McCraw and Arnold's Atlas of Muscle and Musculocutaneous Flaps

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TENSOR FASCIA LATA

ANATOMICAL CONSIDERATIONS

Surface Markings

If one draws a line passing from the greater trochanter to the midlateral aspect of the knee, this line should bisect the center of the tensor fascia lata (TFL) flap. The anterior border of the TFL flap extends to the margin of the rectus femoris muscle, and the posterior border extends to the margin of the biceps femoris muscle. The tensor muscle, itself, is usually palpable just distal to the greater trochanter.

Origin and Insertion

The tensor muscle originates partially from the anterior superior iliac spine but more extensively from the greater trochanter of the femur. The fascia lata extension of the small tensor muscle inserts into the lateral aspect of the knee and acts as a lateral knee stabilizer. This limits the usefulness of the TFL flap in an athletic individual because its sacrifice can contribute to lateral knee instability.

Adjacent Muscle

The tensor muscle lies between the biceps femoris and rectus femoris muscles. The vastus lateralis muscle is attached to the deep surface of the tensor fascia lata flap throughout its course.

Vascular Pattern

The tensor muscle is supplied by the lateral circumflex femoral vessels which also supply the rectus femoris and vastus lateralis muscles. All of these terminal vessels are end-arteries of the profunda femoris vessels and enter the three muscles approximately eight to ten centimeters below the inguinal ligament. There is a significant cutaneous vessel in the proximal skin of the flap, but the dominant blood supply to the TFL cutaneous segment is contributed by the extensive vascular network on both sides of the fascia lata. The skin in the distal and lateral one-third of the thigh is predominatly supplied by direct cutaneous perforators from the vastus lateralis muscle. The relative dominance of these distal perforators limits the effective dimensions of the TFL flap, unless it is "delayed."

Motor Nerve

Inferior branch of the gluteal nerve L4-5.

Sensory Nerve

Lateral femoral cutaneous nerve, L1-3.

USES

Although the arc of rotation of the TFL flap extends from the ischium to the groin and, finally, to the abdomen, its applications are generally limited to the structural reconstruction of the abdominal wall and the replacement of groin skin. The tensor fascia will reach the chest wall margin if the tensor muscle is completely detached from its origin and raised as a pure "island" myofascial flap, as was first done by Waagensteen in 1933. Lower abdominal defects are more easily closed with the adjacent rectus femoris muscle flap which carries an even tougher fascial layer. A simple TFL rotation flap offers the most expeditious method to resurface major groin skin defects. Both the vastus lateralis muscle flap and the inferiorly based rectus abdominis muscle flap can be used for similar groin defects, but their dissection is more complex and their donor sites are even less desirable than that of the TFL flap. The TFL flap is exceedingly useful in spina bifida patients because of its ability to introduce cutaneous sensibility into the sitting area. It is seldom considered for a deep ischial ulcer because of its inability to obliterate the resulting excisional cavity.

REGIONAL FLAP COMPARISONS

The TFL flap is usually compared to the vastus lateralis muscle flap and the rectus femoris muscle or musculocutaneous flaps. The vastus lateralis muscle flap can be used to resurface exactly the same areas as the TFL flap, and it also has the advantage of adding muscular capabilities. The fascia of the vastus lateralis muscle is not as strong as the tensor fascia, but it is still adequate for a full-thickness abdominal defect. Unfortunately, the dissection of the vastus lateralis muscle flap is tedious and bloody. This limits its usefulness for abdominal wall and groin defects. The rectus femoris flap can also carry a similar amount of skin as the TFL flap if the anterior fascia lata is left attached to the rectus femoris muscle. It can be more useful for lower abdominal wall reconstructions because the fascia incorporated on the undersurface of the rectus femoris muscle is even stronger than the fascia lata of the TFL flap. For this reason the rectus femoris muscle alone is usually preferred over the TFL flap for lower abdominal defects or in situations where muscle is needed to obliterate a deep cavity. Even when the transposed rectus femoris muscle flap must be skin grafted, it is the simplest flap to use for osteo-

myelitis of the iliac crest and the hip joint. The V-Y biceps femoris myocutaneous flap is the traditional choice for standard ischial ulcers, unless one is attempting to introduce sensation into the sitting area with the TFL flap. The standard TFL flap will barely cover the ischial tuberosity, and it will not obliterate the usual ten by ten centimeter cavity which results from an ischiectomy.

DISADVANTAGES

The distal one-third of the lateral thigh skin receives its blood supply from the underlying vastus lateralis muscle perforators. This effectively limits the distal extent of the TFL flap unless it is "delayed." The TFL donor site usually can be primarily closed if the flap is no more than ten centimeters in width. When a skin graft is necessary, the "take" of the skin graft on the donor site (vastus lateralis muscle) is quite acceptable, but the esthetic deformity can be significant. Prolonged drainage from the donor site is a common problem; it can easily persist for several weeks when it occurs. A more significant disadvantage is the occasional knee instability which results from the loss of the lateral tensor band. In one case it was necessary to transfer the rectus femoris tendon into the distal tensor band to correct the lateral knee instability which resulted from the use of the TFL flap. It may be possible to circumvent knee instability by attaching the distal cut margin of the tensor band into the proximal fascia of the vastus lateralis muscle. It was initially thought that the use of rectus femoris flap would cause a greater functional loss than the TFL flap, but this has not been the case. Because it is primarily a fasciocutaneous flap, the TFL flap is not effective in correcting contaminated wounds or in obliterating cavities.

ADVANTAGES

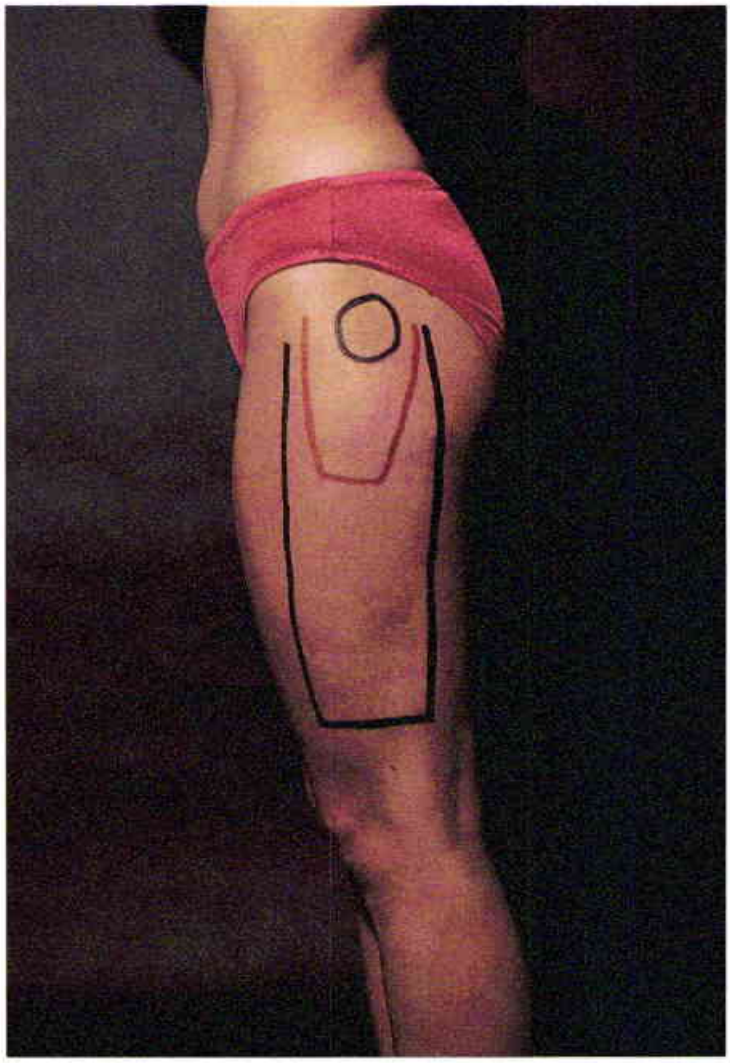
The TFL unit is versatile because it can be used either as a fasciocutaneous or myofascial flap. It is innervated by a predictable sensory branch (lateral femoral cutaneous nerve), which is easily visualized between the iliac crest and the lateral border of the rectus femoris muscle. The lateral femoral cutaneous nerve has made the flap particularly useful for ischial coverage in meningomyelocele patients, since this L1-3 sensory area is spared in the majority of these patients and can be used to transfer sensate skin to the ischium. As a myofascial flap it is certainly the most useful tissue for middle and upper abdominal wall reconstructions, as well as for the difficult problem of the recurrent inguinal hernia.

