Chapter 33 Overview of Surgical Resection of Space Sarcomas

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BACKGROUND

- The three main extracompartmental spaces of the lower extremities are the femoral triangle, the sartorial canal, and the popliteal space. Each of these spaces is confined by the bordering compartments of the lower extremity.
- All extracompartmental spaces have walls comprising the muscles and their fascia of the neighboring compartment, lumen, that is filled with fat, fibrous tissue, and vessels that transverse the space, mainly arteries, veins, and nerves.
- The distinction between intracompartmental and extracompartmental spaces was introduced by Enneking in his classification of soft tissue tumors as part of the Musculoskeletal Tumor Society (MSTS) surgical staging system more than two decades ago. Enneking borrowed the term "extracompartmental" from his classification of bone tumors. In that context, it refers to tumors that originate in the bone and then breach the cortex and have a soft tissue component.
- Extracompartmental tumors were considered to be more aggressive than their intracompartmental counterparts and therefore harder to treat and with a worse prognosis, although this has changed in recent years.
- The original soft tissue sarcoma (MSTS) staging system had three prognostic criteria: metastasis, grade, and compartmentalization.
- The term "compartmentalization" divides soft tissue sarcomas into intracompartmental and extracompartmental tumors. Intracompartmental lesions are bound in all directions by natural barriers such as bone and muscle. These tumors arise within a structure—thigh: anterior, adductor, posterior; leg: anterior, peroneal, posterior superficial, posterior deep.
- In contrast, extracompartmental tumors either arise in spaces that are not bound by tight muscle fascia as compartments are (ie, popliteal space, sartorial canal, femoral triangle, axilla, antecubital fossa, paraspinal, intrapelvis, midhand, midfoot, and hindfoot) or develop secondary to the extension of an intracompartmental tumor beyond the confines of a compartment.
- Extracompartmental tumors have unique characteristics. They can extend a considerable distance with less anatomic restraint. They tend to be larger than their intracompartmental counterparts and frequently arise close to the neurovascular bundle. For these reasons, space tumors were initially considered to have a poorer prognosis than those confined to a compartment at diagnosis. Newer prognostic studies of soft tissue sarcomas do not support the assumption that space tumors have a worse prognosis due to their location but rather due to their size.
- Space tumors have been poorly addressed in Enneking's classification and in the later American Joint Committee on Cancer (AJCC) classification. The classification of an intracompartmental lesion was based on tumor biology. Extracompartmental tumors were originally tumors that grew from within a compartment outward and into an adjacent compartment. Only later was the definition broadened to include space tumors. Since then, these space tumors have been poorly discussed in terms of their anatomy, biology, and surgical approach.
- The newer version of the AJCC classification for the staging of soft tissue sarcomas does not use compartmentalization as a staging criteria but rather tumor grade, size, and depth.
- Resection goals for soft tissue sarcomas of the extremities are wide resection of the lesion with negative resection margins and satisfactory extremity function.
- With intracompartmental tumors, these goals are achieved by resecting the tumor with the muscle that surrounds it. Space tumors lie in proximity to vessels and nerves, so achieving wide resection of the tumor without resecting the vessels is a delicate task.
- Some tumors, although in intimate proximity to the vessels, may still be resected with negative margins, whereas other tumors behave differently and invade the vessels. Vessel invasion dictates vascular resection. This biologic difference in tumor behavior is dictated by tumor grade, size, and histology and the anatomic location in the space from which it arises.
- Different tumors, due to their different biology, dictate different surgical resection techniques. Unlike intracompartmental tumors, space tumors differ vastly from one tumor to the next in the amount and technique of resection needed. Guidelines for resecting the different types of space tumors are lacking.

ANATOMY

Femoral Triangle Space

- The femoral triangle can be depicted as a three-dimensional pyramid. The base is the inguinal ligament, bound laterally by the sartorius and medially by the medial edge of adductor longus or the anterior border of gracilis (**FIG 1**).
- The floor of the femoral triangle is the iliopsoas laterally and the pectineus and adductor longus medially. Its apex is where the sartorius crosses over to the adductors.
- The main vessels traversing the canal are, from medial to lateral, the femoral vein, artery, and nerve. They enter the femoral triangle from the abdomen under the inguinal ligament and exit it distally from the tip of the pyramid into the sartorial canal.

