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ORIGINAL ARTICLE - RESEARCH

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Evaluation of the superior and inferior labial musculomucosal flaps in cats: An angiographic study and case series

Laura E. Canever DVM[1] | **Daniel A. Degner DVM, DACVS**[2]

[1]Dixboro Veterinary Dental Center, Ann Arbor, Michigan, USA
[2]Department of Surgery, Animal Surgical Center of Michigan, Flint, Michigan, USA

Correspondence
Laura E. Canever, Dixboro Veterinary Dental Center, 5740 Plymouth Rd., Ann Arbor, Michigan 48105, USA.
Email: caneverl@gmail.com

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Abstract

Objective: To evaluate the angiosomes of the superior and inferior labial arteries in the cat and describe the use of a musculomucosal axial pattern flap incorporating each artery for reconstruction of palatal defects in cats.

Study design: Cadaveric study and a series of two clinical cases.

Sample population: Five feline cadavers and two client-owned cats.

Methods: The common carotid arteries of five feline cadavers were injected with barium sulfate. Radiographs of excised tissue specimens were examined to map the location of the superior and inferior labial arteries and to visualize each angiosome available for an axial pattern flap. Labial musculomucosal flaps were utilized to reconstruct palatal defects in two live cats.

Results: The superior and inferior labia were predominantly perfused by the superior and inferior labial arteries, respectively, and the angiosome of each artery encompassed the majority of its respective labium. Comparative positive contrast angiograms revealed the vascular supply was located within the musculomucosal layer. Reconstruction of recurrent palatal defects utilizing musculomucosal flaps based on these angiosomes in two clinical cases was successful with complete survival of the flaps.

Conclusion: The upper and lower lips were found to have robust vascular supplies within the musculomucosal layer which can support musculomucosal axial pattern flaps.

Clinical significance: This information provides the veterinary surgeon with additional surgical options for reconstruction of central and caudal palatal defects in the cat.

1 | INTRODUCTION

Successful repair of palatal defects in cats can be challenging.[1,2] In both congenital and acquired defects, there is typically little surrounding tissue available for reconstruction, poor or damaged vascularity, relatively immobile tissues, localized infection of the tissues due to the chronic communication of the oral and nasal cavities, and constant mechanical stresses on the repair from respiration, mastication, and deglutition.[2–4] These hurdles have prompted the development of numerous techniques for repair of palatal defects, including: direct appositional closure,[5] single-layer vestibular flaps,[1,5–11] mucoperiosteal rotation or transposition flaps,[1,5,6,9,11] double-layer flaps,[1,5–8,11,12] overlapping flap technique,[5,11,13] bilateral vestibular mucosal overlapping flaps,[6,11,14] medially repositioned double flap (von Langenbeck technique),[1,5,9,11,13] split palatal U-flap,[1,6,11,15] palatal island flaps,[16,17] myoperitoneal microvascular free flaps,[18] auricular cartilage grafts,[2,3,19] prosthetic obturators[20,21] and tongue flaps.[22]

In addition, axial pattern flaps incorporating branches of the facial artery have been used successfully in humans, dogs, and cats for reconstruction of various defects.[23–30] The superior labial artery musculomucosal flap has been previously described in the successful repair of a large cleft palate in a dog,[25] but to the authors' knowledge, neither the superior nor the inferior labial artery musculomucosal flaps have previously been described in the cat. These flaps are similar to facial artery musculomucosal flaps utilized in humans.[23,24]

The objective of this study was to investigate the angiosomes available for axial pattern flaps based on the superior and inferior labial arteries in feline cadavers and describe their successful use in two live cats with recurrent palatal defects. We hypothesized that the angiosomes of the superior and inferior labial arteries extend the majority of the length of their respective labium in cats and that the vascular supply is located within the musculomucosal layer, which is primarily composed of the orbicularis oris muscle of each lip. Furthermore, we hypothesized that these angiosomes are a suitable basis for an axial pattern flap for reconstruction of central and caudal palatal defects.

