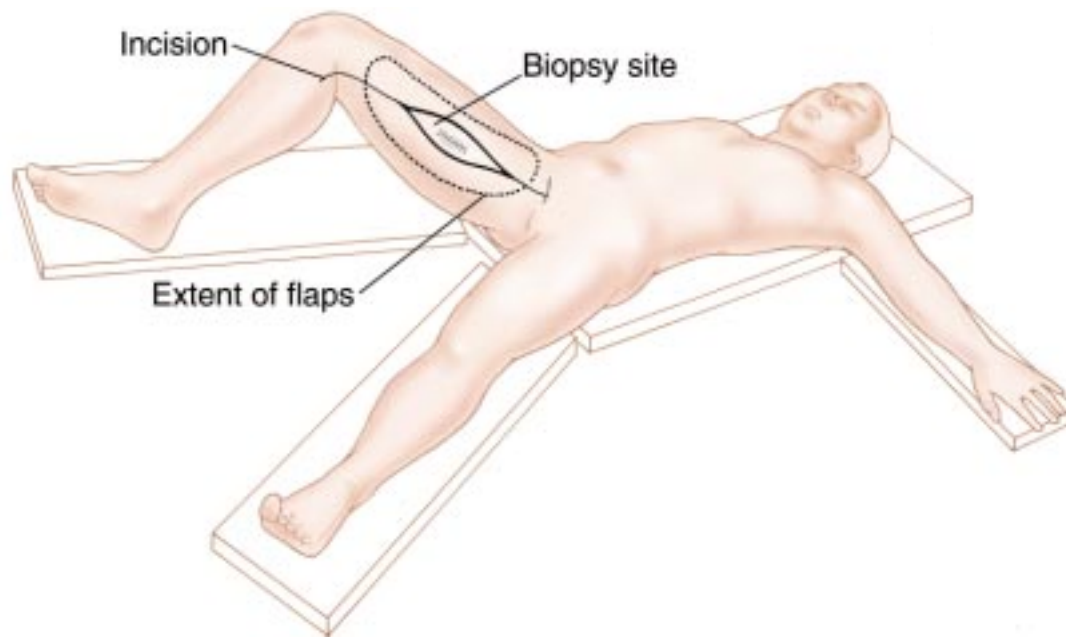


Figure 13.4 Incision. The incision extends from the proximal border of the inguinal region just inferior to the sartorius muscle and parallels the muscle to the posteromedial aspect of the knee. It includes the old biopsy site. This incision permits both large anterior and posterior flaps to be developed in order to visualize the vastus medialis, the sartorial canal, and the entire adductor compartment. The incision can be extended to expose the popliteal space medially if required. The superior extent may have to be "T"ed along the border of the inferior pubic ramus if there is a large soft-tissue component extending to the obturator fossa and ischium.