Sartorial Canal

- The sartorial canal lies between the anterior (quadriceps) compartment and the medial adductor compartment, connecting the tip of the femoral triangle in the proximal thigh to the popliteal fossa in the distal posterior aspect of the thigh. The cross-section of the sartorial canal is shaped like an inverted triangle (**FIG 2**).
- The roof of the canal is made up of the sartorius muscle, which lies anterior and medial to the canal. The adductor longus makes up the floor of the canal. The lateral border is the thick fascia of the vastus medialis. Posteriorly, the border

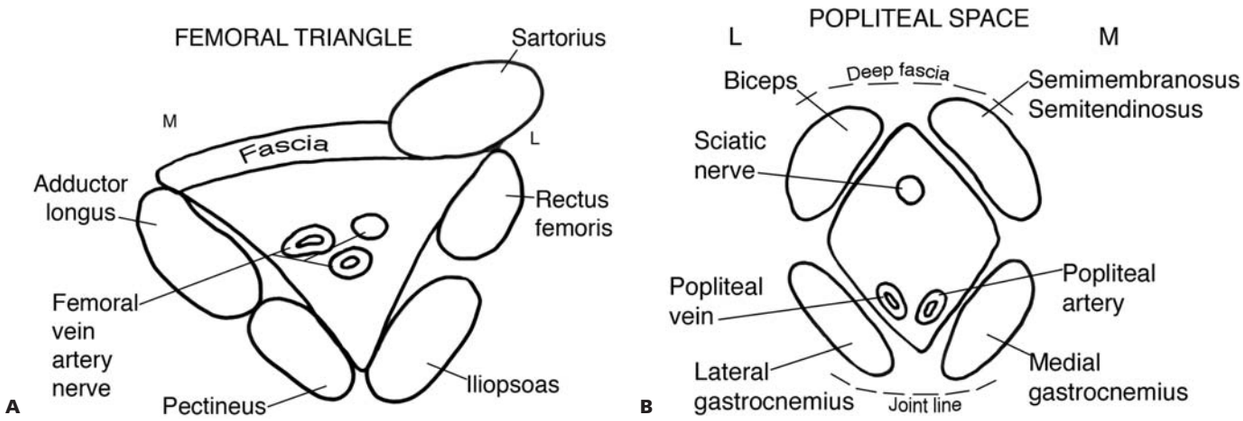


FIG 1 • Cross-sectional anatomy of the lower extremity spaces. **A.** Femoral triangle anatomy follows the general outline of a three-dimensional pyramid. The vessels within the space from medial to lateral are the femoral vein, artery, and nerve. The femoral triangle has as its base the inguinal ligament; it is bound laterally by the sartorius and medially by the medial edge of adductor longus and the anterior border of gracilis. The floor of the femoral triangle is the iliopsoas laterally and the pectineus and adductor longus medially, and its apex is where the sartorius crosses over to the adductors. **B.** Popliteal space anatomy follows the general outline of a three-dimensional diamond shape. The biceps femoris, semimembranosus, lateral gastrocnemius, and medial gastrocnemius muscles form the four walls of the space. The popliteal artery and vein lie deep in the space, while the sciatic nerve is more superficial. The deep fascia serves as a barrier between the space and the superficial tissue.

of the canal is the adductor compartment, namely the adductor magnus.

- Both the posterior and lateral borders are also covered with thick fascia. The superficial femoral artery and the femoral vein enter the canal proximally through the tip of the femoral triangle. These structures lie deep in the canal and are surrounded throughout their length by a very thick fascial sheath.
- The vessels exit the canal at the distal medial end, through the adductor hiatus, a foramen in the distal part of the adductor magnus.