2 | MATERIALS AND METHODS

2.1 | Cadaveric study

Five domestic short-hair feline cadavers were obtained after scheduled euthanasia at a local animal shelter for reasons unknown and unrelated to this study. All cadavers were free of any apparent head or neck abnormalities and had no known history of head or neck trauma. Cadavers were frozen immediately following euthanasia. After thawing to room temperature, a ventral midline incision was made over the mid-cervical region. Dissection was performed to allow visualization of the left common carotid artery, which was then transected. A 3.5 French red rubber catheter was placed approximately 2 cm into the cranial transected end of the vessel and sutured in place using 3–0 polydiaxonone suture (PDS II, Ethicon, Somerville, New Jersey, USA) with a transfixation ligature. Seven and one-half ml of barium sulfate (Liquid E-Z-PAQUE, [60% w/v] barium sulfate oral suspension; E-Z-EM, Inc, Anjou-Quebec, Canada) were injected by hand pressure into the left common carotid artery. The same process was then repeated on each cadaver's right common carotid artery. Our pilot studies showed that a total of 15 ml of barium sulfate were necessary to completely and reliably fill the vasculature to rostral midline of the labia.

The skin from each cadaver's entire head was subsequently removed via sharp dissection. The attached gingiva, alveolar and vestibular mucosa, underlying musculature, periosteum, and masseter muscle were maintained with the skin of the head to preserve the vestibular anatomy and the trunk of the facial artery. The entire dissected tissue section was radiographed using a high-definition digital radiograph machine (Cuattro DR, Heska, Loveland, Colorado, USA) (Figure 1A). Next, the musculomucosal layer was separated from the skin and radiographed separately (Figure 1B). Radiographs were examined to map the angiosomes of interest.

2.2 | Clinical Case 1

An 8-year-old, neutered male domestic short hair cat presented with the complaint of a chronic oronasal fistula. Four years prior to presentation at our hospital, the patient underwent radiation therapy for treatment of a peripheral giant cell granuloma along the right maxilla; the mass had been deemed nonsurgical. Three months later, the cat underwent a caudal maxillectomy for suspected tumor recurrence. Histopathology revealed a well-differentiated osteosarcoma with tumor-free surgical margins. Over the next three years, the patient underwent multiple surgical repairs of a recurrent oronasal fistula at the site of previous treatments. The patient's clinical signs continued and he subsequently presented to our hospital with complaints of hyporexia, frequent sneezing, right-sided nasal discharge, and dysphagia.

On presentation, physical examination revealed a mild, clear, right-sided nasal discharge. An approximately 4 x 4 mm oronasal fistula was noted on the right lateral aspect of the hard palate, palatal to the previous site of the right maxillary third premolar. A thorough oral examination under general anesthesia revealed the previously described palatal defect (Figure 2), loss of palatal rugae and fibrosis of the hard palate surrounding the defect, a mostly edentulous oral cavity, and a roughened, fibrous appearance of the mucosa along the edentulous right maxillary quadrant. A CT scan (Aquilion 16, Toshiba American Medical Systems, Tustin, California, USA) with 7 ml IV iohexol contrast (Omnipaque 300, 300 mg I/ml injection, GE Healthcare Ireland Limited, Cork, Ireland) was performed and identified a 3.9×4.7 mm bony defect of the hard palate. The majority of the nasal turbinates in the right nasal cavity were not present. No evidence of a space-occupying lesion was noted.

