Use of the angularis oris cutaneous flap for repair of a rostral mandibular skin defect in a cat

M. Bradford; D. A. Degner; J. Bhandal
Michigan Veterinary Specialists, Auburn Hills, Michigan, USA

Introduction
Facial reconstruction in the feline patient poses a unique challenge to the veterinary surgeon. Unlike dogs, cats lack lip elasticity and abundant adjacent skin, both of which are ideal for soft tissue reconstruction of the chin. Therefore, this provides limited options for repair of ventral mandibular skin defects. Potential methods for repair include second intention healing, skin graft, indirect pedicle flap, and axial pattern flaps. Challenges in bandaging and prolonged postoperative healing time make healing by second intention a less desirable option for repair (1). A significant disadvantage to the application of a skin graft is that a vascular tissue bed must develop prior to its placement (2). This involves additional maintenance and increased overall healing time. Another concern which makes the use of this method less than ideal is the immobilization required for its success (2).

A direct cutaneous artery within an axial pattern flap allows transposition of the associated skin segment with a high probability of flap survival (2). The superficial temporal, caudal auricular, and omocervical axial pattern skin flaps are considerations for repair of facial defects (2). The superficial temporal axial pattern flap is effective for facial wound reconstruction in cats (3-5). This flap has a peninsular configuration that is based at the zygomatic arch and extends over the forehead to the arch of the zygomatic arch (3-5). Its vascular supply comes from the subdermal plexus and the superficial temporal artery and vein (3-5). Although it has been successfully applied in repair of eyelid, nasal, and labial defects, distal tip necrosis is a common concern with the use of this flap in cats. Additionally, its relatively short length precludes its application to the ventral aspects of the mandible (3-5). The omocervical axial pattern flap has a robust blood supply that is provided by the superficial cervical artery and vein. This vascular enters the angiosome at the level of the cranial shoulder depression (6). The large superficial cervical artery and vein allow its development as an island flap (6). Furthermore, choke anastomoses of the primary angiosome join the angiosome of the contralateral omocervical flap allowing extension over the dorsal scapular region to the contralateral acromial process (6). Although this flap consistently reaches the rostral mandibular region, its survival distally is not reliable. In addition, the omocervical flap requires large bridging incisions from the cranial shoulder depression to the caudal border of the mandibular wound (6).

We hypothesized that the angularis oris axial pattern flap, as previously described in dogs, could be applied in the feline species. This flap was chosen as a result of its convenient point of rotation near the wound and its ability to provide an ample amount of skin from the lateral cheek and neck.

Case description
A 13-year-old, spayed female, Domestic Shorthaired cat was presented after incomplete excision of a sebaceous adenocarcinoma from the rostral mandibular region one year prior. Following recurrence of the mass, the patient was referred for surgical treatment. On physical examination, the cat was in excellent body condition. A 2 cm diameter, firm, immobile, and non-painful intradermal mass was present on the rostral mandible (Fig. 1). No regional lymphadenopathy was detected and the remainder of the physical examination was unremarkable.

Three-view thoracic radiographs revealed a mild diffuse bronchial pattern and moderate cardiomegaly with normal vasculature. There was no evidence of pulmonary metastatic disease. Haematological analysis revealed a mild elevation in haematocrit (52.2%; 29–45%). Biochemical profile and urinalysis results were within normal limits.

The cat was pre-mediated with buprenorphine (0.012 mg/kg subcutaneously). General anaesthesia was induced with propofol (6 mg/kg intravenously). The cat was intubated and maintained on isoflurane in oxygen. Cefazolin (22 mg/kg intravenously) was administered after anaes-

Keywords
Angularis oris, axial pattern flap, facial reconstruction, feline

Summary
The angularis oris axial pattern flap is based on the blood supply of the angularis oris artery and vein. While the use of this flap for repair of canine facial wounds is well documented, this technique has not been reported in the cat. This case report presents the reconstruction of a large ventral chin and rostral lip wound with the use of this flap. Complete survival of this flap was observed in this patient.

Correspondence to:
Daniel A. Degner, DVM, DACVS
3412 E. Walton Blvd.
Auburn Hills, MI 48326
United States
Phone: +1 248 371 3713
Fax: +1 248 371 3714
E-mail: ddegner@comcast.net

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Fig. 1. No regional lymphadenopathy was detected and the remainder of the physical examination was unremarkable.
thetic induction. The cat was positioned in dorsolateral recumbency and the skin on the left lateral aspect of the head and neck was clipped and aseptically prepared. The proposed margins of the flap were outlined on the left side of the head with a sterile marker. The cutaneous anatomical boundaries of the angiosome included the commissure of the lip cranially, the level of the zygomatic arch dorsally, the ventral mandible ventrally, and the level of the wing of the atlas caudally. The skin and platysma muscle were incised along the proposed flap margins. The plane of dissection was maintained just deep to the platysma muscle until direct cutaneous vessels were seen to penetrate into the skin flap, approximately 1 cm caudal to the rostral border of the lip commissure (▶ Fig. 2). At the time of flap elevation, mild to moderate enlargement of the left submandibular lymph node was noted and subsequently excised for histopathological evaluation. The donor site was closed using 1.5 polydioxanone sutures in a simple intradermal pattern. The rostral mandibular mass, including the rostral lip, was then excised with approximately 0.5 to 1 cm lateral normal skin margins. Deeply, the plane of dissection was maintained at the level of the mandibular bone. A bridging incision was created and the prepared angularis oris flap was rotated ventrally into the rostral mandibular defect. The flap was secured in a single layer using metric 1.5 polydioxanone in simple intradermal and simple interrupted suture patterns. The flap was sutured to the rostral gingiva using horizontal mattress sutures of metric 1.5 polydioxanone around the mandibular incisors and canine teeth (▶ Fig. 3).