COMPLICATIONS, PITFALLS, AND DONOR SITE

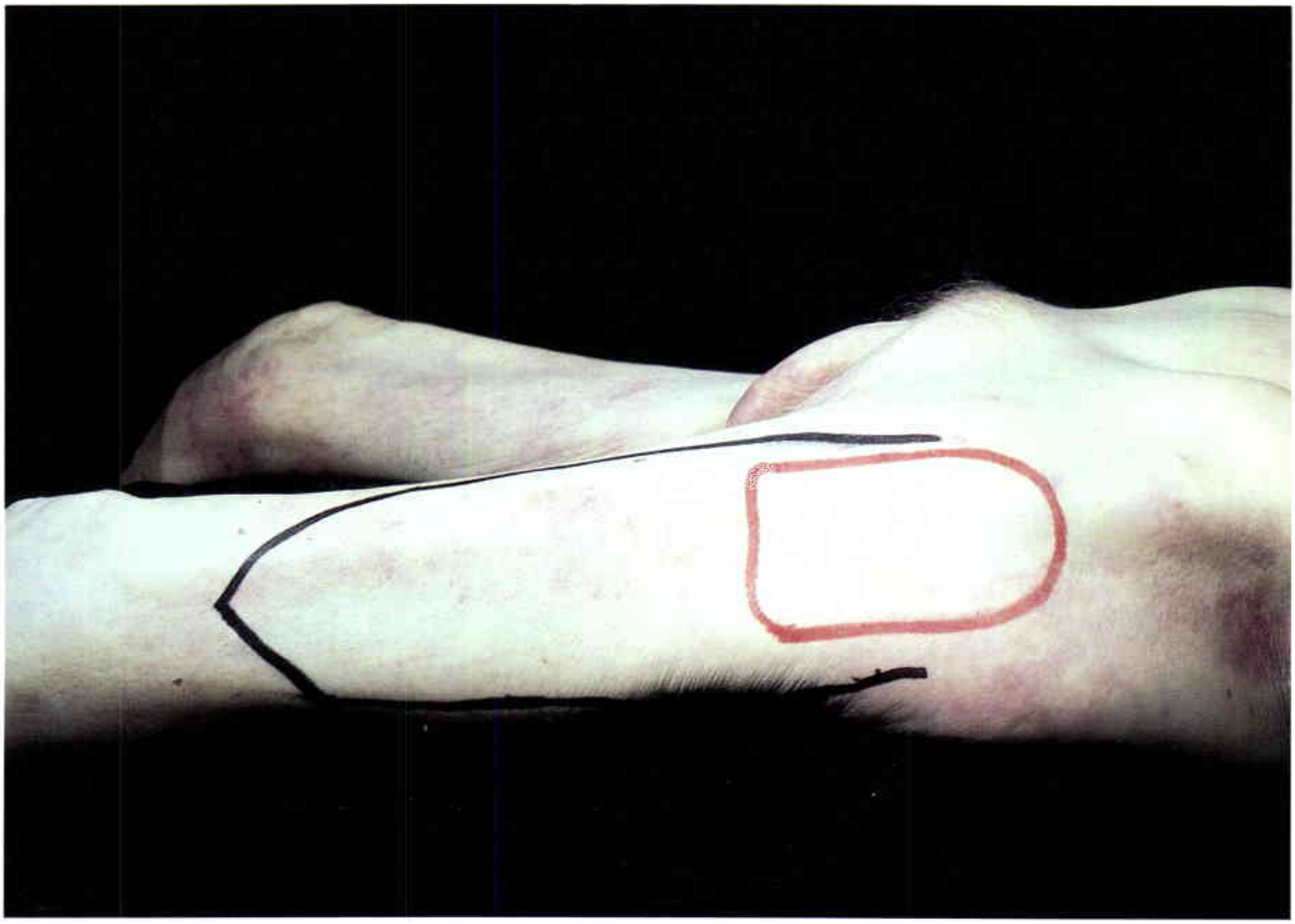
Excessive flap length and improper inset of the flap under tension should be recognized as the most common causes of flap necrosis in this normally robust flap. The flap can sustain a generous amount of either tension or torsion, but the combination of these two stressful events should be avoided. Flap elevation is straightforward, but one must carefully protect the dominant vessels and the lateral femoral cutaneous nerve. Since this sensory nerve enters the anterior border of the TFL flap, the TFL flap must be extended onto the lateral margin of the rectus femoris muscle if the nerve is to be included with the flap. Injury to the lateral femoral cutaneous nerve may result in the well known meralgia paresthetica complex of symptoms. Fortunately, the size and location of the dominant vessels to the flap are predictable.

Prolonged drainage has developed in a small number of patients. In a few cases serous drainage lasted for six or more weeks and was probably caused by a lymphatic fistula or a draining lymphocele. Lateral knee instability is an unusual complication, but it is correctable by the transfer of the rectus femoris tendon into the distal tensor band. It can probably be prevented by attaching the cut distal tensor band into the tendon of the vastus lateralis muscle.

There are very few pitfalls in the mechanics of flap elevation because the plane between the vastus lateralis muscle and the tensor fascia is easily defined. It is possible to injure the dominant vessels when raising the flap as an "island" flap, but their location is consistent. Vascular "spasm" can be caused by traumatic handling of the dominant vessels, and it may lead to partial flap necrosis. Rather than stretching the TFL vessels over the rectus femoris muscle, the origin of the rectus femoris muscle should be divided to increase the upward mobility of the TFL flap. Fortunately, this transection of the rectus femoris muscular origin does not affect the subsequent use of an "island" rectus femoris flap in the same muscle. The donor site is quite acceptable if it can be primarily closed. A skin-grafted donor site is remarkably unesthetic in appearance. Primary closure is facilitated by complete elevation and incision of the fascia lata on the medial aspects of the thigh anteriorly and posteriorly. This fascial "release" advances the skin margins of the remaining thigh skin by an additional five to six centimeters, which can make a critical difference in the donor site closure.



1
The disparity between the small size of the tensor muscle and the surrounding TFL flap dimensions is demonstrated in a model. This donor defect will require a skin graft for closure.



