The caudal superficial epigastric (CSE) flap is a highly versatile axial pattern skin flap that can be used to cover large open wounds (Figure 1, page 70) on the:

- Ipsilateral or contralateral mid to caudal trunk
- Perineum
- Hindlimbs (to some extent)

In dogs with greater body length-to-limb length ratios (such as basset hounds) and cats, this flap can extend to cover wounds as distal as the metatarsus.

This extensive range of skin transfer is due to the long, robust CSE artery, which branches from the external pudendal artery in the caudal part of the inguinal canal; then continues cranially just deep to the mammary glands along the mammary row (Figure 2, page 70).

When creating the flap, once the cranial, medial, and lateral aspects of the flap have been freed, most of the skin of the mammary chain can be elevated from the abdominal fascia and effectively transferred to distant skin defects. The donor skin defect can then be closed routinely, similar to closure after a unilateral mastectomy.

**INDICATIONS**

Due to the flap's abundant blood supply and skin with thick subcutaneous tissue padding, the flap can be used to successfully cover:

- Deep wounds without a granulation bed
- Wounds with exposed bone or tendon
- Areas that require durable full-thickness skin coverage.

The most common indications for CSE axial pattern flaps are (Figures 3–5, page 71):

- Large degloving injuries to the hindlimb
- Large skin defects after wide surgical excision of neoplasia.

**GENERAL PREOPERATIVE CONSIDERATIONS**

- Perform thorough physical examination and obtain a minimum database, including complete blood count and serum biochemical profile.

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**What You Will Need**

- Standard surgical instrument pack
- #10 or #15 scalpels
- 3-0 or 4-0 monofilament absorbable sutures on a taper needle
- 3-0 or 4-0 monofilament nonabsorbable sutures on a cutting needle
- Many laparotomy sponges

**Optional but helpful:**

- Variety of skin hooks
- Electrocoagulation

**Optional:**

- Jackson-Pratt drain bulb and multifenestrated tubing
- Extra (8–10) small towel clamps
- Atraumatic DeBakey thumb forceps
• **KEY POINT**: In patients with skin defects caused by significant trauma, rule out trauma to other organ systems (e.g., bladder rupture, diaphragmatic hernia). Do not rush reconstruction of an acute traumatic wound. Rather, focus first on appropriate early open wound care and patient stabilization.

• Before any major reconstructive effort, limit contamination in a traumatic wound with appropriate antibiotic therapy, local wound management, and bandaging.

**SURGICAL TECHNIQUE**

Assess Skin Coverage

1. **KEY POINT**: Prior to surgery, ensure that the CSE axial vessel is healthy along its course by visual inspection of the area. If trauma or skin loss is close to the inguinal ring or mammary chain, and vessel viability is questionable, color flow Doppler imaging or angiogram studies can help determine whether the axial vessel has been damaged. If concerns exist regarding vessel viability, use the healthy contralateral mammary chain for skin transfer.

2. Determine the approximate length of skin perfused by the caudal superficial axial vessel (angiosome) by measuring from the superficial inguinal ring to the region midway between the first 2 mammary glands (the most cranial extent of the skin nourished by this vessel) (**Figure 1A**).

   This length of skin is the same in both males and females. However, in males, one or more small branches of the CSE vessel supply the preputial skin. These branches must be carefully ligated to allow full rotation of the flap base in male animals.

3. Measure the distance from the base of the flap to the farthest point of the open wound. I prefer to add about 20% to the length of the skin flap needed to cover the defect because some length of the flap is lost as the flap is rotated into position and the flap can be expected to shrink somewhat. Determine the feasibility of the flap to cover the defect on the basis of these initial measurements.

4. Determine the maximum width of the flap by measuring from the abdominal midline to the nipple; then extend that measured length lateral to the nipple (**Figure 1A**).

5. If a “paddle” of skin is needed to cover a large round defect broader than the maximal flap width, consider folding the terminal aspect of the flap in a...
“U” turn to essentially double its effective flap width (Figure 6). To ensure the planned flap transfer is feasible, add this extra folded skin into your proposed skin flap length measurement.

**Patient Preparation**

1. Administer general anesthesia and place patient in dorsal or lateral recumbency to allow simultaneous access to both the desired donor mammary chain and skin defect.

2. In addition, administer first-generation cephalosporin antibiotics at anesthesia induction and then every 90 minutes until wound is surgically closed.

