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Axial pattern flaps, using the deep circumflex iliac artery, superficial brachial and cranial superficial epigastric direct cutaneous arteries in the dog

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Summary

Three dogs (Boxer, Labrador Retriever and German Shepherd) between the age of 7-10 years were presented with the history of tumour masses on right caudo-lateral thigh, right cranial forearm and left cranial and caudal thoracic mammary gland region, respectively. Fine needle aspiration cytology of the tumour masses and the sentinel regional lymph nodes were done. Plain radiography was done to rule out distant metastasis. In all the three cases the tumour masses were large in size, firmly adherent to the tissues underneath and sufficient loose skin was not available to close the skin defect following surgery. Hence axial pattern flaps were chosen to close the skin defect, following wide margin excision of tumour masses, leaving 3 cm from all the dimensions including healthy tissue. Deep circumflex iliac axial pattern flap, superficial brachial axial pattern flap and cranial superficial epigastric axial pattern flap were chosen to close the skin defect in case 1, case 2 and case 3, respectively. Post-operatively the dogs were admitted in in-patient unit for 5 days to restrict movement of the dog for immobilization of the flap and for wound dressing. All the cases recovered uneventfully with few complications.

Key words: Axial pattern flaps, Canine, Extensive tumours, Histopathology, Reconstruction

Introduction

An axial pattern flap is a pedicle graft that incorporates a direct cutaneous artery and vein into its base. These vessels extend up the length of the flap to a variable degree and its terminal branches supply blood to the subdermal plexus (Pavletic, 1980). As a result, axial pattern flaps have better perfusion as compared to pedicle grafts (subdermal plexus flaps), whose circulation is derived from the subdermal plexus alone (Pavletic, 1991). Axial pattern flaps based on deep circumflex iliac artery, superficial brachial artery and cranial superficial epigastric artery have been discussed in the article below. These 3 axial pattern flaps can be used for closure of large skin defects following tumour mass excision in the lateral thigh region, antebrachium and sternal region, respectively (Smith *et al.*, 2009; Kirpensteijn and Haar, 2013).

Case description

Three dogs of different ages between 7-10 years, with

the history of large tumour masses on the right caudo-lateral thigh region, right cranial forearm and on the left cranial, caudal thoracic mammary gland, respectively; were presented to Small Animal Clinic - Out Patient - Surgery Unit, of Madras Veterinary College Teaching Hospital. The tumour masses in all the cases were large in size, firm in consistency and deeply attached to the underlying tissues. Fine needle aspiration cytology of the tumour masses and regional lymph nodes pre-operatively and histopathology post-operatively, revealed mast cell tumour in case 1, fibrosarcoma in case 2 and mammary adenocarcinoma in case 3, respectively. Plain radiographs of thorax lateral and ventro-dorsal view in all the cases revealed no distant metastasis.

Treatment

Pre-operative antibiotics and analgesics were administered. The dogs were premedicated with Diazepam[®] 0.2 mg/kg B.W. intravenously (Lori, Neon Laboratories, Mumbai) and Butorphanol tartrate[®] 0.2

mg/kg B.W. intramuscularly (Butadol-2, Neon Laboratories, Mumbai). General anaesthesia was induced with Propofol® 4 mg/kg B.W. (Neorof, Neon Laboratories, Mumbai) intravenously and maintained with Isoflurane® 2% (Forane, Abbott Pharmaceuticals, India) in 100% oxygen using Boyles anaesthetic apparatus.

Case-1 (deep circumflex iliac axial pattern flap)

The dog was positioned on left lateral recumbency and the flap areas were prepared aseptically. Deep circumflex iliac axial pattern flap planning was done meticulously, by drawing the outline of the flap on the lateral caudal abdominal wall. The caudal line was drawn from the proximal half of the ilium and extended distally following the femoral shaft. The second (cranial) line was drawn parallel to the caudal line. The outline of the flap required to cover the defect was drawn (Fig. 1A).