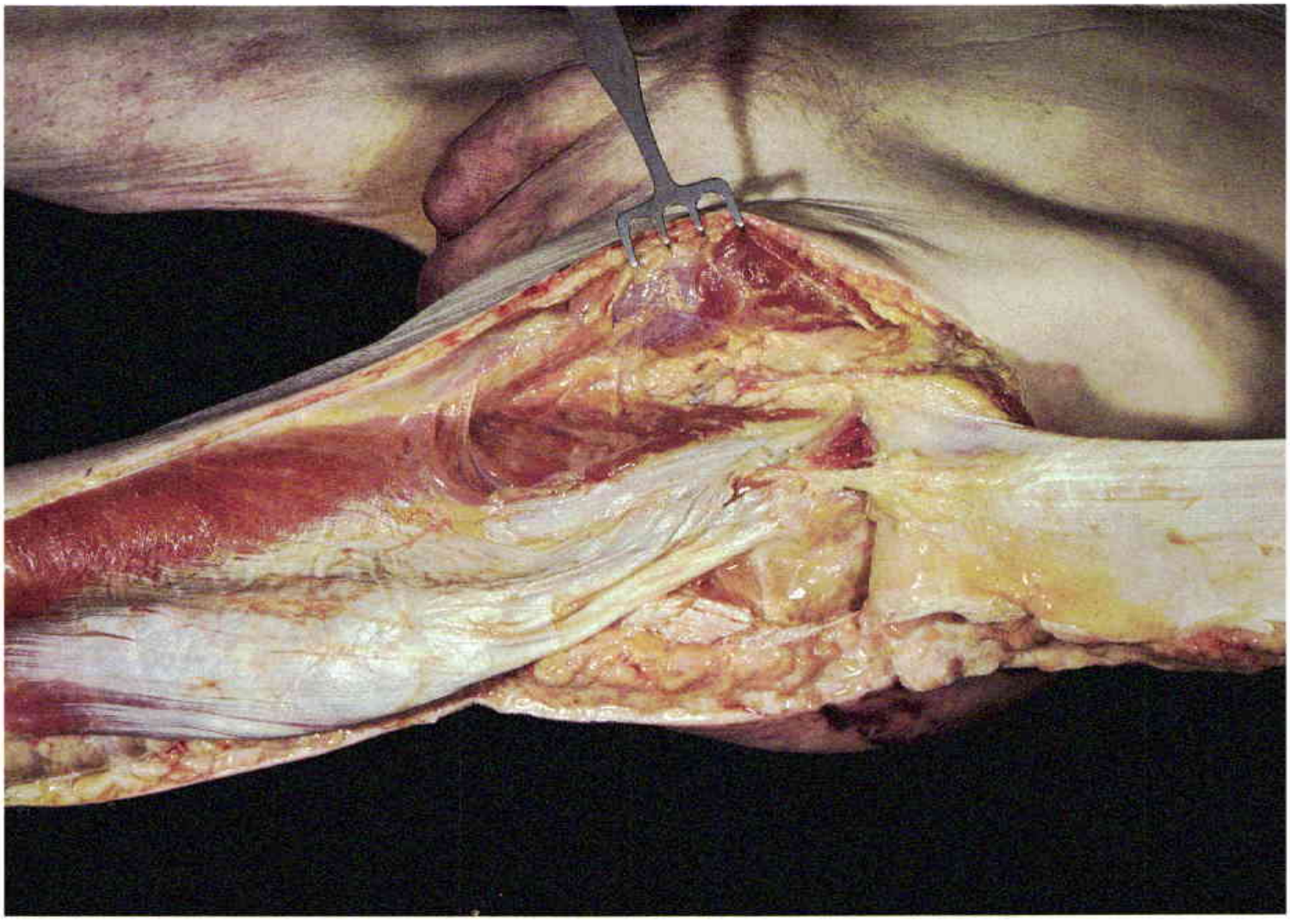
2

A very large TFL flap is outlined in the cadaver. This will create a defect which must be skin grafted. There is a cutaneous vessel which enters the proximal cutaneous "base" of the flap and provides a separate blood supply to the skin. It is unlikely that a longer flap would be reliable because of the relative dominance of the vastus lateralis perforators in the distal one-third of the thigh.

3
The outlined TFL flap extends from the margin of the biceps femoris muscle posteriorly to the midline of the thigh anteriorly. Note that the tensor fascia is deficient distally in the area of the biceps femoris tendon.

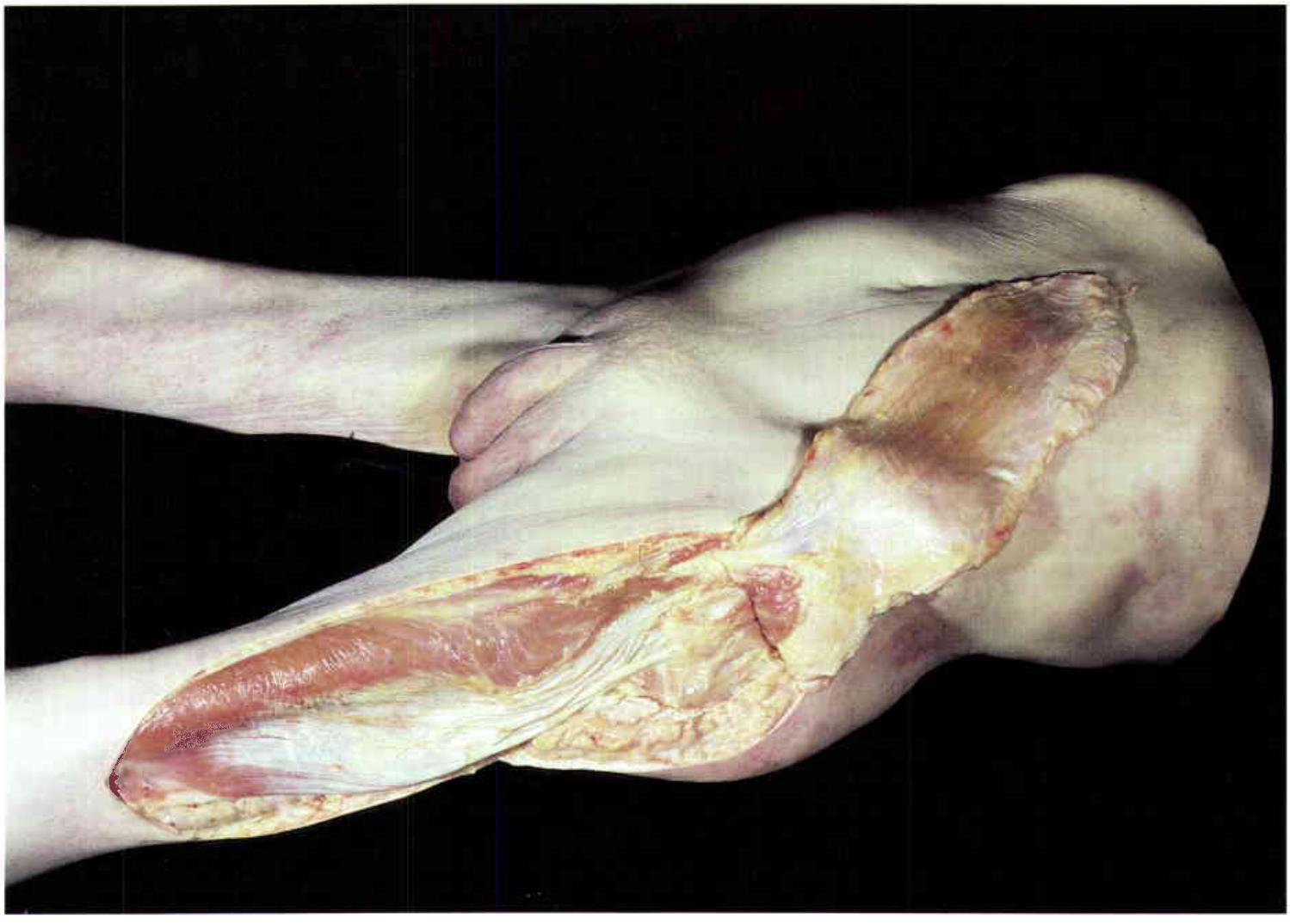
4

The tensor fascia is readily dissected away from the underlying vastus lateralis muscle. In this example the deep fascia was included from the margin of the rectus femoris muscle to the margin of the biceps femoris muscle. The small tensor muscle is partially elevated from its trochanteric origin.



