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Peer Reviewed

# Forelimb Amputation

**F**orelimb amputation is a salvage procedure performed for traumatic injuries (eg, irreparable fractures, soft tissue wounds), severe neurologic or ischemic lesions confined to the forelimb (eg, brachial plexus avulsion), certain congenital deformities, invasive neoplasia, and uncontrolled infection.

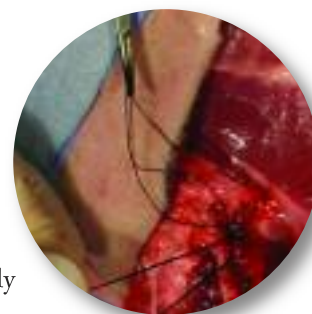
The technique described here may be preferred because it readily exposes major nerves and vessels, does not require bone cutting, and results in a cosmetic wound, as no prominent scapula remains. This procedure also carries lower risk for postoperative pressure necrosis because scapular/bony prominences (eg, the acromion) are removed. This is also the preferred technique to remove neoplasia, particularly lesions located in the proximal forelimb, because it allows resection with extensive surgical margins.

## CONSIDERATIONS FOR LARGE-BREED DOGS

Large- or giant-breed dogs undergoing forelimb amputation have difficulty adapting after surgery, particularly if they are obese or have concurrent neurologic deficits or significant contralateral limb osteoarthritis. Temporarily placing a sling on the affected limb may give owners a good idea about the pet's ability to adapt following the procedure. The veterinarian and owner must weigh the risk for disability against the immediate benefit of pain relief after removal of a debilitating neoplastic process or elimination of a life-threatening limb infection.

## BEFORE THE PROCEDURE

IV prophylactic antibiotics targeting skin contaminants should be administered to ensure optimal blood and tissue concentrations when the wound is created and throughout the procedure. Moderate to severe pain should be anticipated, especially during the first 24 hours after amputation.



Appropriate preemptive analgesic medications are warranted, and multimodal analgesia (including opioids) should be administered. In general, no blood products are needed in otherwise stable patients. However, a large-bore venous catheter is required if the need for rapid fluid infusion or transfusion should arise.

## POSTOPERATIVE CARE

Exercise should be limited until suture removal at 14 days. Some patients benefit from mild wound compression with an elastic body suit or conforming soft bandage. Cold compresses seem to help reduce mild wound edema postoperatively for up to 3 days (5 minutes, q8h). When no contraindications exist, appropriate oral analgesics, including NSAIDs, should be administered for 3 to 5 days after surgery.

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## WHAT YOU WILL NEED

- Standard general surgery pack
- Self-retaining (eg, Gelpi) or handheld (eg, Senn) retractors
- Bone-holding forceps (eg, Kern) or stout towel clamp
- 2-0 to 4-0 monofilament absorbable and nonabsorbable suture

## STEP-BY-STEP FORELIMB AMPUTATION

*Note:* The left limb is shown in all steps; cranial is toward the left of the image. Labeling of structures has been deliberately limited to avoid obscuring pertinent surrounding landmarks.

### STEP 1

(A) Place the patient in lateral recumbency with the affected limb uppermost. (B) Hang and prepare the entire limb up to the dorsal midline, including ample surrounding skin, for aseptic surgery. For ventrum preparation, extend the ventral margin to the sternum, caudally to the fourth or fifth rib margin and cranially to the midcervical area. This will allow the limb to be shifted in the surgical field to facilitate dissection. Mark the planned incision site with a sterile pen.

(S = shoulder joint)



#### AUTHOR INSIGHT

Studying an anatomy textbook closely before performing this procedure can be extremely helpful. The regional anatomy can be confusing, and excessive dissection and unnecessary collateral damage to surrounding structures can result in increased risk for wound complications.