Popliteal Space

- The popliteal space is shaped like a three-dimensional diamond. On its proximal lateral side is the biceps femoris muscle. On the proximal medial side are the semitendinosus and semimembranosus muscles. On the distal side of the space are the lateral and medial heads of the gastrocnemius muscles (see **FIG 1B**).
- Anterior to the space is the posterior capsule of the knee joint. Posterior to the space is a thick popliteal fascia.

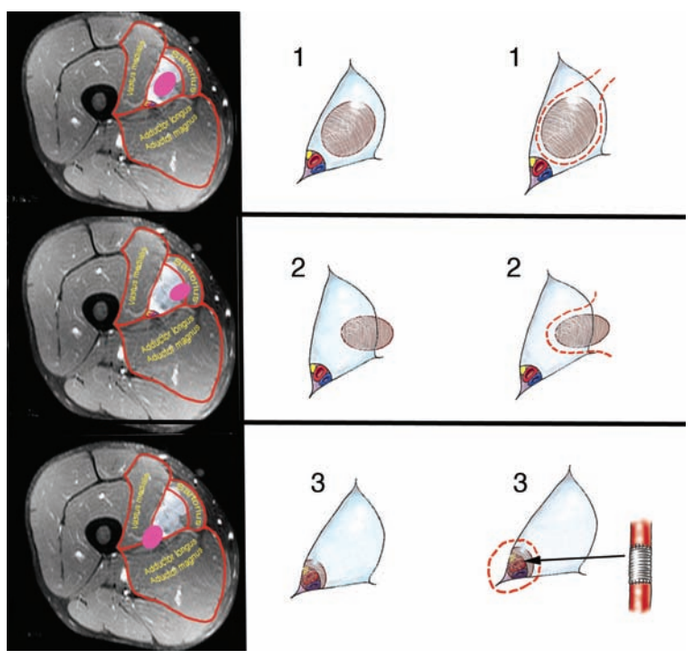


FIG 2 • Systematic resection of extracompartmental space tumors. The left column shows axial MR images of the three different types of tumors in the sartorial canal. The middle column shows a schematic of the tumor location. The right column shows the recommended planes of surgical resection (*dotted line*). Resection types 1 to 3 are presented in the rows from top to bottom. Type 1 (intraluminal) tumors lie within the space and are resected with a thin cuff of surrounding tissue. Type 2 (wall) tumors arise from the muscles surrounding the space and are resected as a typical muscle resection. Type 3 (vessel) tumors invade the vessels and are therefore resected en bloc with the vessels.

- Vessels of the popliteal space are the popliteal artery and vein, which enter proximally through the adductor hiatus and exit distally between the two heads of the gastrocnemius.
- The sciatic nerve enters the space through the proximal tip and divides into the peroneal and tibial nerve branches.