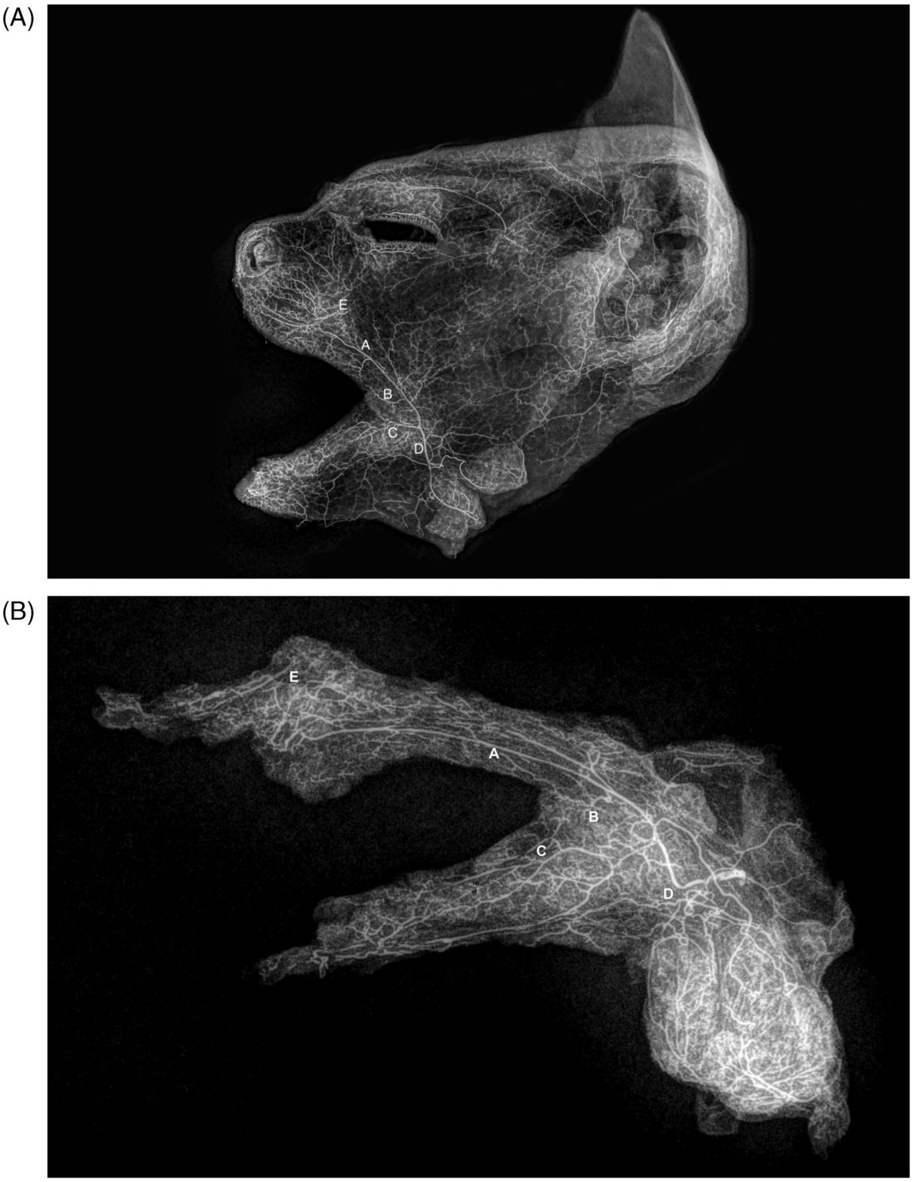

FIGURE 1 (A) Angiogram of the skin and underlying musculomucosal layer of the face after contrast injection of the common carotid artery. (B) Angiogram of the musculomucosa surrounding the oral commissure after excision of the skin. A, superior labial artery; B, angularis oris artery; C, inferior labial artery; D, facial artery; E, infraorbital artery

A surgical plan was made to utilize a superior labial artery musculomucosal axial pattern flap, as had been investigated in the preceding cadaveric study. It was decided to use the flap originating from the left vestibular mucosa, given the previous radiation therapy targeted at the right lateral portion of the maxilla and the abnormal appearance of that mucosa on clinical examination.

The patient was prepared for surgery in a routine manner. Transillumination of the left maxillary vestibular mucosa revealed the presence of the superior labial artery; the location and course were consistent with the findings of the preceding cadaveric study. The length of the flap was planned using a surgical ruler, measuring from the intended pivot point of the flap near the lip commissure to approximately 3 mm past the furthest extent of the palatal defect. This measurement was then rotated from the pivot point over the donor bed and the necessary length marked as the distal extent of the flap. A measurement was also taken to include the width of the defect at its widest point and 2–3 mm past the edge of the defect on both sides. This measurement was then superimposed over the planned flap area to ensure sufficient width. The perimeter of the planned axial pattern flap was outlined using a surgical marking pen (Devon Surgical Marker, Aspen Surgical Products, Caledonia, MI, USA) ensuring 2–3 mm of vestibular or alveolar mucosa remained on all sides to facilitate closure of the donor site (Figure 2).