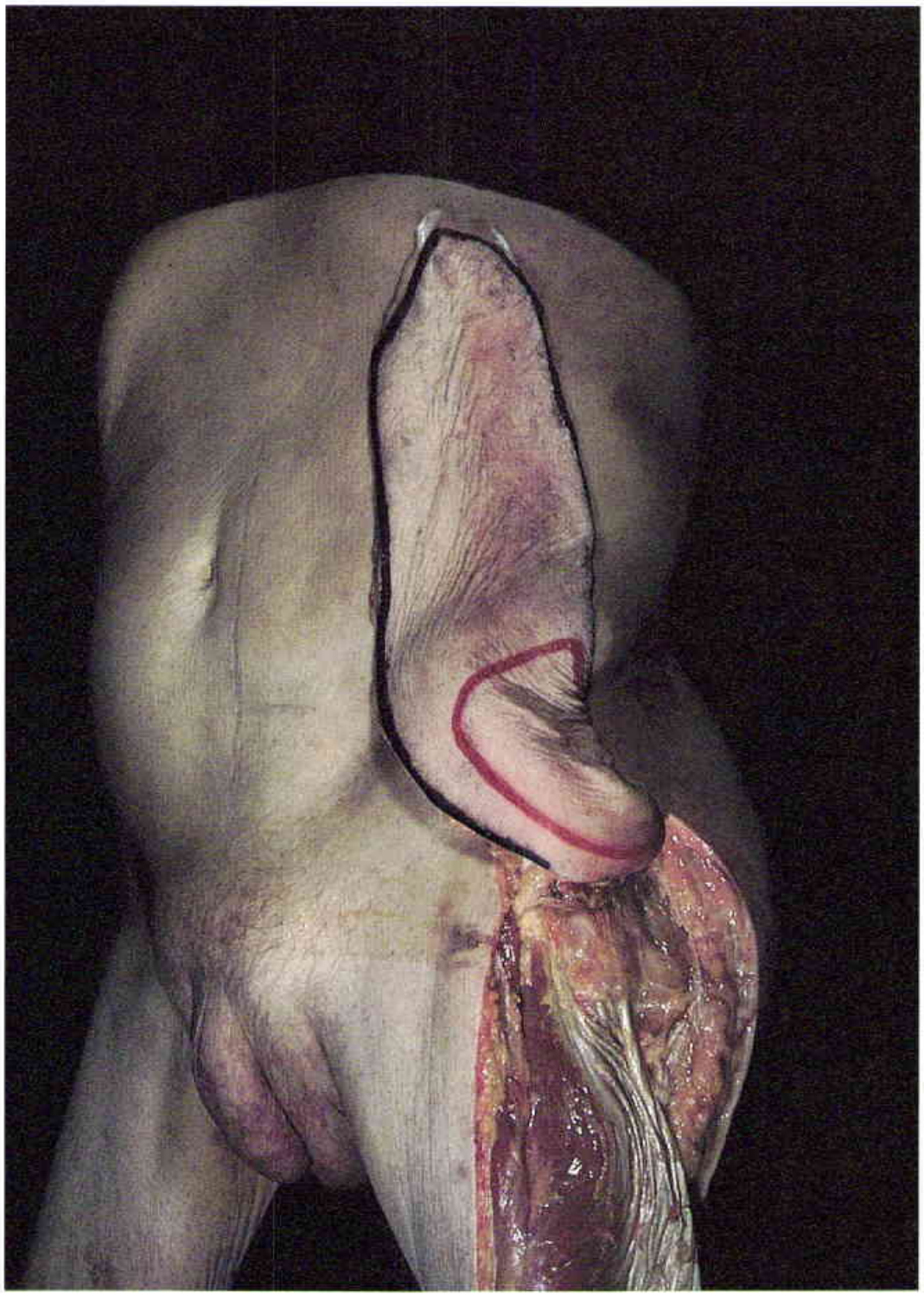
5

The TFL flap has been completely elevated away from the vastus lateralis muscle. The dominant vascular pedicle is seen piercing the proximal tendon of the vastus lateralis muscle and then entering the medial edge of the tensor fascia. The tensor muscle has been partially elevated away from its origin on the greater trochanter. It is safe to remove the tensor muscle from its origin completely since the dominant vasculature is not harmed by this maneuver.

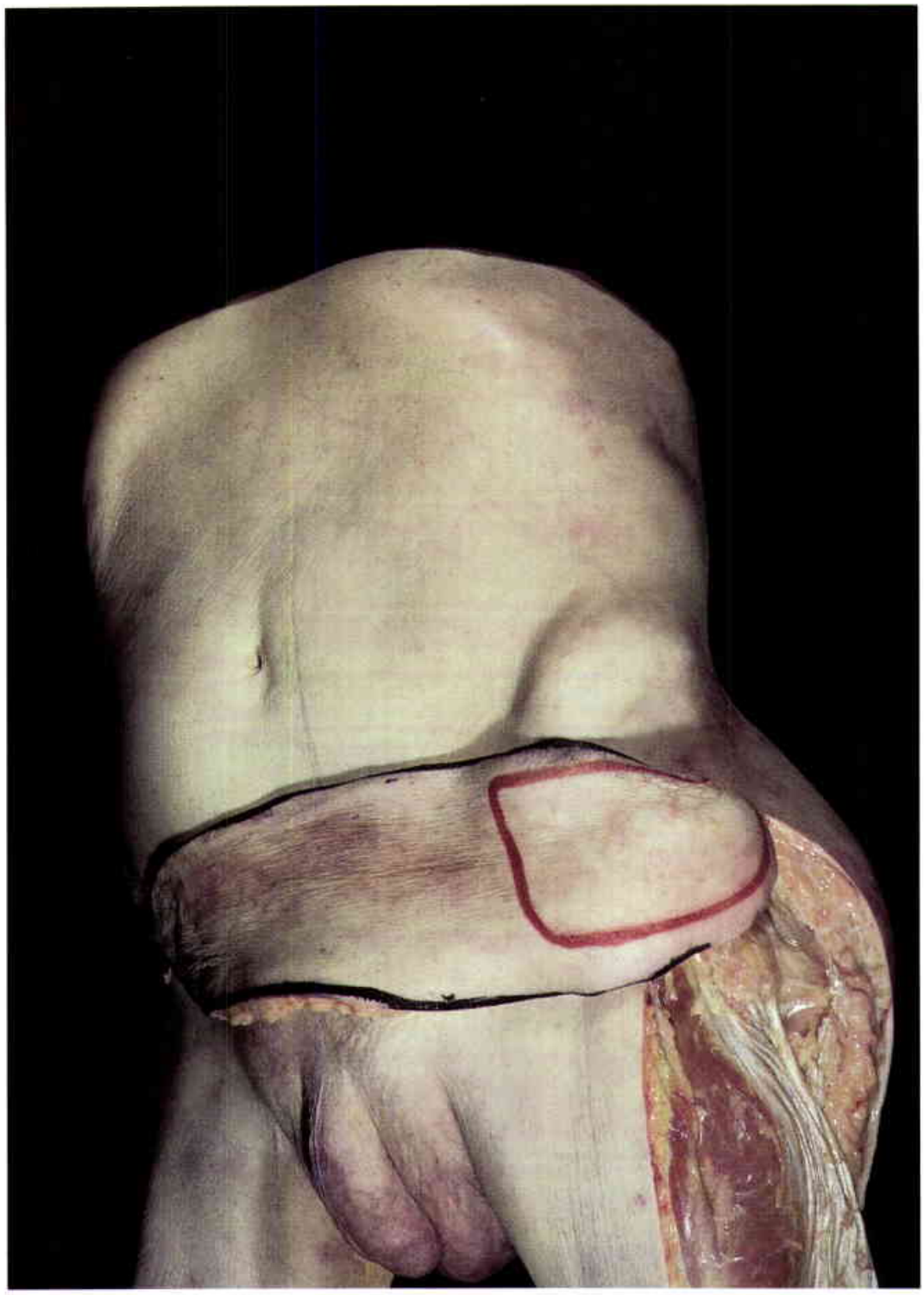


6

The fascial undersurface of the TFL flap is demonstrated. The lateral circumflex femoral vessels are seen entering the tensor muscle just medial to the greater trochanter. These vessels arise from the profunda femoris vessels and then pass beneath the rectus femoris muscle approximately ten centimeters below the inguinal ligament.