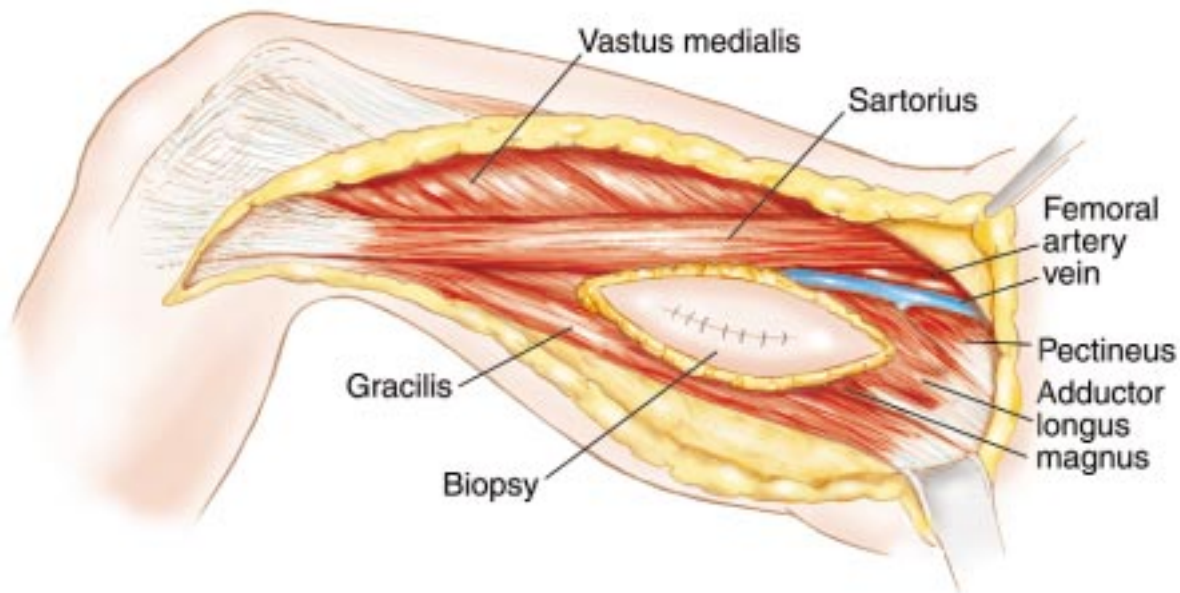


Figure 13.5 Exposure. Large anterior and posterior fasciocutaneous flaps are elevated and retracted anteriorly to expose the vastus medialis and the sartorial canal and posteriorly to the lower edge of the adductor muscle group. If necessary, the incision "T"s along the inferior pubic ramus to expose the proximal portion of the posterior hamstring compartment for large tumors of the proximal region. Note that the biopsy site is left en-bloc with the underlying adductor muscles. The sartorius muscle is the key to the dissection of the entire muscle group. The sartorial canal is opened proximally to identify the common femoral arteries and veins prior to ligation of the profundus vessels. The muscles are detached from their origin (superior and inferior pubic rami) and along the obturator foramen. The obturator vessels are ligated and transected. The dissection continues from proximal to distal. The profundus femoral vessels are usually ligated and transected.

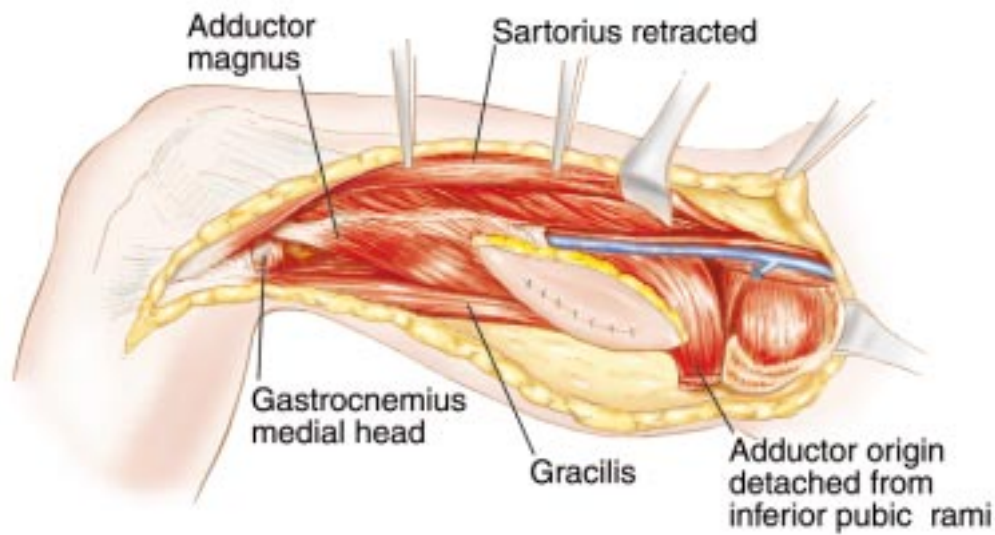


Figure 13.6 Exploration. The sartorial canal is mobilized along the sartorius muscle. The common femoral artery and vein and profundus femoral artery and vein are identified, as well as the popliteal artery and vein as they exit the adductor hiatus by the knee joint. Care must be taken to identify the profundus and common femoral arteries and veins prior to ligation of the profundus vessels. The muscles are detached from their origin (superior and inferior pubic rami) and along the obturator foramen. The obturator vessels are ligated and transected. The dissection continues from proximal to distal. The profundus femoral vessels are usually ligated and transected.