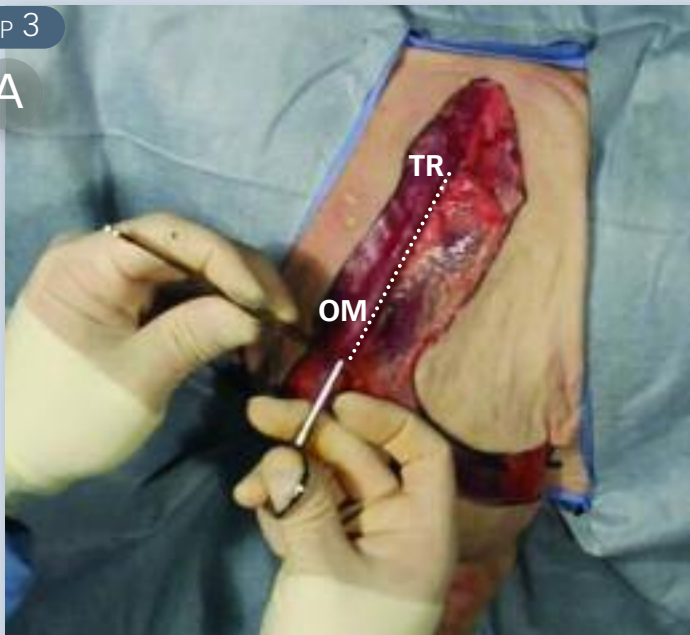
### STEP 2

Incise the skin. We prefer to create an incision that, when closed, appears as a rounded “L” instead of a triangulated wound as some textbooks recommend. Make the initial incision over the scapular spine beginning at the dorsalmost aspect, and proceed down to just above the acromion. Curve the incision cranially across the shoulder joint (S), and extend it medially in a gentle curve through the midbrachium and toward the axillary skinfold (see Step 1B). Create a second incision beginning at the acromion and slowly curve it toward the axillary fold to connect with the medial incision. Control SC bleeding with electrocoagulation or ligation.

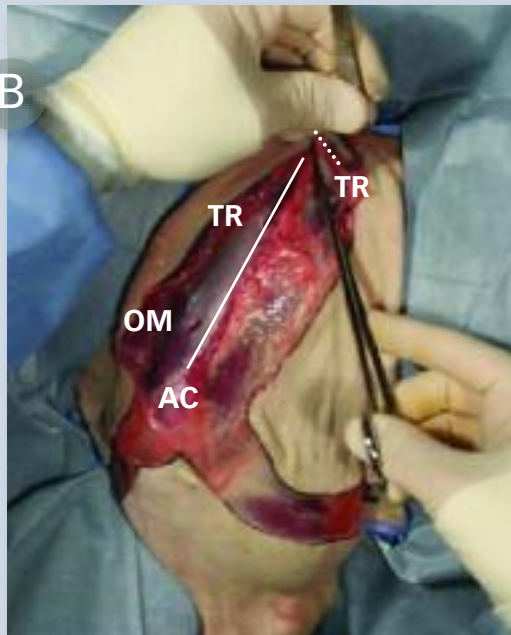


STEP 3

A



B



C



D



Dissect the scapula from the trunk. Incise through SC tissue and reflect the cranial skin margin on the scapular spine just enough to see the muscular insertions on the scapular spine (*dotted line* in A). The caudal skin margin should be undermined more extensively along the muscle fascia to the level of the caudal aspect of the scapula and brachium. Find the ventral margin of the thin omotraversarius (OM) muscle cranial to the acromion (AC), and undermine it bluntly with scissors. Continue to undermine the cranial portion of the trapezius (TR) muscle to the dorsal aspect of the scapular spine. Incise these muscle attachments close to the scapular spine.