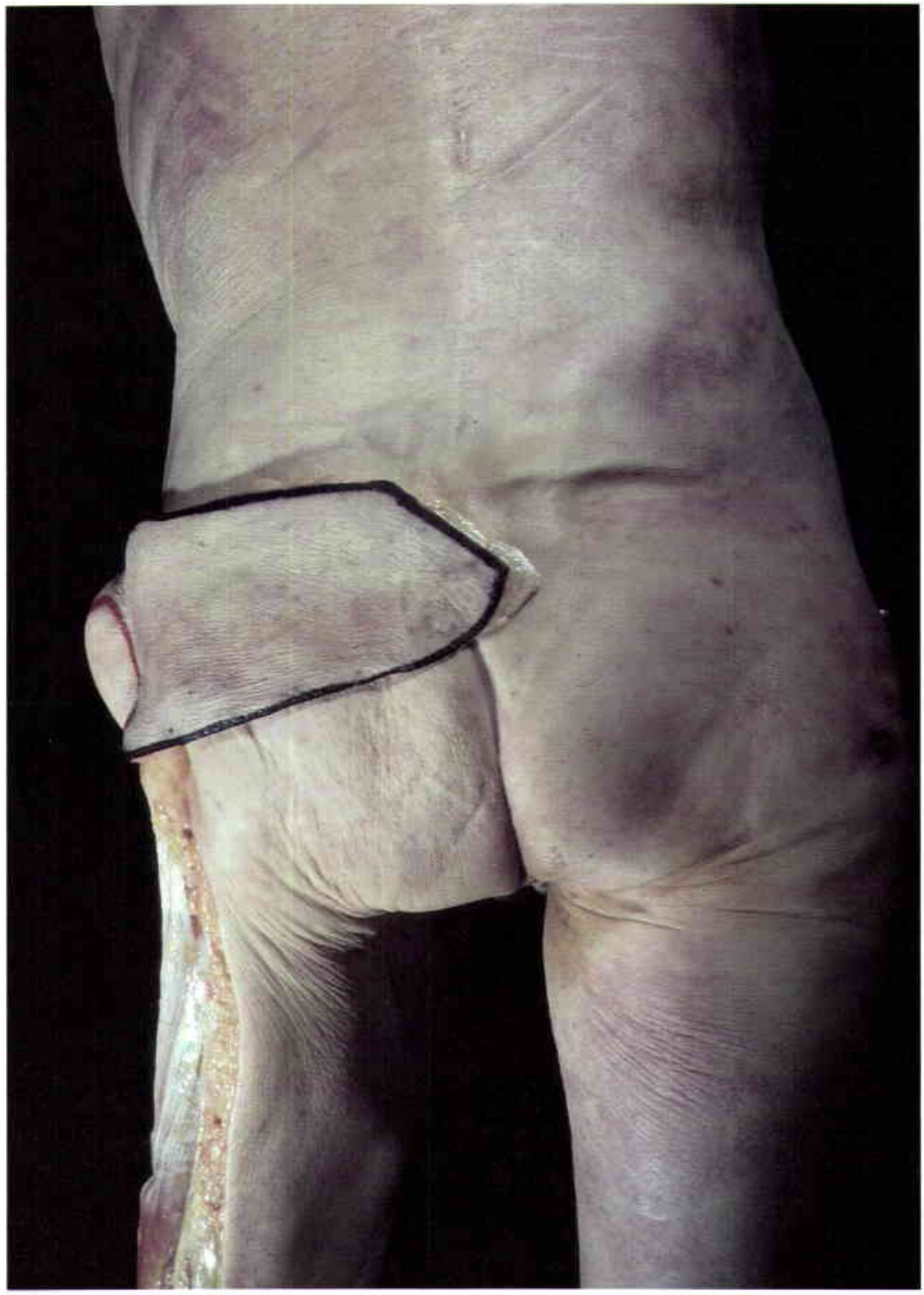


7
The tip of this flap reaches the lower chest wall. Complete elevation of the tensor muscle from the greater trochanter and the creation of a true "island" flap will allow the most distal portion of the tensor fascia to reach the xiphoid.



8
The entire suprapubic area can be resurfaced by the TFL flap.

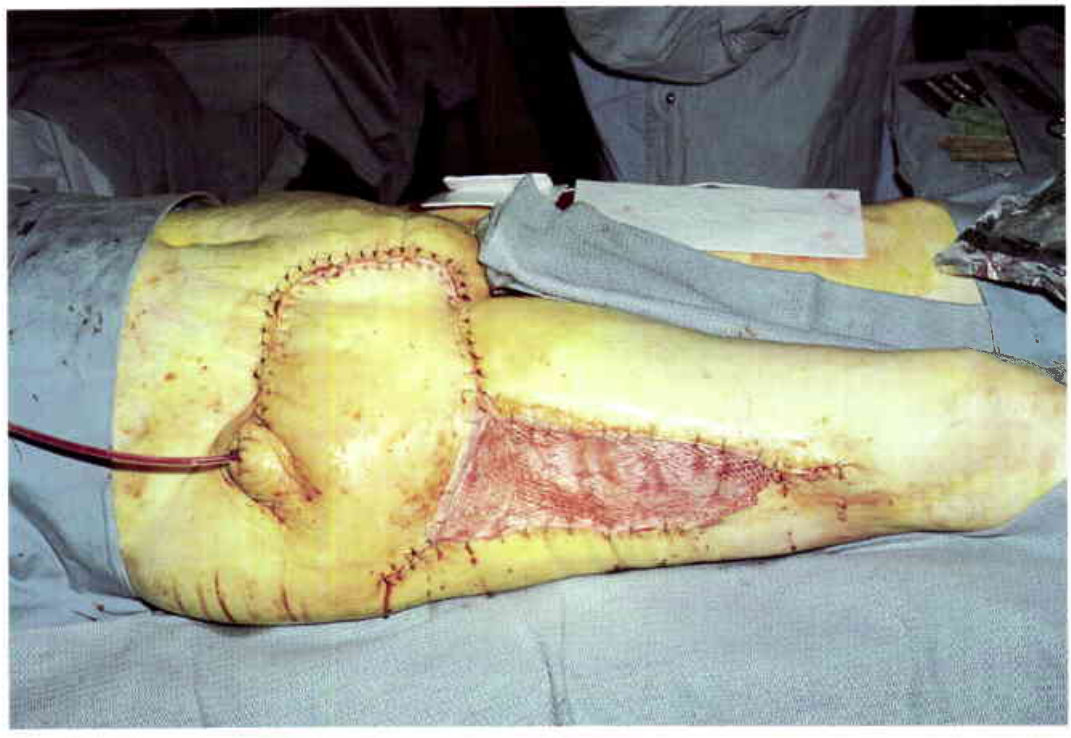
9
Generally the TFL flap will barely cover an ischial defect. This flap has an exceptional posterior excursion.



10
The posterior rotation shows the TFL flap reaching the midsacrum. The long legs of this cadaver provided an unusually lengthy flap.