INDICATIONS

- A set of surgical guidelines is a helpful clinical conceptual tool in resecting lower extremity soft tissue sarcomas from the three anatomic spaces. Using preoperative MRIs and initial intraoperative impressions, tumors may be divided into three groups.
- Tumors are divided according to their location of origin.
  - Type 1 tumors arise from within the space. Typically they originate from fat or fibrous tissue within the space. These tumors are termed "luminal" because they may approximate but do not adhere to the walls of the space or any of the arteries, veins, and nerves in the space. They lie within the lumen.
  - Type 2 tumors arise from one of the walls that border the space. These tumors arise from within a muscle or the muscle fascia that borders the space.
  - Type 3 tumors invade the arteries, veins, or nerves and are termed vessel lesions. These lesions either originate from or invade the vessels walls.
- The surgical planes of resection differ for each of the three types:
  - Type 1 (luminal) lesions are resected with a thin cuff of healthy tissue that surrounds the tumor. At times these tumors almost deliver themselves once the space is opened. Tumor margins, although negative, are often close.
  - Type 2 (wall) lesions are essentially resected with the muscle from which they originate. Wide surgical resection is achieved by resecting the tumor with its muscle of origin and the fascia covering that muscle.
  - Tumors that approximate the vessels and are adherent to the vessel sheath are resected with the vessel sheath as an oncologic barrier and should be approached in the following manner. On approaching the tumor area, if the sheath appears free and separates easily from the wall of the artery, the surgeon continues the dissection, leaving the sheath attached to the surface of the specimen by making an incision in the sheath on the side away from the tumor and extricating the artery (and vein if possible) from its sheath.
  - The fibrous sheath surrounding the vessels is inspected carefully on frozen section after it has been removed en bloc with the tumor. Even when the tumor does not adhere to the vessel sheath, it should be removed separately from the tumor so that it can be examined to rule out tumor invasion through the sheath, thus ensuring safe resection margins.
  - Type 3 (vessel) tumors are imbedded in the vessel wall. When it is clear that the vessels are involved, the surgeon establishes vessel control proximally and distally and works around the tumor widely all the way around until the soon-to-be specimen is tethered by the vessels proximally and distally. The surgeon then chooses the grafts to be used, administers heparin, and applies vascular clamps proximally and distally. The specimen is removed, followed by reconstruction.
  - This circumferential freeing of the tumor and the normal tissue margin is the essential difference between space tumors involving the vessels and those not involving them, a difference in surgical strategy.
  - After the artery is resected it must be reconstructed with a synthetic graft or a reverse saphenous vein graft. Venous resection does not need to be reconstructed as long as the ipsilateral saphenous vein is intact. Potential morbidity from venous resections arises from the risk of edema in the affected limb. Nerves invaded by tumor must be resected en bloc (namely, sciatic, femoral, tibial, and peroneal). These nerve resections do not dictate a need for amputation but can be treated with limb-sparing surgery. As the tumor is resected en bloc with the vessel, these resections, while challenging surgically in their reconstructive aspects, are relatively straightforward in their tumor resection aspects and can achieve wide surgical margins.

IMAGING AND OTHER STAGING STUDIES

Plain Radiography

- Plain radiography studies are performed to rule out local invasion of the bone by the tumor.

Computed Tomography and Magnetic Resonance Imaging

- These studies are used to assess the anatomic location and size of the tumor and its relation to surrounding structures. These studies are particularly important since the tumor often distorts the normal anatomy in these small, tight spaces. Arterial contrast and three-dimensional reconstruction enhance these studies even further.
- MRI is useful in assessing the tumor's invasion into neighboring anatomic structures, namely the muscles bordering the canal and the vessels traversing the canal.

Bone Scan

- Bone scan is used to rule out distant metastatic disease and may give a clue to the malignancy of the tumor, as high-grade tumors show a strong tumor blush in the late arterial flow phase of the three-phase technetium scan.

Angiography and Other Studies

- Angiography is used to assess the vascularity of the tumor, tumor blush, the location of the vessels feeding the tumor, and the relation between the tumor and the major artery and vein, giving vital information as to whether the tumor has displaced or invaded the vessel.
- Venography of the limb is used to rule out venous thrombus, tumor thrombus, or direct tumor involvement.

Biopsy

- Core needle and open incisional biopsy give vital information about the tumor. The proximity of these tumors to major vessels adds an additional risk factor for both iatrogenic damage to the vessels and contamination of the space with tumor cells due to hematoma. We prefer a small needle biopsy and a fine-needle aspiration. It is most important to determine whether the tumor is a lymphoma or a mesenchymal tumor (soft tissue sarcoma).
- Lymphomas do not require surgical resection. The exact histogenesis is not required if it is a soft tissue sarcoma, because

resection margins are usually more defined by the anatomy than the actual surgical procedure. However, it is important to determine the grade (high or low) because neoadjuvant chemotherapy may be recommended.

SURGICAL MANAGEMENT

- Wide exposure of the space is critical. The space must be unroofed by retracting and at times detaching the overlying muscle.
- Initially critical vessels should be identified and controlled proximally and distally to the tumor, where the anatomy has not been distorted.
- Tumor is resected in a circumferential manner with wide margins when possible. When the lesion is in intimate proximity to the vessels, the sheath of fibrous tissue surrounding the vessels should be resected en bloc with the tumor unless it is evident that it has not been invaded. The vessel sheath should be opened from the opposite side of the tumor to assess whether tumor that adheres to the sheath has invaded the vessel wall as well.
- Tumor that invades the vessels must be resected with the vessels, which then need to be reconstructed.
- When the tumor does not seem to grossly invade the vessels, the sheath that has been resected en bloc with the tumor should be examined on frozen section to rule out microinvasion.
- Soft tissue reconstruction is done by moving adjacent muscle to cover the vessels. This is essential. If there is later wound breakdown, the vessels must have good vascularized soft tissue coverage.