The outline of the tumour mass leaving 2 cm margins on all sides of the mass was pre-drawn with sterile skin marker pen (Fig. 1B). First the tumour mass was excised enbloc with wide margins along with healthy tissue with one deep fascial plane. The skin was incised over the pre-drawn lines of the flap. The flap was undermined in a stepwise fashion and precaution was taken to prevent damage to the cutaneous vessels. The deep circumflex iliac artery was identified and the flap was elevated and rotated on to the defect on its lateral thigh region (Fig. 1C). Stay sutures were placed to aid the flap onto the position. Then a bridging incision was made between the flap and the defect to rotate the flap into position (Fig. 1D). A corrugated drain sheet was placed in the dependent part of the body to allow drainage of tissue fluids. The flap was sutured to the defect in two layers with Polyglycolic Acid 2-0 sutures. Skin was sutured with polyamide 1-0 in mattress pattern (Fig. 1E).

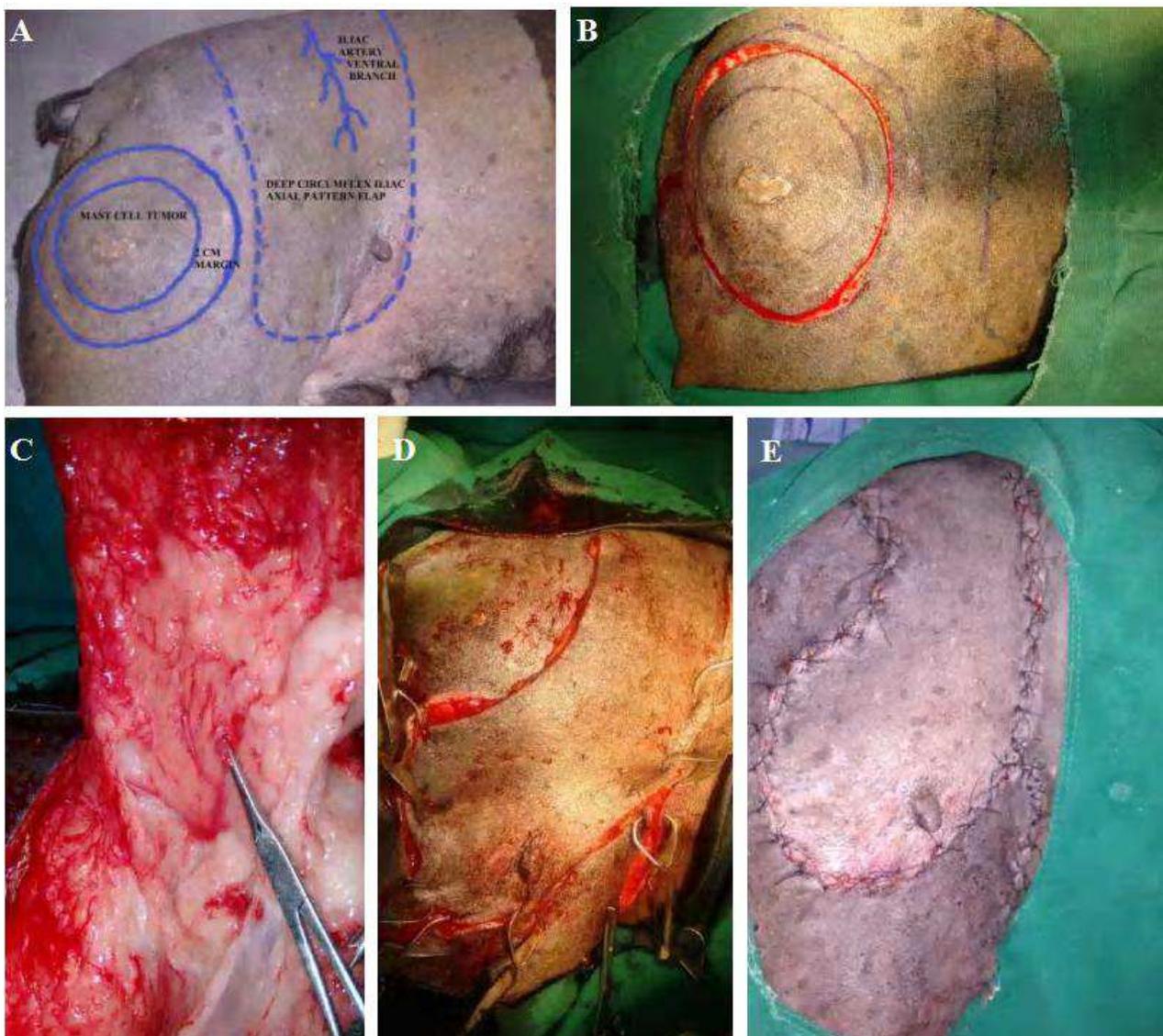


Fig. 1: Deep circumflex iliac axial pattern flap. **A)** Flap planning. Skin marking of the flap and margins of the tumor mass, **B)** Outline of the tumor mass and enbloc excision leaving 2 cm margins, **C)** Deep circumflex iliac artery, **D)** Transposition of the flap onto the defect, and **E)** Suturing of flap into the defect with polyamide 1-0 sutures

Bandaging was done.