The thin TR caudally attaches more dorsally, about three-quarters up the scapular spine (*line* in B). Do not damage muscle that lies just under this attachment. Incise the caudal part of the TR at its insertion on the scapular spine (B, *dotted line* indicates cut edge of TR). Retract the TR and place a bone-holding forceps or stout towel clamp on the dorsal spine. While retracting the scapula laterally, sever the taut rhomboideus (RM) muscle close to its dorsal scapular attachment (C). Continue lateral retraction of the scapula and elevate the broad insertion of the serratus ventralis (SV) muscle off the dorsomedial face of the scapula (*dotted area* in D). At this point all muscles that extend from the trunk to the scapula have been removed.

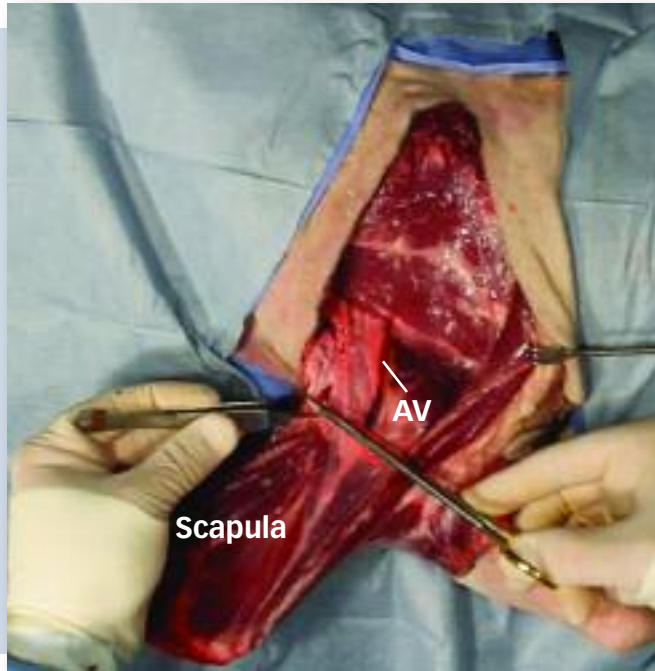
AUTHOR INSIGHT

Strive to incise muscles at their origins or insertions. Radiosurgical division of muscle bellies and insertion sites is helpful in controlling hemorrhage.

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STEP 4

Divide the brachial plexus and axillary vessels. Retract the freed scapula laterally to expose the axillary neurovascular region within loose connective tissue. After injecting the nerve trunks with 0.2–0.4 mL of local anesthetic (eg, bupivacaine), sharply sever the nerve bundles. Bluntly dissect the axillary artery and vein (AV), and securely double-ligate these structures.



AUTHOR INSIGHT

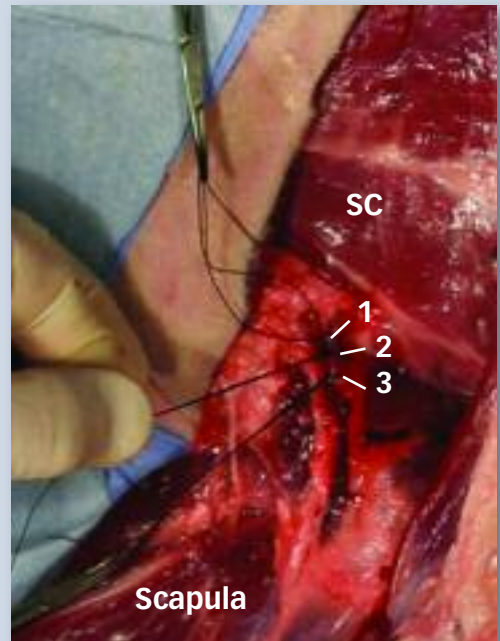
Avoid deep dissection around the AV. Stay superficial to the level of the adjacent first rib to avoid accidental penetration into the nearby thoracic cavity during vessel isolation.

AUTHOR INSIGHT

Double-ligate major blood vessels with prolonged absorbable monofilament absorbable suture, such as polydioxanone (PDS II, etihicon.com) or polyglyconate (Maxon, covidien.com). Ligate large arteries and veins separately to avoid risk for formation of an arteriovenous fistula. Avoid accidental devitalization of remaining muscle and tissue by ligating only vessel branches to tissue that is slated for removal. Always check the location of this pedicle, particularly when continuing medial dissection, to avoid accidental disruption of the pedicle and severe hemorrhage.