3. Clip and prepare a generous area surrounding the proposed skin defect and donor skin region. Plan to include plenty of adjacent skin in the aseptically prepared field because, as the donor site is closed, surrounding skin will be mobilized into the field. When the skin defect involves the hindlimb, hang and aseptically prepare the limb to facilitate skin transfer and wound closure.

4. Aseptically drape the entire field, with ample skin included around the exposed donor and recipient sites.

**FIGURE 3.** Skin defect due to wide surgical excision of a fibrosarcoma in left flank area (A) and CSE flap from left mammary chain transferred to cover defect (B).

**FIGURE 4.** Large defect due to wide excision of a large scrotal mast cell tumor in a 10-year-old boxer (A). Left CSE flap reconstruction (B), with a Jackson-Pratt drain placed under the flap and donor area. Note that the drain exit is lateral to the closed donor region.

**FIGURE 5.** A large degloving wound extending from the medial stifle to the tarsus in a mixed breed dog, which was reconstructed with a left CSE flap. The hock region is visible at the distal most aspect of the flap (bottom of image).

**FIGURE 6.** Labrador retriever with left CSE flap; the distal aspect is folded to form a “paddle” to reconstruct a large caudal thigh defect after wide excision of a malignant tumor. Yellow dashed arrow depicts the folded distal end of the flap.
Recipient Wound Preparation

1. Using aseptic technique, debride and lavage the wound if it is not fully covered with healthy granulation tissue. Culture tissue removed from the wound bed, particularly if the wound is considered contaminated.

- If the flap is being used to reconstruct an open wound, irrigate the wound bed with an appropriate antiseptic solution and routinely clip and aseptically prepare the surrounding skin.
- If the wound is more chronic and skin wound edges are partially epithelialized, square off the wound edges and remove thin epithelialized tissue, extending the wound bed margins with a scalpel blade.

2. Sharply undermine the skin edges of the wound for several millimeters to create a free edge to which the flap will be sutured. Cover the prepared recipient wound with moistened laparotomy pads as you begin flap (donor skin) preparation.

Donor Skin Preparation

1. Draw the proposed flap dimensions with a sterile drawing pen (Figure 7). The medial border is located on the ventral abdominal midline from the pubis to a point between the first and second mammary glands. In male dogs, the medial caudal border includes the skin just lateral to the base of the prepuce.

2. The lateral border of the flap should run parallel, and to an equal length, to the medial border (the midline). Draw the lateral borderline equidistant away from the nipple line as the distance measured from midline to the nipple line.

Essentially, the width of the flap is double the measurement from the midline to the nipple line.

3. Taper down the lateral skin margin toward the inguinal ring area, which makes the donor defect in the inguinal region easy to close after flap transfer.

4. After ascertaining the appropriate flap length, draw a line connecting the medial and lateral skin flap lines at the distal aspect of the proposed skin flap. Create the shape of the distal end of the flap with rounded margins to facilitate closure of the cranial aspect of the donor defect without dog-ear formation.

Incise & Undermine the Flap

1. Using a scalpel blade, incise skin along the borders of the drawn lines to outline the flap. Because the skin incision tapers caudally in the inguinal region, do not damage the nearby underlying CSE vasculature.

2. Starting at the distal aspect of the flap (the most cranial aspect), carefully and sharply undermine the subcutaneous tissue directly off the abdominal wall. In the cranial most aspect, expect firm adherence of subcutaneous tissue to the underlying pectoral muscles. Undermining is easier as dissection progresses caudally because the subcutaneous tissues are loosely connected to the underlying fascia. Avoid using thumb forceps to grasp skin edges; rather, use skin hooks or digital manipulation to handle and retract the flap (Figure 8).

3. Cover the donor skin edges and defect with moistened laparotomy pads as you undermine the flap.
4. **KEY POINT**: Because undermining progresses toward the inguinal ring region, use extra caution as you bluntly dissect subcutaneous tissue around the base of the flap and pudendal epigastric trunk. Consider leaving the inguinal fat pad (vaginal process) and connecting fat intact as long as the base of the flap can be rotated into position effectively.

Create a Bridging Incision If Necessary
1. If the base of the flap does not extend to include the skin defect, a bridging incision is necessary to allow a pathway for the flap to reach the recipient bed.
2. Make an incision through the skin and subcutaneous tissue directly between the base of the flap and recipient bed. Determine where the flap base best sits within its rotated arc to decide where to create the bridging incision (**Figure 9**).
3. Undermine the skin adjacent to the bridging incision to allow for the width of the tapered skin flap base to comfortably fit within it.