Post-operatively right hind limb edema was noticed and the dog found difficulty in walking, which slowly improved after 5 days of surgery. Seroma formation was noticed in the immediate post-operative period which resolved after 3 days.

Case-2 (superficial brachial axial pattern flap)

The dog was positioned on left lateral recumbency. The outline of the tumour mass leaving 2 cm margins on all sides of the mass was pre-drawn with sterile skin marker pen and the tumour mass was excised enbloc with wide margins along with healthy tissue (Fig. 2A). Two parallel lines were drawn from the elbow joint to the greater tubercle of the humerus (Fig. 2B). Incisions were made following the pre-drawn lines from the end to

the base of the flap (Fig. 2C). The superficial brachial artery was identified and the flap was then elevated and rotated laterally onto the defect (Figs. 2D and E). Stay sutures were placed to position the flap into the defect. The flap was sutured onto the defect in two layers in routine manner (Fig. 2F).

Post-operatively modified Thomas splint was applied on the right fore limb to prevent the dog from flexing its elbow and carpal joint and for immobilization of skin flap. Mild discomfort was noticed while walking which improved after five days of surgery. Mild colour change was noticed on the distal part of the flap as the flap length was more than twice the width of the flap. Sutures were removed on the twelfth day after surgery and the necrosed part of the flap healed by secondary intention after 14 days of surgery.