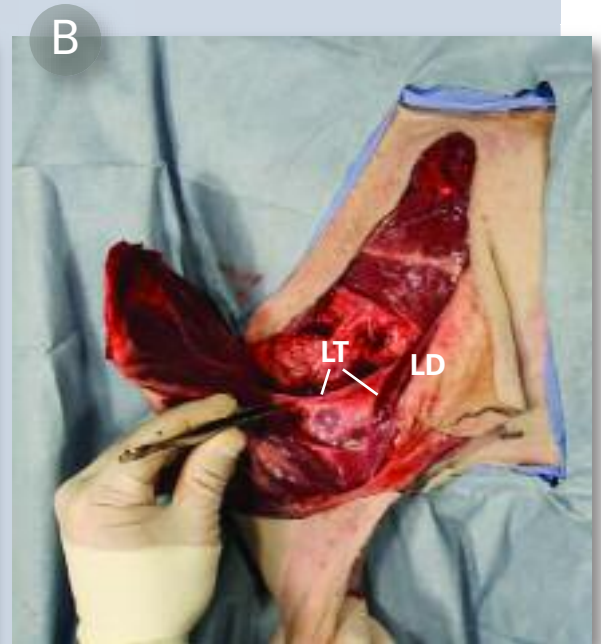
STEP 5

For the axillary artery, first place a circumferential ligature (1) toward the body followed by a distal transfixing ligature (2); the circumferential ligature (3) remains with the limb when it is removed to prevent loss of blood pooled in the limb. Dotted line indicates the artery transection line between ligatures 2 and 3.



### STEP 6

Dissect any remaining SC tissue attached to the caudal aspect of the scapula and upper forelimb. Internally rotate the limb, and isolate the latissimus dorsi (LD) muscle with blunt finger dissection down to its attachment on the medial brachial fascia. Incise this attachment (*dotted line* in A), and preserve the lateral thoracic (LT) vessels and axillary lymph node (*dotted circle* in B) that lie just under it; ligate the LT. Bluntly remove the lymph node located just cranial to the cut LD fascia and submit for biopsy if indicated.



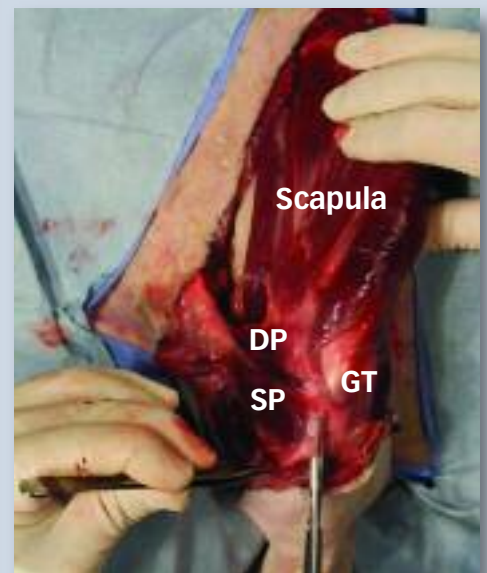
### STEP 7

Externally rotate the limb and ligate the omo-brachial vein overlying the cleidobrachialis (CB) muscle. Transect the CB near the greater tubercle (GT) of the humerus. Isolate and ligate the omo-cervical artery and vein just under the muscle.



### STEP 8

Lift the limb to expose to the medial aspect of the forelimb and axillary area. Dissect the tensor fascia antibrachii muscle and any remaining SC tissue, and isolate the superficial (SP) and deep pectoral (DP) muscles. Externally rotate the limb and divide the pectoral muscle close to its insertions on the proximal humerus. Identify and preserve the ligated axillary artery and vein pedicle first, then carefully free any remaining attachments and remove the limb.



