Chapter 11
Soft Tissue Reconstruction of the Thigh

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Goals of reconstruction for proximal lower extremity wounds vary according to the specific location, involved structures, and etiology of the index lesion. Commonly, the plastic surgeon is tasked with providing soft tissue for a traumatic or iatrogenic wound to cover vital vascular structures, fill large dead space, protect implants or hardware, or resurface areas prone to chronic pressure. Thankfully, the proximal lower extremity is uniquely suited to local tissue harvest, owing to several composite flap options with well-established vascular patterns and functional redundancy.

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Thigh Anatomy and Function

Anatomically, the thigh can be separated into three compartments—the anterior, posterior, and medial compartments—which are encircled by investing fascia and extend longitudinally along the length of the femur. Functionally, the muscles in these compartments contribute to the core movements necessary for ambulation: knee extension (anterior), knee flexion (posterior), and leg adduction (medial).

The blood supply to the thigh is important, not only for supplying structures of the upper leg, but also for ensuring circulation to the entirety of the lower extremity. Entry of the femoral artery into the lower extremity occurs at the femoral triangle, bounded by the inguinal ligament superiorly, the adductor longus medially, and the sartorius muscle laterally. Given the easily identified anatomy, this area is often accessed for vascular procedures. After entering the thigh, the femoral artery gives off a deep branch, called the profunda femoris, which courses within the medial compartment and supplies branches to a majority of the medial and posterior muscles. Near the origin of the profunda femoris arise the medial and lateral circumflex arteries, which supply muscles of the medial and anterior compartments respectively. Other notable branches of the femoral artery include the superficial circumflex iliac artery and the medial descending genicular artery. Once the femoral artery passes through the adductor hiatus of the adductor magnus muscle just proximal to the knee, it becomes the popliteal artery and continues distally into the lower leg. Skin of the thigh is supplied via septocutaneous and musculocutaneous perforators from the above vessels.

Three main nerves traverse the thigh, one through each of the three muscle compartments. The femoral nerve passes under the inguinal ligament to enter the anterior compartment and supply innervation to the included muscles, as well as cutaneous branches to the overlying anterior thigh and knee skin. The obturator nerve enters the medial compartment through the obturator canal before branching to innervate the thigh adductors and supply cutaneous thigh sensation. The sciatic nerve is responsible for all posterior compartment muscles before continuing distally to become the common peroneal and tibial nerves. Finally, there is a direct branch of the lumbar plexus, the lateral femoral cutaneous nerve, which enters the anterior compartment laterally before piercing the tensor fascia lata and supplying cutaneous sensation to the anterolateral thigh.

Free Flaps Versus Local Flaps

Thigh defects vary widely in size and involved structures, depending on the etiology and chronicity of the wound. Despite their variability, however, most wounds can be treated with locoregional flaps alone, without the need for free tissue transfers, because the thigh comprises sufficient soft tissue options. Composite pedicled flaps may include a combination of skin, fascia, and muscle, depending on availability and reconstructive need. Though most vascular pedicles to thigh musculature enter proximally, recurrent distal circulation may be sufficient for certain flaps to allow for distally based rotation and therefore distal thigh and proximal leg coverage.

Local Flaps for the Hip

A substantial proportion of hip defects arise from poor pressure control in an otherwise immobile or insensate patient. Pressure ulcers can progress to include all subcutaneous structures and can be difficult to manage, given their potential for bacterial colonization or infection, as well as the need for pressure offloading. In these situations, consideration is given to providing well-vascularized soft tissue while minimizing donor site morbidity, as these wounds are often recalcitrant and require additional future procedures.

When more conservative methods, including negative-pressure wound therapy and skin grafting, are not an option, local musculocutaneous and fasciocutaneous options must be considered. The anterolateral thigh flap is a close, reliable flap that provides adequate healthy tissue pedicled proximally on the descending lateral femoral circumflex artery. Additionally, this flap includes a fascial component for joint capsule coverage if needed, and it can be jointly harvested with the vastus lateralis if more significant tissue loss is present, or if surgical removal of the proximal femur (a Girdlestone procedure) is deemed necessary [1, 2].

Further posterior, the gluteus maximus advancement flap allows for mobilization of the inferior border of this muscle without disruption of its origin or insertion; it can then be advanced into the defect to provide muscular coverage. The overlying skin is also advanced, and modifications including V-Y closure allow for additional dermal tension relief [3, 4].

Other authors advocate for utilization of the tensor fascia lata musculocutaneous flap, which can be rotated directly, or islandized and tunneled to the defect, potentially decreasing donor site morbidity [5]. Other methods of closure include large random-pattern skin-only advancement flaps, which have the added benefit of potential readvancement should the wound recur.