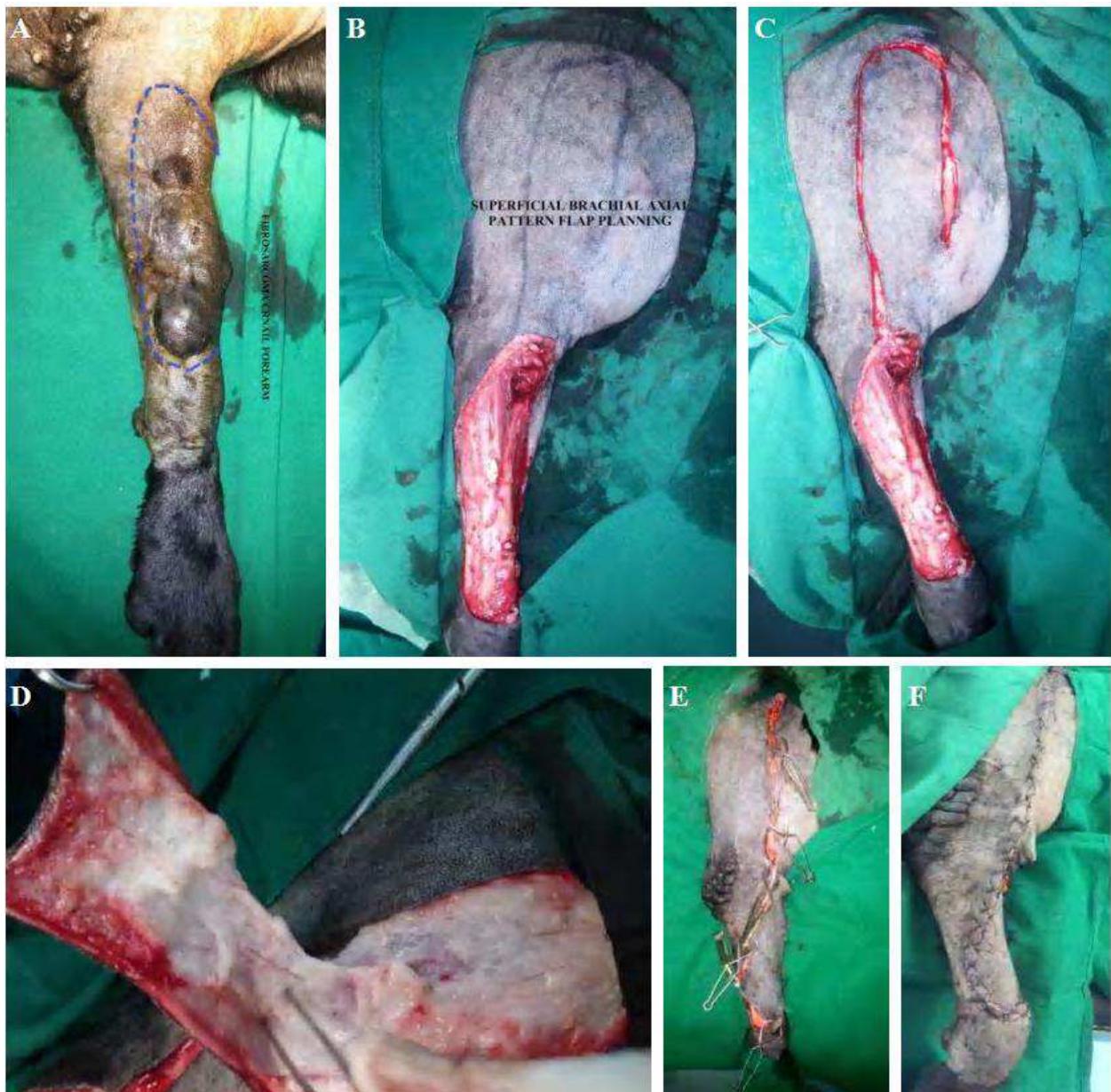


Fig. 2: Superficial brachial axial pattern flap. **A)** Fibrosarcoma cranial forearm region, **B)** Flap planning using sterile skin marker, **C)** Incision made on the flap, **D)** Elevation of the flap and superficial brachial artery seen, **E)** Transposition of flap into the defect, and **F)** Suturing of flap into the defect

Case-3 (cranial superficial epigastric axial pattern flap)

The dog was positioned on dorsal recumbency. Unilateral mastectomy was planned in this case as there was local metastasis of tumour mass in the entire left mammary chain. The cranial part of the defect following mastectomy was closed with cranial superficial epigastric artery based flap and the caudal part of the defect was closed with left flank fold subdermal plexus flap. Cranial superficial epigastric axial pattern flap was outlined with the base of the flap located just lateral to the xiphoid process (Fig. 3A). The outline of the entire left mammary chain was marked with sterile marker pen leaving 2 cm margins on all sides of the tumour mass. Unilateral mastectomy was performed and the sentinel lymph nodes were excised (Fig. 3B). The skin of the cranial epigastric flap was then incised according to the pre-drawn outline (Fig. 3C). Stay sutures were placed into the caudal border of the flap to enable non-traumatic

rotation of the flap into the defect. The skin of the left flank fold flap was also incised, undermined by preserving the subdermal vessels and elevated and transposed onto to the caudal part of the defect (Fig. 3D). Stay sutures were placed to position the flap onto the defect (Fig. 3E). The flap was sutured into the defect in two layers routinely (Fig. 3F).