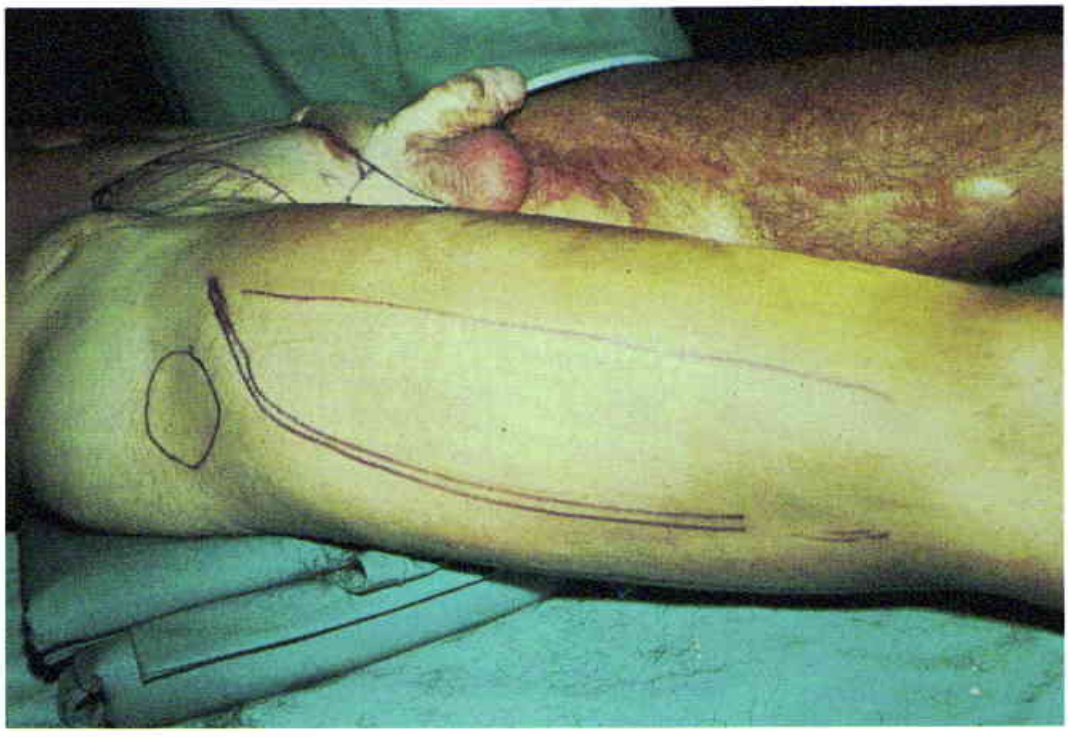
11
Seventy-eight-year-old woman with a carcinoma of the cervix treated with a radical hysterectomy and bilateral groin irradiation. The extensive irradiation ulcer of the right groin has been present for two years. (Case of P.G. Arnold and G. Irons)

12
The irradiation ulcer of the groin and lower abdomen was excised. No tumor was found. A very wide TFL flap is outlined to accommodate the large excisional defect.



13
TFL flap rotated into the defect. The donor site was immediately grafted.

14
Appearance of the flap and donor site at three years. The wound has remained healed.



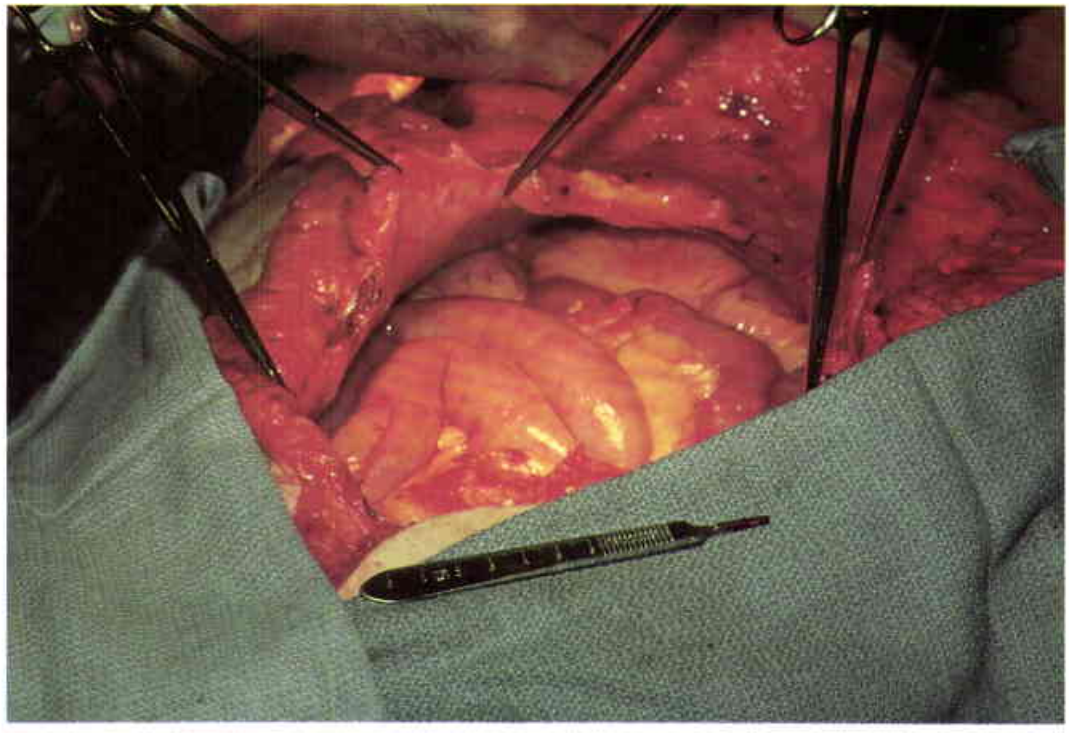
15

This twenty-six-year-old patient sustained a high voltage electrical injury to the perineum, abdomen, and right thigh. The full thickness of the left lower quadrant of the abdominal wall had been lost. A skin graft covered a herniated Marlex® mesh graft in this area. The anterior margin of the TFL flap is outlined. The posterior margin (double line) of the flap will be defined after the ability to close the donor site has been determined. (Case of J.B. McCraw, C.E. Horton, and G. Hoffman)

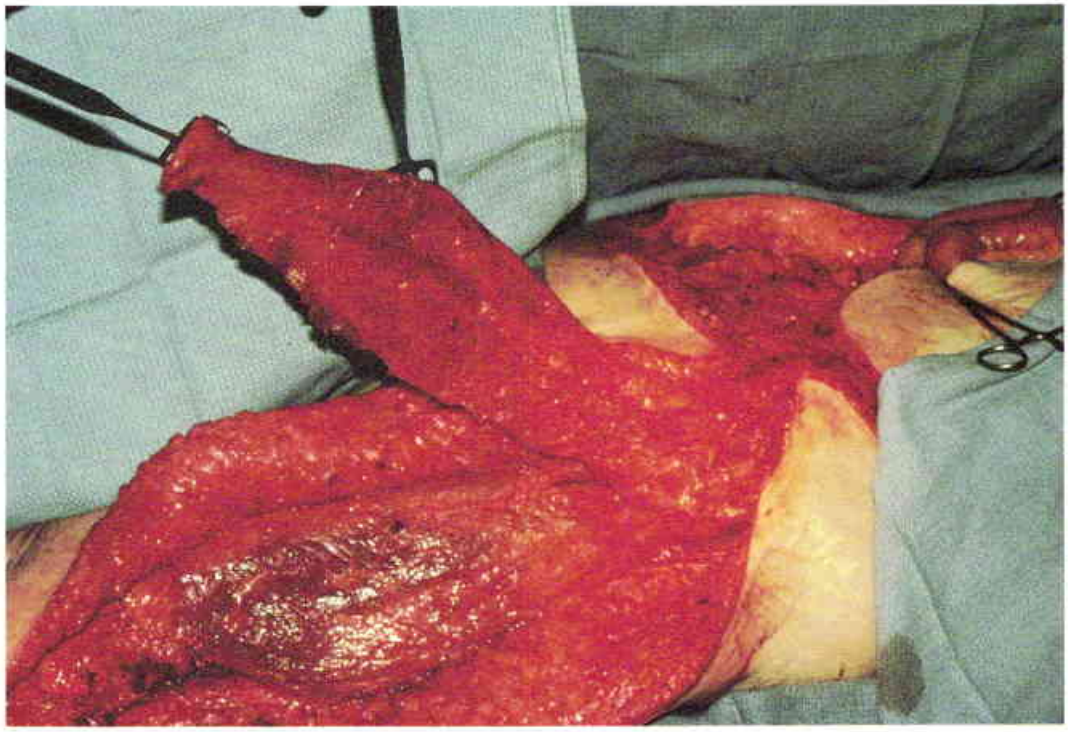
16

The "island" TFL flap is rotated into position. Primary closure of the donor defect was facilitated by anterior and posterior incisions of the deep fascia. The fascia on the undersurface of the TFL flap was used to repair the abdominal wall defect. The cutaneous portion of the flap was used to replace the skin graft of the lower quadrant. The closure of the donor defect was somewhat difficult because the entire medial thigh had previously been skin grafted.