Preoperative Planning

- Preoperative MRI and CT and possible three-dimensional CT angiography are useful to identify the exact size and location of the tumor. This will help in classifying the type and thus in choosing the type of surgery that is required.
- Angiography is extremely important to determine accurately the position of the artery within the specific space. Often the artery is greatly displaced from the normal anatomic relationships. In the popliteal space, the artery is often displaced anterior to the tumor, whereas the sciatic nerve (tibial and peroneal branches) is often displaced in the opposite direction (ie, posteriorly and or laterally). In addition, the decrease in tumor blush from the initial angiogram and the final one after induction chemotherapy (for high-grade sarcomas) correlates well with the percentage of tumor necrosis. If there is a good angiographic response, then a marginal resection is very reasonable.
- Venography: The major veins may be occluded due to pressure of the soft tissue mass or invasion of the vascular sheath, and therefore by inference the major artery or nerves may be involved by tumor. Venous grafts are not performed because most will not remain patent.
- Neurologic examination: Involvement of a major nerve within a space often presents with severe pain or motor weakness. This should suggest to the surgeon that the major nerve may have to be sacrificed. In general, femoral nerve (femoral triangle) or sciatic nerve (popliteal space) involvement is not a sole indication for amputation.

Positioning

- Femoral triangle (space): A supine position is used. The abdomen and the thigh must be prepared together. It is often necessary to begin the exploration of the femoral vessels retroperitoneally to identify and to place a vascular loop around the external iliac artery and vein for proximal control.
- Sartorial canal: The patient is placed supine and the lower extremity is flexed and rotated externally at the hip. The entire thigh, lower pelvis, and leg are prepared so that the distal pulses can be palpated (or assessed using Doppler).
- Popliteal space: The patient is placed prone. The posterior thigh from above the gluteal crease to the foot is prepared free. This provides good exposure to the retrogluteal area, the posterior thigh (if the tumor extends proximal from the space), the popliteal space, and the leg (calf) if the tumor extends distal to the popliteal space, specifically below or between the gastrocnemius muscles.

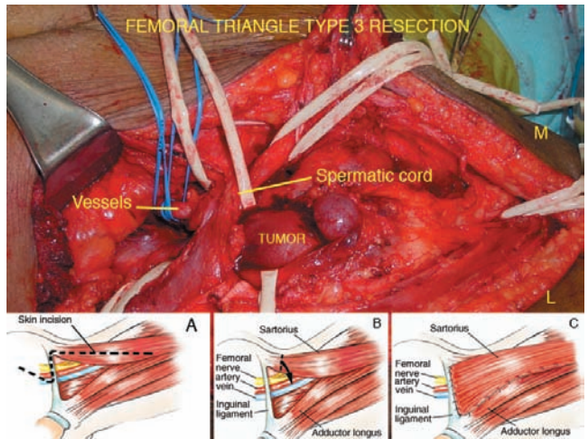
Approach

- Femoral triangle: The incision begins proximal to the inguinal ligament as a gentle S and crosses the inguinal ligament. It then proceeds distal to the tip of the femoral triangle to the proximal portion of the sartorial canal. The incision somewhat parallels the medial border of the sartorius muscle. The major vessels are located proximal and distal before any attempted resection.
- Sartorial canal: The incision follows the sartorius muscle from the apex of the femoral triangle to the level of the adductor hiatus. If necessary, the incision may be extended to include the popliteal space (if the tumor is distal in the canal) or proximal (if the tumor is located proximal in the canal and extends into the femoral triangle). The sartorius muscle is mobilized either anteriorly or posteriorly along its borders (as long as the sartorius is not involved with tumor). Segmental pedicles to the sartorius muscle may be ligated. If the sartorius muscle is involved, then the muscle is transected proximal and distal to the tumor for exposure before resection.