Local Flaps for Groin Reconstruction

Given the proximity of large-caliber vessels to the skin surface as they exit the femoral triangle, the groin has become a common access site for vascular procedures, but the result can be untoward complications that create large soft tissue defects, often with exposure of critical structures at the wound base. In these instances, the primary goal of reconstruction becomes vascular protection and elimination of dead space. Reconstructive flaps are chosen predominantly for their ability to adequately reach the defect with enough tissue bulk to provide robust coverage. For smaller defects, the sartorius muscle lies in close proximity and can be disinserted from its iliac crest origin and turned inferomedially [6]. It can also be transected and rotated proximally or used as a turnover flap (Fig. 11.1). Alternatively, a proximally based

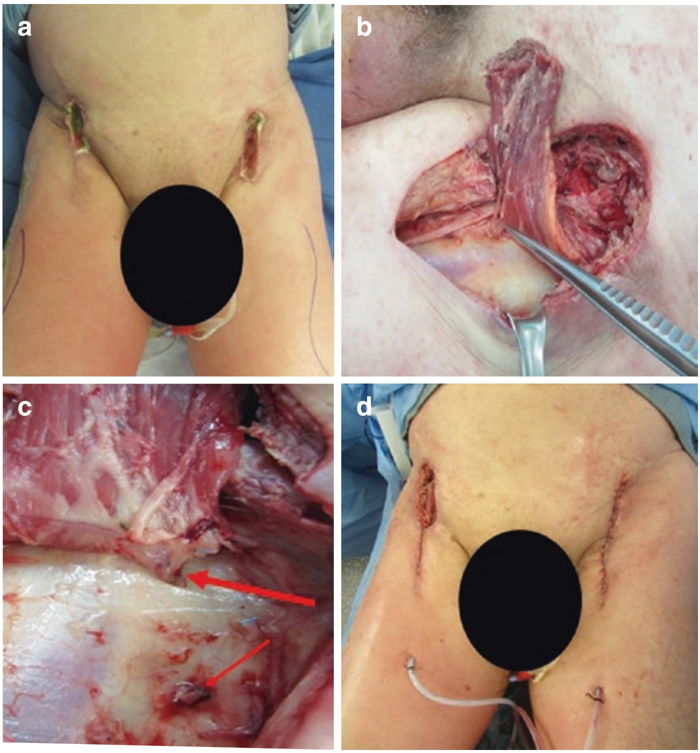

Figure 11.1 Sartorius flap for groin reconstruction. (**a**) The patient had bilateral groin wounds with exposed femoral arteries after endovascular aortic aneurysm repair. Reverse sartorius flaps were rotated to the bilateral groins. (**b**) Forceps identify the perforating branch of the superficial femoral artery. (**c**) The *large red arrow* identifies the perforating branch of the superficial femoral artery supplying the flaps; the *small red arrow* identifies a ligated branch necessary for sufficient rotation of the flap. (**d**) Final intraoperative result with closure of the skin over the left flap. The right side was left open and healed secondarily. (*Photos courtesy of* Derek Bell, MD)

gracilis flap, rotated about its main pedicle off the medial circumflex artery, may be used [7–9].

As the defect size increases, additional tissue must be mobilized. The rectus femoris flap, pedicled proximally off the lateral femoral circumflex artery, is an easily harvested muscle that supplies well-vascularized muscle bulk to the proximal groin with minimal functional morbidity [10, 11] (Fig. 11.2).

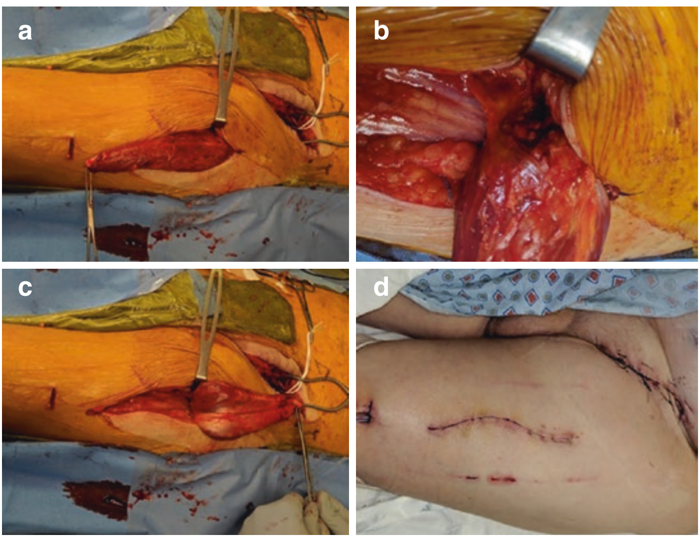

Figure 11.2 Left rectus femoris flap for groin coverage after femoral patch angioplasty infection and femoral artery rupture. (**a**) A lazy S incision is created over the mid-thigh, using the patella and anterior superior iliac spine as reference points along the trajectory of the flap. A small counter incision is created just proximal to the patella to access and transect the insertion of the rectus femoris tendon. (**b**) The descending branch of the lateral femoral circumflex artery pedicle entering the rectus femoris muscle. (**c**) The muscle flap is rotated and advanced proximally. It is passed deep to and through a subcutaneous tunnel. (**d**) Postoperative result shows a healed wound. (*Photos courtesy of* Derek Bell, MD)