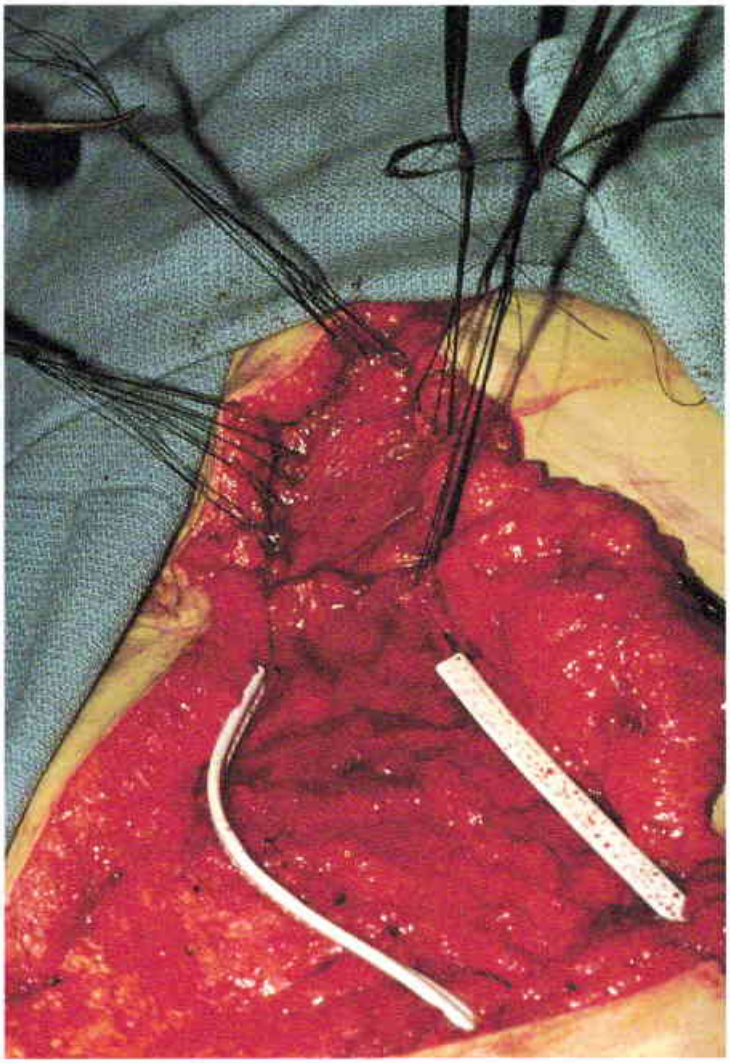
17
This sixty-nine-year-old patient was left with a recurrent abdominal hernia after six abdominal repairs with artificial mesh. The patient had also undergone cobalt irradiation for carcinoma of the cervix, which resulted in an irradiation ulcer in the suprapubic area. (Case of J.B. McCraw and M. Greenspan)