TECHNIQUES

TUMORS OF THE FEMORAL TRIANGLE

- The femoral triangle is exposed through a longitudinal incision that curves over the inguinal ligament and extends to the sartorial canal. The external iliac vessels (retroperitoneal) are exposed and a vessel loop is placed around them (**TECH FIG 1**).
- Wide subcutaneous skin flaps are made above the femoral triangle fascia to permit identification of the tumor, sartorius muscle, and adductor fascia.
- The proximal end of the sartorial canal is opened and the superficial femoral artery and vein are located to gain distal control.
- The deep fascia of the canal is opened, exposing the tumor.
- The tumor is explored and its surgical type is determined. Its relationship to the femoral nerve and femoral vessels is assessed. This will define which structures need to be resected and which can be preserved. If a vascular graft is required, either Gore-Tex or contralateral saphenous



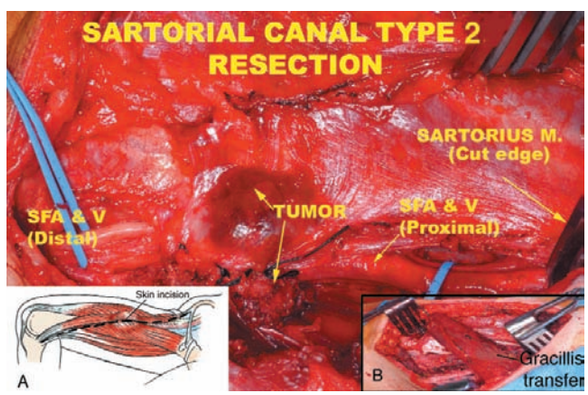
TECH FIG 1 • Intraoperative image of a type 3 resection of a leiomyosarcoma arising from the femoral vessels. Proximal and distal control of the involved vessel is crucial. A vessel loop is placed on the external iliac artery (marked vessel). The spermatic cord is tagged and mobilized. **A.** The skin incision and the surgical approach follow the line of the inguinal ligament and sartorius muscle. **B.** The sartorius muscle is detached proximally to allow better exposure and soft tissue reconstruction. **C.** Soft tissue is reconstructed by fanning out the sartorius muscle, thus achieving a muscle barrier between the femoral vessels and the skin.

vein can be used. If the femoral nerve is resected, medial and lateral hamstring transfers are performed at a second stage after wound healing or radiotherapy.

- The tumor is resected with surrounding fat, lymphatics, and any necessary muscle.
- Hemoclips are placed around the surgical bed.
- The sartorius muscle is routinely detached from the anterior superior iliac spine and rotated to cover the remaining defect and neurovascular structures. The sartorius muscle is tenodesed to the inguinal ligament and the remaining adjacent musculature. The skin flaps are then closed. A flat drain is placed deep to the muscle transfer.

TUMORS OF THE SARTORIAL CANAL

- The incision follows the course of the sartorius muscle. It may be extended proximally (femoral triangle) or distally (popliteal space) as required (**TECH FIG 2**).
- Wide subcutaneous flaps are elevated off the deep fascia to expose the anterior and posterior borders of the sartorius muscle.
- The sartorius muscle is then mobilized either along the anterior interval with the vastus medial muscle or posteriorly along the adductor interval
- If the sartorius muscle is not involved by tumor (based on the preoperative MRI), the muscle is usually preserved. The sartorial canal is explored both proximal and distal to the tumor mass to identify the superficial femoral artery and vein. If the saphenous nerve is encountered, it may be sacrificed.
- Tumor resection is then performed according to the type of tumor. Type 1 (intraluminal) tumors usually require only a simple marginal excision. If the tumor approaches the vessels, then the sheath is removed and sent for a frozen section examination. If no tumor is present at this margin, the sartorius flap is then closed.
- For a type 2 tumor, the initial approach is similar to that described above, except the tumor's muscle of origin must also be resected. This is often a portion of the sartorius muscle or the vastus medialis. Tumors involving the adductor muscles are less common. Resection of the adjacent vascular sheath is routinely performed, similar to type 1 tumors.
- Type 3 tumors often arise from the vascular sheath. The initial approach is similar to that for types 1 and 2 but also involves resection of the superficial femoral artery and vein. The vascular surgeons perform this portion of the operation. The artery must be reconstructed, either with a Gore-Tex graft or the ipsilateral saphenous vein. Heparinization may be required.