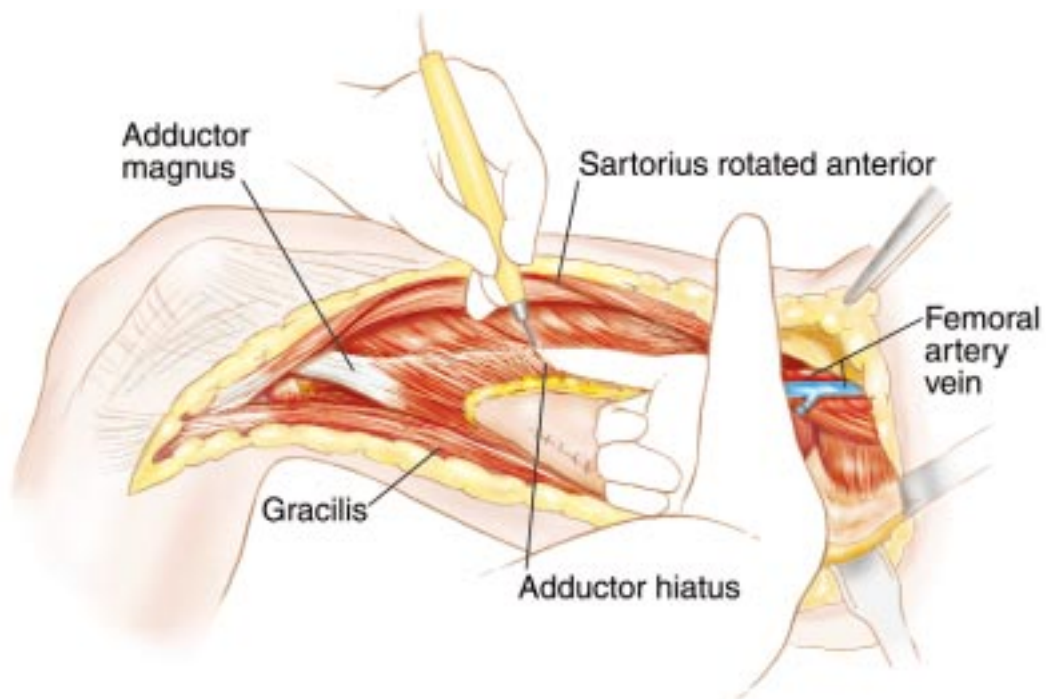


Figure 13.7 Release of adductor muscles from insertion. The adductor magnus and longus are detached from their insertions on the femur throughout its length to the adductor hiatus. The adductor magnus tendon is then transected distally. A finger is inserted into the sartorial canal in order to guide the cautery and protect the underlying vessels.

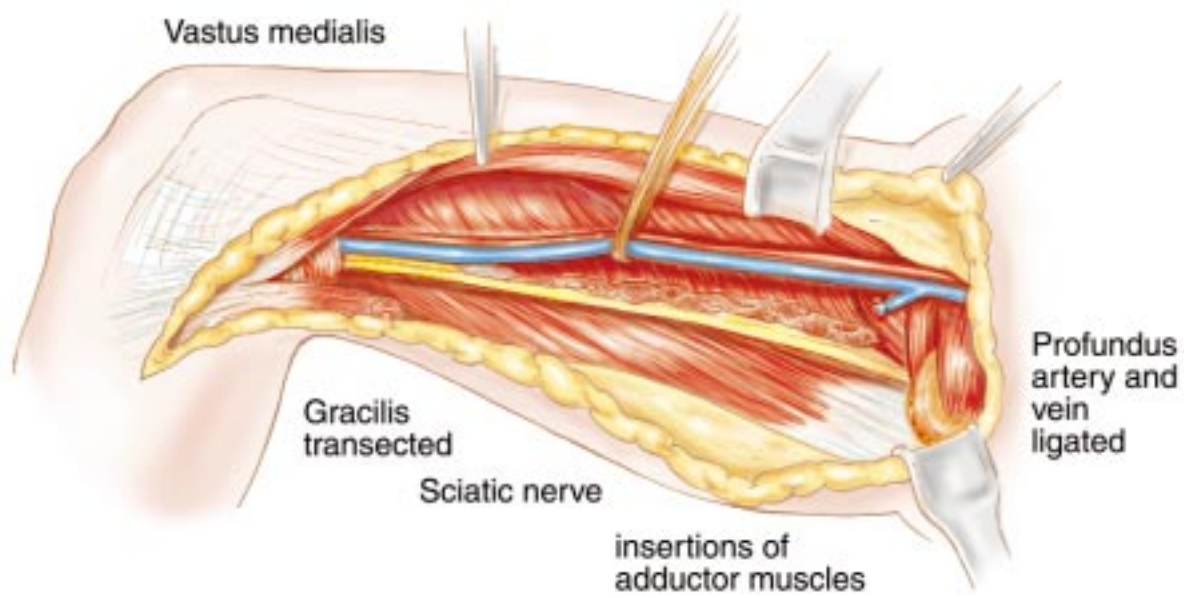
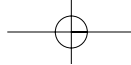


Figure 13.8 Completion of tumor removal. The remaining structures to be transected are the insertions on the distal portions of the femur, as well as portions of the gracilis muscle if required. The entire tumor is then removed and the wound is inspected. The SFA and vein are inspected for any leaks. The cut edge of the muscles along the femur may be oversewn for hemostasis. If there is a large adductor tumor, occasionally a portion of the proximal medial hamstrings must also be removed en-bloc.