18
The huge abdominal wall defect could not have been closed primarily.



19
A tensor myofascial flap is elevated as a pure "island" flap.

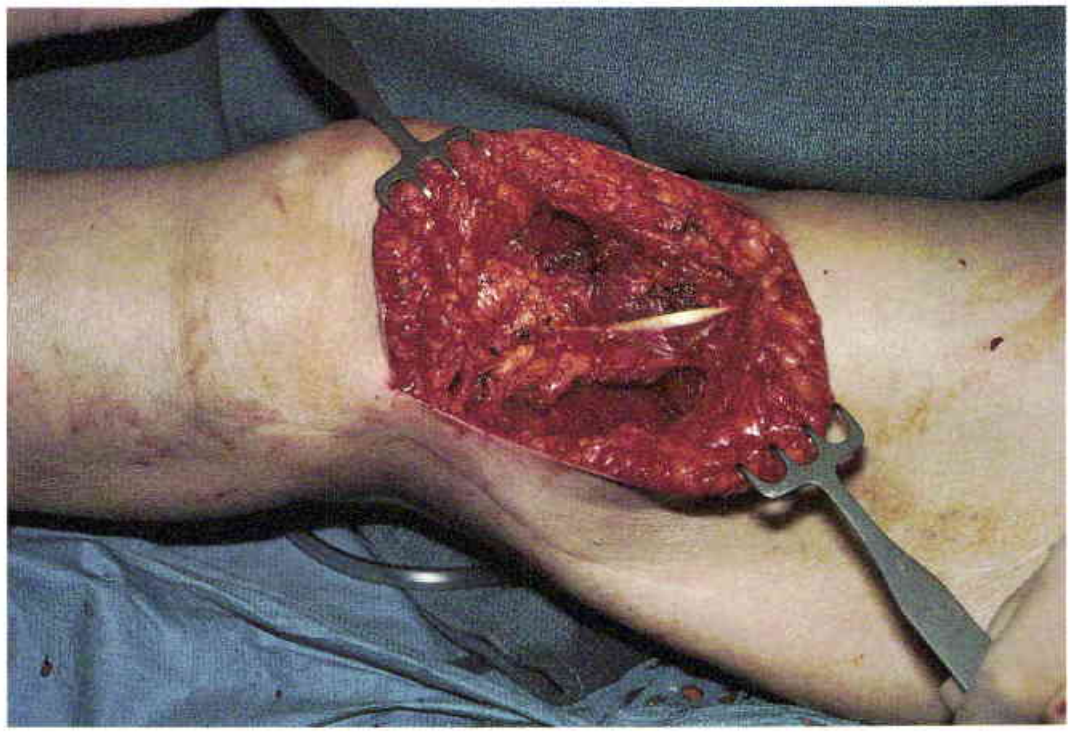


20
The tensor fascia was used as an end-to-end patch, interposed between the two rectus abdominis muscles.

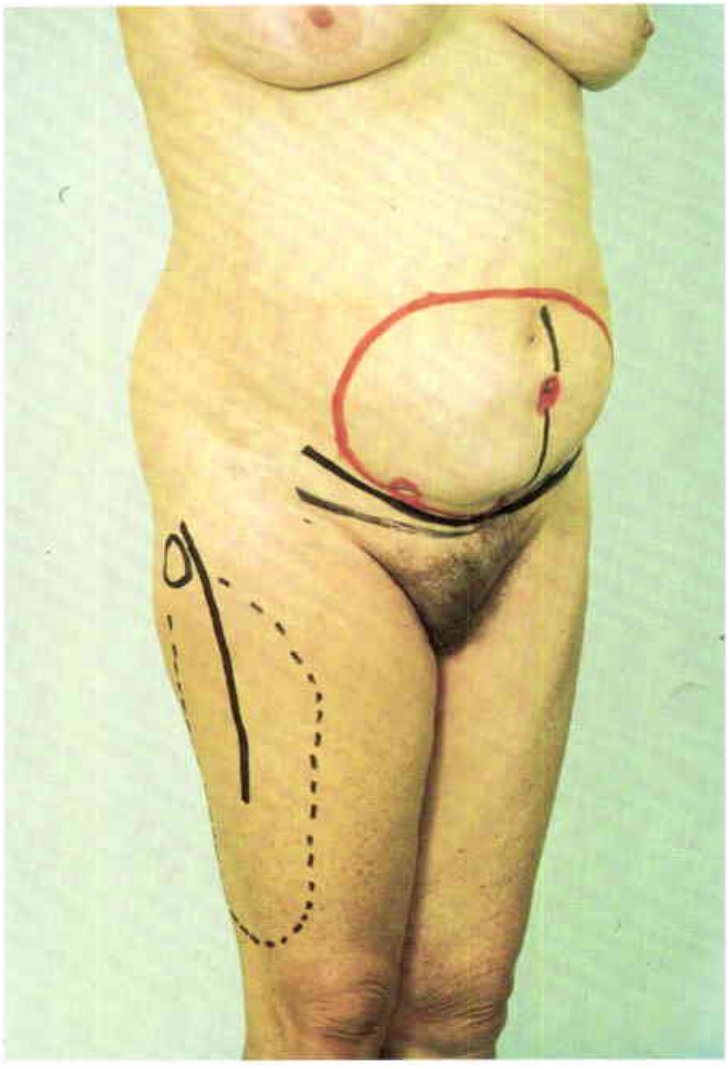
21
Postoperative view demonstrating good abdominal wall stability. This is the same procedure described by Dr. Owen Waagensteen in 1933.

22
Healed donor site.

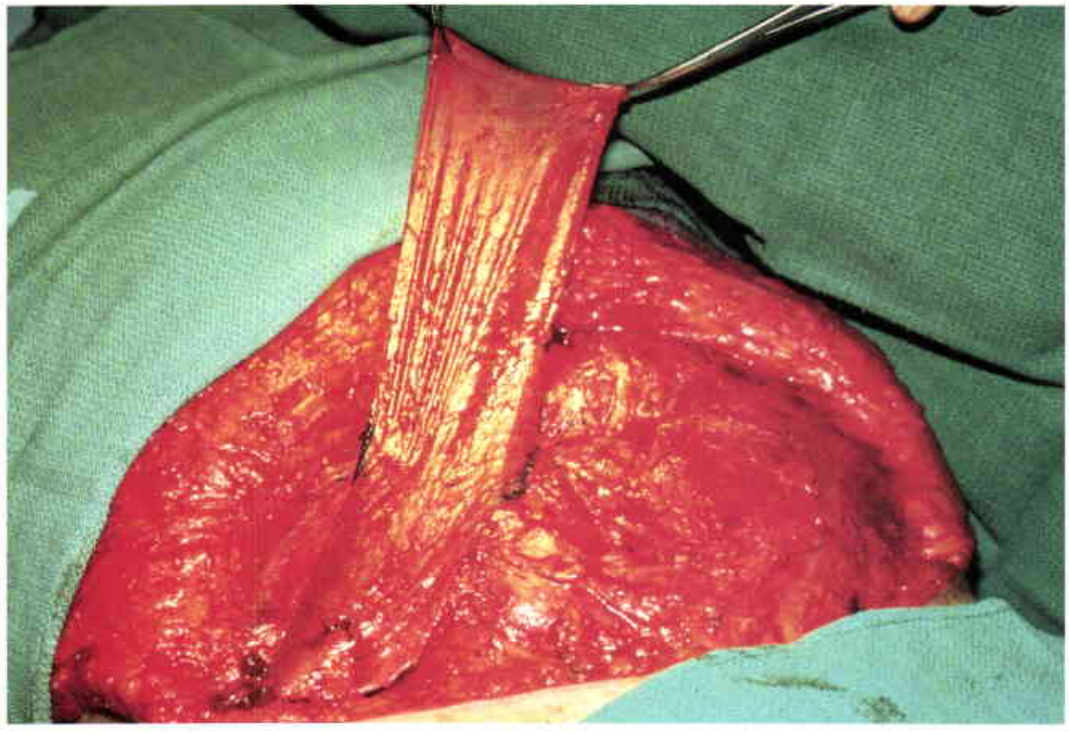
23
Two years later the patient developed left lateral knee instability. The rectus femoris tendon is elevated for transfer into the distal tensor band.



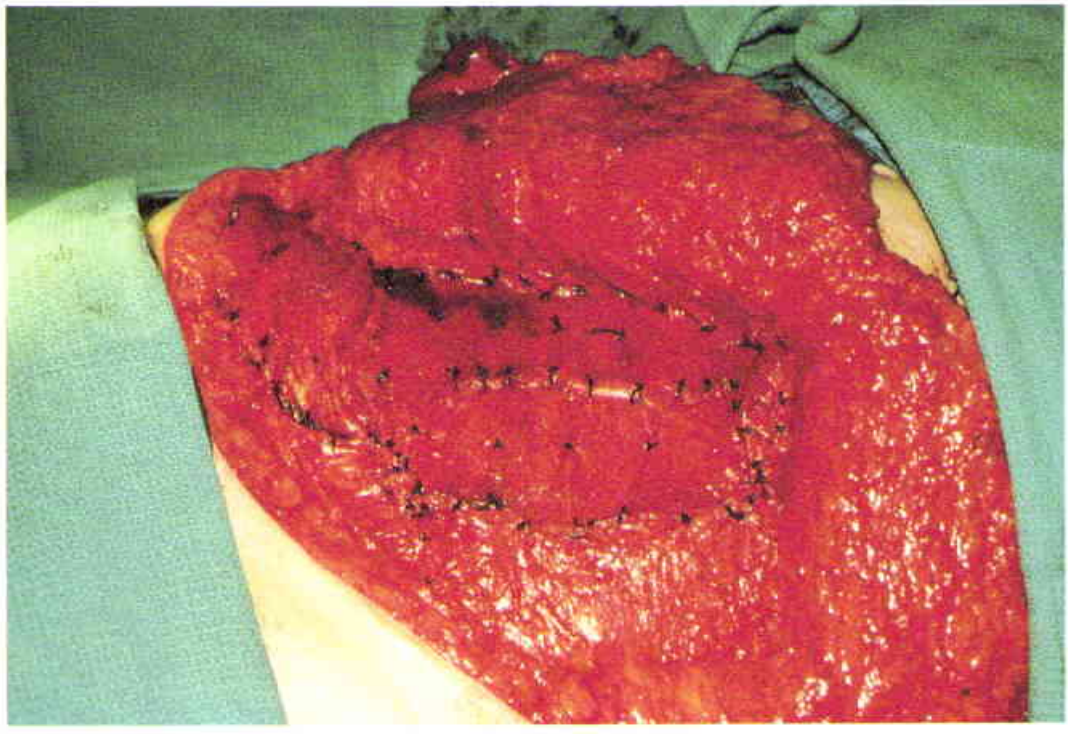
24
The rectus femoris tendon transfer adequately corrected the deficient lateral knee stability that had resulted from the use of the TFL flap.



25
Infected Marlex® mesh repair of an abdominal hernia in a severe asthmatic. A tensor myofascial flap is outlined. (Case of J.B. McCraw and G. Hoffman)



26
"Island" tensor myofascial flap transposed into the abdominal defect.



27
Lateral view of the end-to-end repair of the abdominal fascial defect.

28
Solid abdominal repair at one year. Note the unsightly bulge of the tensor muscle in the right groin. This fullness decreased very little with time and could have been avoided by trimming the tensor muscle initially.

TENSOR FASCIA LATA

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