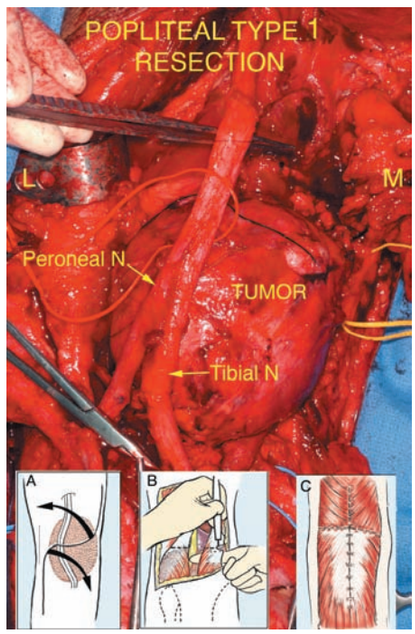


TECH FIG 2 • Type 2 resection of a tumor of the sartorial canal arising from the wall (vastus medialis) that comes in close proximity of the vessels. Even so, the tumor was resected and the vessels were spared, as it did not penetrate the fascial sheath surrounding the vessels. **A.** The skin incision is carried along the sartorius muscle. The sartorius is resected with the tumor if necessary from an oncologic point of view. If the tumor is not connected to the sartorius muscle it may be disconnected distally for exposure. **B.** Soft tissue reconstruction with a gracilis muscle transfer affords good soft tissue coverage of the vessels of the sartorial canal and is considered crucial. The distal end of the gracilis muscle is disconnected and rotated anteriorly. The muscle is then spread out like a fan and reattached anteriorly.

TECHNIQUES

TUMORS OF THE POPLITEAL SPACE

- A "lazy S" incision is made over the popliteal space. The medial arm is always made along the medial border of the medial hamstrings because the popliteal vessels come into the space medially from the adductor hiatus (**TECH FIG 3**).
- The lateral arm of the incision is made along the lower border of the biceps femoris muscle because the peroneal nerve is initially picked up just below the deep fascia as a satellite of the biceps muscle.
- Wide subcutaneous flaps are made exposing the deep popliteal fascia. Great care is taken not to penetrate this fascia early because it is easy to get lost in the popliteal fat.
- The peroneal nerve is first identified just medial to the biceps muscle, just under the deep fascia.
- The deep fascia is then opened longitudinally and the sciatic nerve is identified between the medial and lateral hamstrings.
- The four muscles that make up the "diamond" of the popliteal space are now identified: the medial and lateral hamstrings proximally and the medial and lateral gastrocnemius muscles distally.
- The midline of the gastrocnemius muscles is identified. The popliteal vessels and the tibial nerve are mobilized and a vessel loop is placed around them for distal control.
- The sciatic nerve is then mobilized, both the peroneal and the tibial nerve components.
- The popliteal artery and vein are identified proximally near the medial hamstrings deep in the fossa as they enter from the adductor foramen. The surgeon can easily feel the pulse (a tourniquet should not be used), and a finger can be safely placed into the adductor hiatus for localization.
- Careful dissection and mobilization of the vascular and nerve structures are then performed.
- The medial or lateral head, or both, of the gastrocnemius muscles may be released from their origins on their respective femoral condyles to help in the exposure. Similarly, the semimembranosus or biceps femoris muscle may be released for better exposure.
- If the tumor extends proximally (between the hamstrings or distally between the gastrocnemius muscles), then the corresponding muscle must be released to obtain a wide excision.
- The popliteal vessels are usually displaced and not involved by tumor, unless a leiomyosarcoma is arising from them. In this situation a vascular graft is required.
- The tumor is resected only after all of the above structures are identified and mobilized. Sheaths of the adjacent nerves or vessels are removed and sent for frozen section examination to determine whether further resection is required.
- Soft tissue closure is necessary to cover and fill the popliteal space to prevent wound problems. The medial and lateral gastrocnemius heads are tenodesed to each other, covering the distal portion of the popliteal space and the neurovascular structures. Similarly, the medial hamstrings are tenodesed to the biceps femoris muscle to close over the proximal popliteal space. Both the gastrocnemius and the hamstrings are then sutured together to make a nice muscle closure of the entire popliteal space.