For each of the above flaps, if there is not adequate skin for primary closure, a skin graft should be employed to cover exposed muscle. By contrast, a pedicled anterolateral thigh flap provides sufficient soft tissue for large wounds, including a fascial component as well as the underlying vastus lateralis muscle if needed, and the overlying skin paddle can be tailored to fit the groin defect prior to inset [12] (Fig. 11.3).

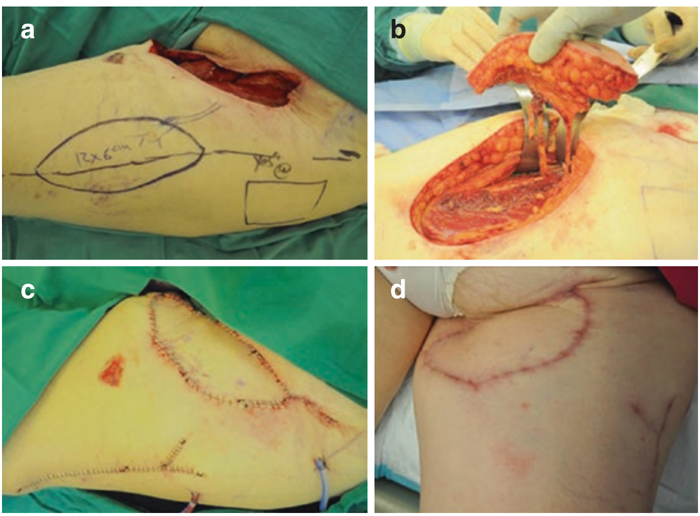

Figure 11.3 Left thigh pedicled anterolateral thigh (ALT) flap for groin coverage after skin cancer resection. (**a**) The patient had a resection of the soft tissue of the groin to remove a squamous cell carcinoma. The defect had exposed femoral vessels at the base. A pedicled ALT flap (12 × 6 cm) was designed to fill the defect. (**b**) The flap was elevated on two distinct perforators and tunneled under the rectus muscle. (**c**) The flap was inset to fill the defect, and the donor site was closed primarily. (**d**) The patient was seen 3 months after surgery, with a well-healed wound. (*Photos courtesy of* Scott T. Hollenbeck, MD)

Local Flaps for the Upper Knee

Knee and distal thigh defects offer a unique challenge, as the chosen donor tissue must offer enough bulk to fill the defect while remaining pliable and thin enough to cover a highly mobile joint surface. Additionally, medial and lateral defects cannot always be resurfaced by the same local tissue. The workhorse for knee defects remains the pedicled gastrocnemius muscle. Either the lateral or medial bellies of this muscle may be utilized, though the medial head is more commonly harvested, as it is larger, longer, and offers a longer pedicle around which to rotate. Additionally, the harvest of the lateral gastrocnemius muscle must contend with potential damage to the common peroneal nerve, which passes inferoposterior to the lateral head's origin [13].

When the gastrocnemius muscle is unavailable, the anterolateral thigh flap, with or without underlying vastus lateralis muscle, also serves as a reliable tissue source for reconstruction. This flap can be designed as a rotational flap, propeller flap, or transposition flap, depending on the location of the septocutaneous or musculocutaneous perforators [14, 15]. In most cases, the dominant pedicle to this flap, the descending branch of the lateral femoral circumflex artery, must be ligated, thereby causing the flap to rely on arborization through the lateral superior genicular artery distally. If needed, the flap may be delayed to ensure a more robust pedicle [13]. Other authors have advocated for salvage of complex knee wounds with distally pedicled gracilis [16] or sartorius [17] flaps, based on their minor or segmental pedicles respectively, but poor vascular reliability remains a potential pitfall.

Summary

Reconstruction of the thigh encompasses a vast breadth of wound sizes and etiologies, including trauma, infection, compression, iatrogenic wounds, and others. Thankfully, the thigh has a high number of available tissue options on reliable vascular pedicles that can be mobilized to provide adequate soft tissue coverage. Given the local options, free flaps are rarely required to bring new tissue to this area for wound coverage. Coverage in this area must be highly robust, however, for the reconstruction will likely be subject to repetitive compression or friction, may be covering critical vascular structures or stabilizing hardware, or may be placed over highly mobile joints.

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