Post-operative care

The surgical wound in all the cases was bandaged with an antibiotic ointment every 2 days. The drain tube was removed on day 3 post-operatively. Inj Ceftriaxone[®] 10 mg/kg B.Wt BID (C-Tri, Intas Pharmaceuticals, Ahmedabad, India), Inj Tramadol[®] 2 mg/kg B.Wt TID (Supridol, Neon Laboratories, Mumbai), Tab Meloxicam[®] 0.2 mg/kg B.Wt SID and Tab Cetrizine[®] 0.1 mg/kg B.Wt BID per-orally was administered for 7 days. Bandage changing was done every alternate day for ten days until suture removal. Sutures were removed on

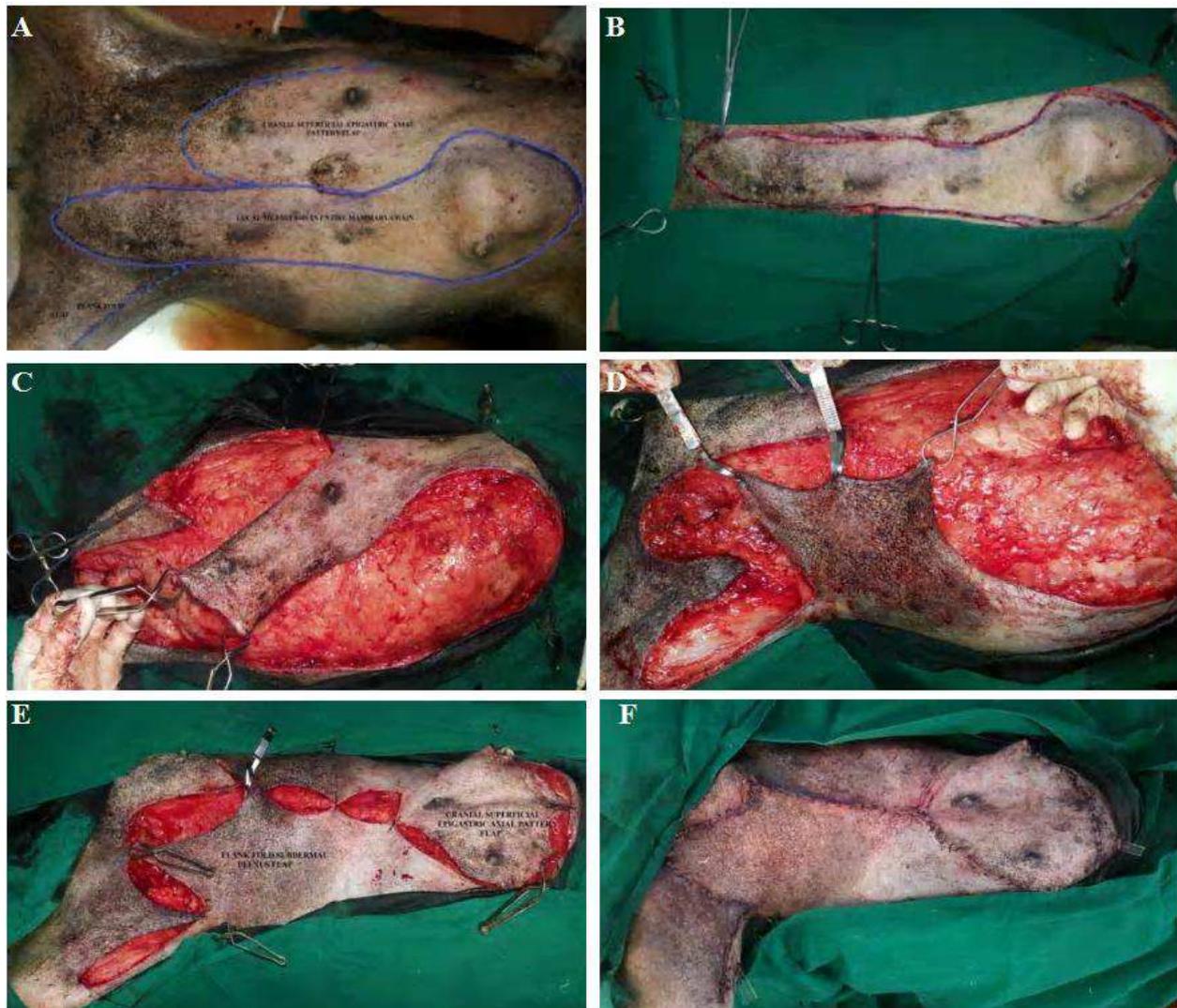


Fig. 3: Cranial superficial epigastric axial pattern flap. **A)** Flap planning and skin marking around the tumor mass, **B)** Unilateral mastectomy. Enbloc excision of entire left mammary chain, **C)** Elevation and transposition of cranial superficial epigastric axial pattern flap, **D)** Elevation and transposition of left flank fold subdermal plexus flap, **E)** Closure of the defect with cranial epigastric and flank fold flap, and **F)** Suturing of both the flap into the defect with polyamide 1-0 sutures in mattress pattern

twelfth day in all the cases. All the cases were followed up for a period of one month until complete recovery.

Discussion

Axial pattern flaps have several advantages in reconstructive surgery. These flaps have an inherent blood supply, which allows their initial survival without a vascular bed (Pavletic, 1980). These flaps were more commonly used to facilitate wound closure after tumour resection or trauma (Kostolich and Pavletic, 1987).

A deep circumflex iliac axial pattern flap (ventral branch) can be used to cover extensive defects of the flank region, the medial and lateral thigh and the pelvic region. It consists of dorsal and ventral branch, of which ventral branch was used (Gregory and Gourley, 1990) to cover the defect on lateral thigh region as performed in the above case 1.