TECH FIG 3 • Large popliteal type 1 resection of a luminal tumor. Intraoperative picture shows wide exposure of the popliteal space. The tumor is in close proximity to the sciatic nerve above it and the popliteal artery and vein just below it (vessel loops). As it is a luminal tumor, resection with negative margins was achieved without resection of the surrounding vessels. **A.** Skin incision and subcutaneous flaps necessary to permit exposure. Care should be taken not to open the popliteal fascia while developing the flaps to reduce the risk of neurovascular injury. **B.** Release of the gastrocnemius heads, which are then reflected distally for maximal exposure. The popliteal vessels are identified distally between the gastrocnemius heads. **C.** Tenodesis of the heads of the gastrocnemius and the hamstring muscles, forming a muscular coverage over the popliteal vessels and nerves.

PEARLS AND PITFALLS

Preoperative classification of the type of space tumor is essential.	■ Tumors are classified as types 1, 2, or 3 (discussed earlier). Classification will suggest the planes of resection and the structures to be removed.
CT and MRI are essential.	■ CT and MRI are used to identify the local anatomy and to determine the type of tumor.
Angiography	■ Angiography determines the anatomic position and probable displacement of the major vessels passing through the space.
Type 3 resections	■ In type 3 resections, the major vessel must be resected and reconstructed. Heparinization may be required postoperatively. Venous reconstruction is usually not recommended.
Vascular control	■ Always obtain proximal and distal control of the major vessels before approaching or resecting the tumor.
Neurologic examination of femoral and sciatic nerve function	■ Any motor weakness almost always indicates tumor involvement of the major nerve.

POSTOPERATIVE CARE

- Pulses are checked hourly for the first 24 hours.
- Drains are removed on postoperative day 2 or 3.
- Full weight bearing is permitted within 1 to 2 days.
- Minimal rehabilitation is required. Motion is limited according to the anatomic space for 7 to 10 days to permit complete wound healing. Popliteal incisions are protected with a bent-knee brace until the wound is well healed.
- Postoperative radiation therapy is started only after the wound is well healed, between 2 and 4 weeks.

OUTCOMES

- We have treated 53 patients with space tumors. Malignant fibrous histiocytoma and liposarcomas are the most common. A classification system was developed as described above. Most sartorial tumors tend to be of low grade and involve the wall; the sartorius muscle is most often involved.
- Liposarcomas and secondarily malignant fibrous histiocytomas were the most common histogenic types. Tumors involving the wall of the space were more common than those that are intraluminal or those that arise from the major neurovascular structures. Tumors arising from the major vessels were leiomyosarcomas.
- Popliteal tumors, often high grade, can be dissected with negative margins and followed by radiation therapy. Sciatic nerve resection is very unusual.
- Amputation for all space tumors is needed in less than 10% of cases and is usually reserved for tumors that locally recur.
- The overall survival depends on the grade. Local recurrence is less than 10% for all sites. Radiation therapy is used for all high-grade sarcomas after wound healing.
- The surgical classification has been implemented on 53 patients with soft tissue tumors of the lower extremity spaces (femoral triangle, sartorial canal, and popliteal fossa).

COMPLICATIONS

- The most common problem is wound or flap necrosis. This is more common in the popliteal space. Incisions of the femoral triangle or the sartorial canal heal well.
- Neuropraxia, especially of the peroneal nerve, is common but, function almost always returns.
- Infection is unusual.
- Preoperative radiation is not used due to the risk of wound dehiscence or necrosis.
- Secondary amputations occur in less than 5% to 10% of patients, often after local tumor recurrence.

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