Transfer the Flap into the Recipient Bed
1. Rotate the flap onto the wound. **KEY POINT**: The flap can be stretched somewhat to accommodate the wound defect, but do not allow tension or kinking of the CSE vessel if the flap is rotated 180 degrees or more.
2. Ensure the distal aspect of the flap is positioned in the distal most area of the open wound. Try multiple flap positions until you find the best location for the flap (**Figure 10**).
3. Once the best flap position is found, move the affected limb in multiple directions to ensure the flap is not under tension (especially for normal standing and walking limb positions).
4. If the open wound is round and wide, and a “U turn” of the distal flap to create a “paddle” is planned, additional flap maneuvers may be necessary before beginning closure (**Figure 6**, page 71).
5. If the flap does not fully cover the open wound, use other reconstructive options for closure.
6. While many surgeons prefer routine closed-suction drainage of these flaps to avoid seroma, I have found that drains are generally not necessary if atraumatic subcutaneous dissection and undermining were conducted and hemostasis was meticulous. If drainage is elected, ensure there is a good seal around the wound edges during closure. Do not exit the closed suction drain through the flap; instead, exit it lateral to the flap (**Figure 4**, page 71).

Suturing Wound Edges
1. **KEY POINT**: I prefer not to tack down or use walking sutures in the subcutaneous tissues to attempt to reduce motion and dead space under the flap and inguinal region. These sutures could inadvertently damage the blood supply to the flap.
2. Starting at the distal most aspect of the flap, use widely spaced interrupted hypodermal sutures
to fasten the flap into its permanent location (Figure 11). Alternatively, some surgeons use small towel clamps to help hold the flap and donor defect edges together while suturing.

3. Once these sutures have loosely positioned the flap, begin closing the hypodermal layer with monofilament absorbable 3-0 or 4-0 suture material in a continuous pattern. Close the skin with a simple interrupted or simple continuous pattern (my preference) 3-0 or 4-0 monofilament nonabsorbable sutures or with skin staples.

4. Keep the donor defect covered with moistened laparotomy pads until the hypodermis of the flap and defect margins is closed. Undermine the donor skin margins if tension develops while closing the defect.

5. Continue closure of the donor defect with hypodermal and skin sutures using the materials mentioned previously (Figure 12).

POSTOPERATIVE CARE

Bandaging
Once surgery is complete, place an Elizabethan collar on the patient and cover the mammary donor region with a stockinette or light bandage (at the surgeon's discretion). I prefer not to bandage the flap after surgery as bandages often "ride up" in the inguinal region, which can cause discomfort and, more important, put pressure on the flap vasculature, compromising perfusion of the flap.

Cold Therapy
The donor area can be cold-packed for several days after surgery, but I prefer to avoid cold packing the flap region, which can cause vasoconstriction of the subdermal blood supply and compromise the flap.

Medical Therapy
KEY POINT: Expect the extensive skin incision and undermining to cause substantial pain post surgery. Therefore, systemic opioids and nonsteroidal anti-inflammatory drugs are administered postoperatively for 24 to 48 hours. Appropriate orally administered analgesics are given for 5 to 7 days after surgery.

Postoperative antibiotic use is limited to patients with signs of wound infection or those in which there was a break in aseptic technique during the surgical procedure.

Home Care
Owners are instructed to monitor wounds carefully and seek veterinary attention if they notice increasing discomfort, inflammation, or drainage after surgery. Patients should be strictly limited to leash walks, and prohibited from stair climbing, jumping, or running until suture removal at 14 days after surgery. The patient can then gradually increase activity.
MANAGEMENT OF COMPLICATIONS

Seromas, hematomas, and wound dehiscence are potential postoperative complications seen after extensive reconstructive surgery such as described in this article (Figure 13).

- When a seroma or hematoma forms, do not invade the wound; consider cage rest and hot packing the wound beginning several days after surgery.
- Consider early reconstruction of minor wound edge dehiscence if there are no signs of infection.
- The distal aspect of the flap is most susceptible to avascular necrosis and dehiscence. Debride necrotic tissue and manage the wound open until a healthy granulation tissue bed forms. The surgeon can decide to leave the wound open for second intention healing or attempt secondary closure.

PROGNOSIS

If performed correctly, CSE axial pattern flaps have a low risk for flap necrosis (< 10%) and infection. Minor complications, such as seroma, partial incisional dehiscence, flap edema, and bruising, are generally amenable to conservative management and do not affect long-term prognosis.

CSE = caudal superficial epigastric

Suggested Reading

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