Superficial brachial artery axial pattern flap is used to cover ante-brachial wounds and defects involving the elbow region. A cutaneous branch of the superficial brachial artery supplies the cranio-medial ante-brachium and the cephalic vein runs on the lateral side of this vessel (Kirpensteijn and Haar, 2013). In the above case 2, the flap covered almost two-thirds of the forearm region. Because of the small size of this vessel, meticulous surgical technique is essential in the preservation of the microcirculation to the flap (Pavletic, 2010).

The cranial superficial epigastric axial pattern flap can be used for closure of large skin defects following tumour excision in the sternal region. The flap includes third, fourth and fifth mammary glands. Both the artery and vein are most commonly located in the hypogastric area, caudal to the ventral border of the costal arch and medial to the xiphoid process (Kirpensteijn and Haar, 2013). In the above case 3, this flap was used to cover the large sternal defect following mastectomy.

The most common post-operative complications of axial pattern flap are improper wound drainage, partial dehiscence of sutured flap, distal flap necrosis, infection and seroma formation. These complications can be reduced by proper wound management techniques like drain tube placement, aseptic precautions, appropriate

dimensions of the flap and surgical debridement of devitalized distal skin flap (Trevor *et al.*, 1992). In the above mentioned cases, case 1 and case 3 had mild edema of the limbs and seroma formation. In case 2, there was necrosis of the distal part of the skin flap, which healed later on by second intention after 10 days.

Axial pattern flaps can be used to close large skin defects following wide margin excision of tumour masses in dogs and cats. These flaps are supplied by direct cutaneous arteries and veins and hence survival rate of these flaps is approximately twice that for subdermal plexus flaps of comparable size. These flaps can be used in the regions like lateral thigh, cranial forearm and inguinal region, where sufficient loose skin may not be available following wide margin excision of tumour masses.

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