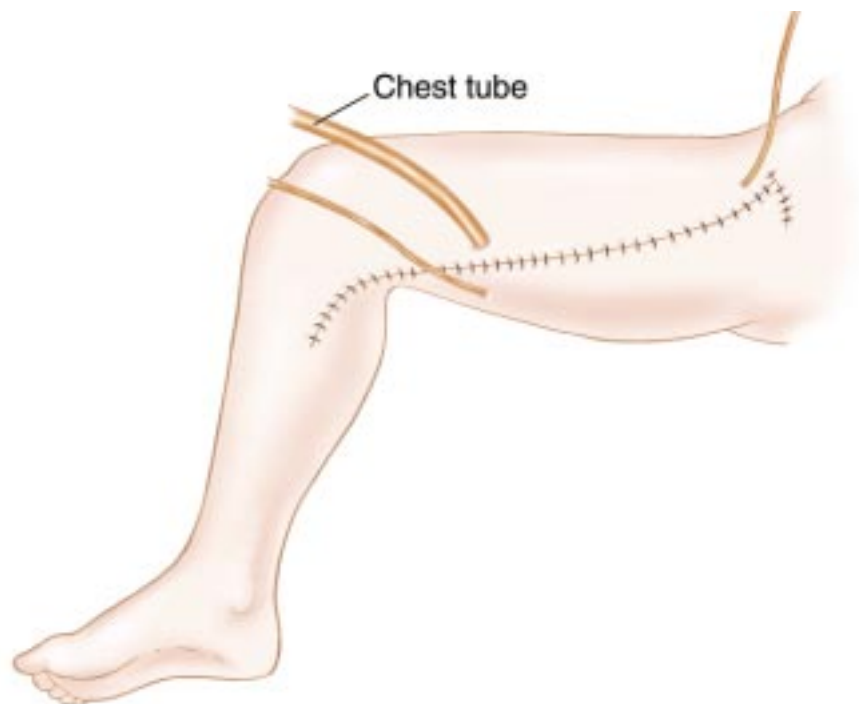
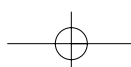


Figure 13.9 Closure. The incision is closed with interrupted layers of sutures. A large 28-gauge chest tube, as well as smaller suction catheters, are utilized to prevent a postoperative seroma. Note a small "T" was utilized proximally in order to develop a flap posteriorly to reach the level of the ischium.



DISCUSSION

Most soft-tissue sarcomas arising within the adductor muscle group can be safely resected by complete or partial muscle group resection. This chapter describes in detail the anatomic constraints, indications, and techniques for such a procedure. Limb-sparing surgery for adductor group tumors has a 90–95% chance of local control. Less than 5–10% of all adductor tumors require an amputation. A modified hemipelvectomy may, however, be required in select circumstances.

Traditionally, large high-grade soft-tissue sarcomas of the adductors – especially those adjacent to the pelvic floor, hip joint, or groin – were treated by an amputation above the pelvic ring, i.e. a modified hemipelvectomy. This operation removes all the tissues and structures at high risk of local recurrence. A modified hemipelvectomy preserves a portion of the ilium and the gluteus maximus so as to permit a myocutaneous closure. If the gluteal region had been contaminated, a classic hemipelvectomy (i.e. through the sacroiliac joint), was

performed. Unfortunately, amputations are still required today, solely because of inadequate or poorly planned biopsies.

The various surgical strategies that have been developed – induction chemotherapy, regional infusion, and/or pre-or postoperative radiation therapy – make limb-sparing surgery very safe. Most patients have an excellent functional result, with minimal loss of adductor strength.

The key to success in adductor group muscle resections is careful preoperative surgical staging of the patient and the tumor, evaluation of the superficial femoral artery, evaluation of the close anatomic restraints (the pelvic floor, sciatic nerve, and hip joint), and surgical resection of all involved structures. The reconstruction is relatively simple, involving closure of the sartorial muscle over the superficial femoral vessels. Adduction is maintained by the medial hamstring and the gluteus maximus muscles. A short course of rehabilitation with an abductor brace permits the patient to resume a normal life.