Postoperative care

The cat recovered from anaesthesia without complication and was monitored for 48 hours postoperatively in the intensive care unit. During hospitalization, isotonic saline (3 ml/kg/h; intravenously), buprenorphine (0.012 mg/kg; subcutaneously q6h), and ceftazolin (22 mg/kg; intravenously q8h) were administered. Transoral administration of buprenorphine (0.012 mg/kg; q6h) and oral administration of amoxicillin-clavulanic acid (10 mg/kg; q12h) were continued for four and seven days, respectively. The skin flap appeared viable at the time of discharge two days postoperatively.

Postoperative evaluations

Physical examination performed two weeks after surgery revealed healing of the incision sites and complete survival of the cutaneous flap. Histopathological evalu-
ation of the resected tissue confirmed a diagnosis of sebaceous adenocarcinoma with surgical margins free of neoplastic cells. The lymph node had evidence of hyperplasia with small clusters of neoplastic cells in the cortical region. The six month postoperative examination did not reveal any evidence of gross recurrent disease and regional lymph nodes were of normal size. The skin flap was fully haired and had mild porphyrin saliva staining on its rostral aspect (Fig. 4).

**Discussion**

The vascular anatomy to the skin over the facial region has been well described in dogs (7-9). The facial artery arises near the angle of the jaw and divides to form the inferior and superior labial arteries and the angularis oris artery (9). These vessels are directed cranially with the inferior labial artery, superior labial artery, and angularis oris artery supplying the lower lip, upper lip, and commissure of the lips, respectively (9). These three vessels also have direct cutaneous branches that are directed caudally near the commissure of the lip within the platysma muscle, which is directly attached to the skin (7). Within this thin muscle layer, the vessels have interconnecting anastomoses. The direct cutaneous branch of the angularis oris artery extends to the level of the vertical ear canal, whereas the cutaneous angiosomes of the superior and inferior labial arteries end more cranially (7).

At the caudal aspect of the masseter muscle, the cutaneous branch of the angularis oris artery joins the transverse facial and the cutaneous branch of the masseteric arteries (7). As a result of this vascular arrangement in the canine, a skin flap can be based at the commissure of the lips (Fig. 5) (7). The margins of this flap include the ventral zygomatic arch dorsally, the ventral mandible ventrally, a line drawn perpendicular to the long axis of the mandible to the medial canthus of the eye rostrally, and the vertical ear canal caudally (7). In one clinical canine case, distal tip necrosis of the flap resulted when its caudal border was extended to the wing of the atlas (7). This suggests versatility in the length of the flap extending caudally well beyond the vertical ear canal.

To the best of our knowledge, this is the first published case report to demonstrate the application of an angularis oris axial pattern flap for facial wound reconstruction in a cat. We extrapolated the information obtained from canine studies and successfully applied it to a cat. It is assumed that the angularis oris artery and vein were important in the survival of this flap because of its length. The flap dimensions in this case exceeded a 2:1 ratio with its caudal border extending to the wing of the atlas in order to accommodate the dimensions of the wound. This challenges the previous application in the dog in which flap survival is based on the subdermal plexus vasculature and its length is limited to twice the width of its base (2). The direct cutaneous vessels of the platysma muscle are also thought to contribute to the survival of this flap. The rostral border was about 1 cm from the commissure of the lip, at a point where the direct cutaneous vessels enter the platysma muscle (7). The thickness of the platysma muscle in this cat limited our appreciation of the vasculature along the entire length of the flap.

![Fig. 4](A and B) Six month postoperative examination demonstrating successful healing of an angularis oris axial pattern skin flap.

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There are important considerations in the application of the angularis oris axial pattern flap in the cat. A peninsular design must be maintained to ensure that the pedicle is not compromised as the flap is set into the recipient wound. As a result, a ‘dog ear’ will be present at the rostral aspect of the commissure of the lips. This segment of skin is retained to prevent compromise to the subdermal blood supply to the flap. Care must be taken to avoid iatrogenic trauma to the parotid salivary duct, the branches of the facial nerve, and the facial vein during elevation of this flap. Aesthetically, the hair of the transposed flap will be oriented cranially and will grow longer than the natural hair of the chin. In spite of this minor cosmetic imperfection, its function and durability are retained as a result of the thickness of the flap.

Sebaceous adenocarcinoma is uncommon in cats, and it normally occurs in cats that are 10 years of age or older (10-12). The lesions are usually solitary and most commonly affect the head, neck, and trunk (12). Carboplatin was the recommended chemotherapeutic option in this case. The owner declined all further diagnostic and treatment modalities following the positive result for localized metastasis to the left submandibular lymph node. At the six month postoperative examination, the cat was doing well without gross evidence of recurrence or metastatic disease.

Other potential applications of the angularis oris flap may include the repair of labial, temporal, periorbital, and dorsal nasal defects. This case study provides evidence that the angularis oris axial pattern skin flap is a viable option for successful repair of facial defects in the cat. Additional experimental or clinical cases and angiographic studies are needed to fully define the extent and usefulness of this flap.

References