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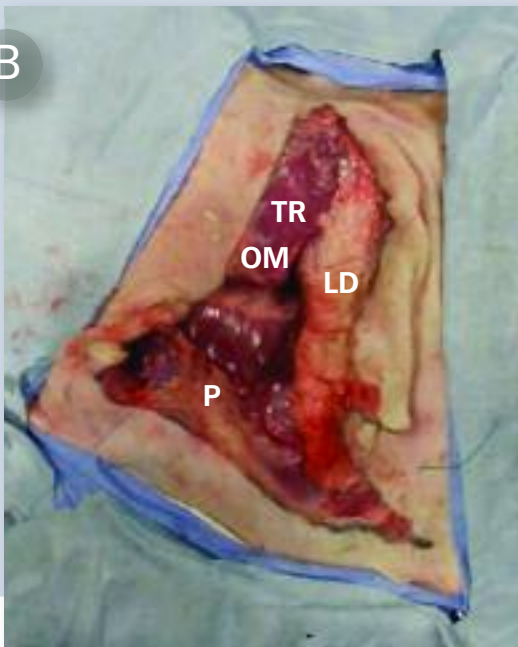
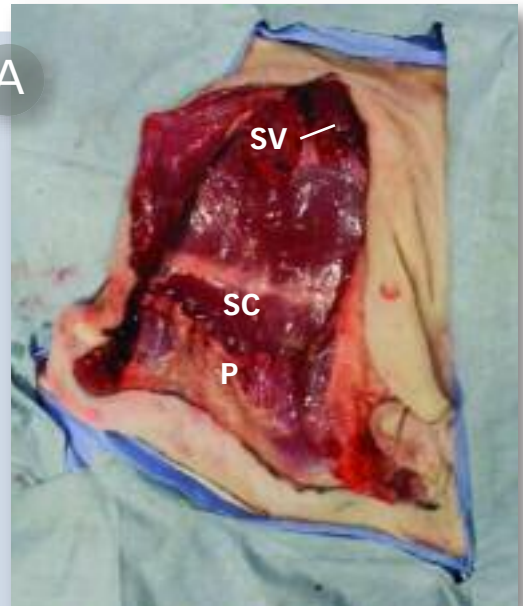
**AUTHOR INSIGHT**

To help ensure a secure closure, appose muscles by taking tissue bites primarily of the strong fibrous layer surrounding cut muscle bellies. Be sure to invert severed muscle edges and cover these edges with fascia. If the severed muscle edges are exposed, lymphatic fluid tends to seep into the subcutaneous space, one cause of seromas. Attempt to close muscles without tension. Strive to use atraumatic technique, and attempt to eliminate dead space and motion of tissue layers to avoid other factors related to seroma formation.

**STEP 9**

Begin closure by apposing the pectoral (P) muscles to the scalenus (SC) muscle to protect and cover incised nerve bundles and ligated vessel stumps (*dotted line* in A). At the dorsal aspect of the wound, close the serratus ventralis (SV) muscle.

Next, from dorsal to ventral, close the cranial and caudal TR bellies together and continue the continuous closure line (*dotted line* in B) to include the OM to the LD. Close any remaining muscle planes as needed. Attempt to manipulate skin edges to evenly distribute the incised edges and reduce dog-ear formation. Begin SC closure with several equally spaced simple interrupted tacking sutures to evenly distribute skin edges for cosmetic result. Individually close the remaining SC tissues and skin with continuous appositional patterns, such as the simple continuous or Ford interlocking sutures (C). In most patients, no wound drain is necessary.



**AUTHOR INSIGHT**

To avoid seroma formation following amputation, handle tissue gently, apply effective hemostasis, securely close fascial tissue over muscle edges, eliminate dead space, and avoid excessively dissecting through subcutaneous tissue under the dorsal skin margins.

See Aids & Resources, back page, for references & suggested reading.