Using a no. 15 blade on a scalpel handle, an incision was created through the vestibular mucosa 2–3 mm from the mucocutaneous junction. A second incision, relatively parallel to the first, was created 2–3 mm apical to the mucogingival junction. A third incision was made perpendicular to the first two incisions, through the alveolar mucosa and vestibular mucosa at the level of the mesiobuccal line

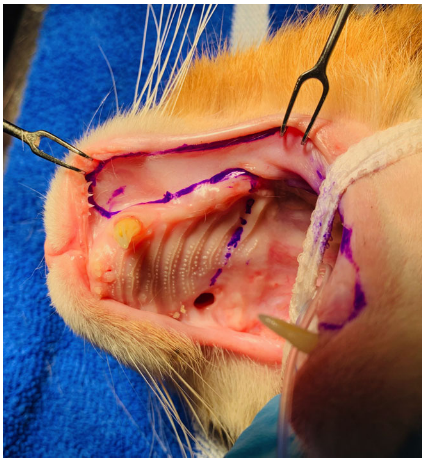

FIGURE 2 Case 1. Preoperative clinical photograph of the chronic palatal defect with surgical marker used for surgical planning. Note the fibrosis and lack of palatal rugae surrounding the defect as a result of previous radiation therapy, partial maxillectomy, and attempts to surgically close the defect

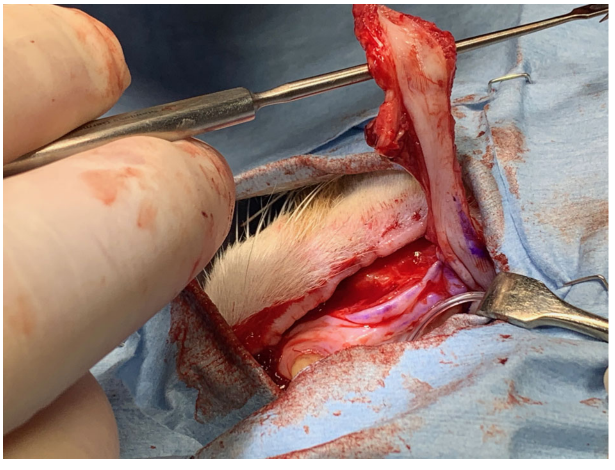

FIGURE 3 Case 1. Intraoperative clinical photograph showing dissection of the musculomucosal flap. The patient's nose is to the left and the caudal oral cavity is to the right of the image

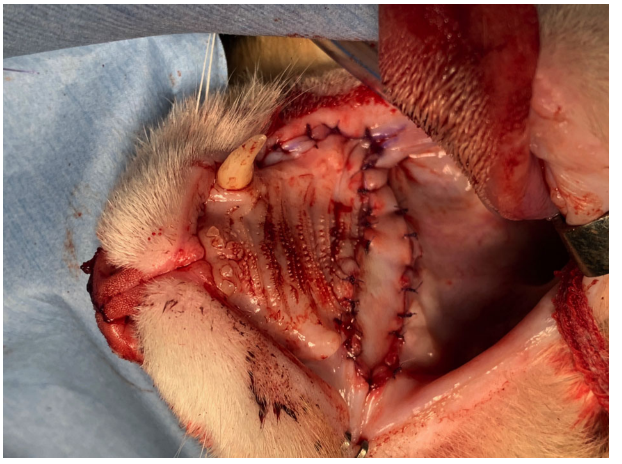

FIGURE 4 Case 1. Postoperative clinical photograph showing reconstruction of the palatal defect using a musculomucosal axial pattern flap incorporating the superior labial artery. Note that the musculomucosal flap has been harvested from the side contralateral to the defect because of concerns regarding the integrity of the ipsilateral superior labial tissues

angle of the maxillary canine tooth. The parallel incisions were continued to the intended caudal extent, or pivot point, of the flap which was located in the caudal oral mucosa just ventral to the maxillary dental arch.

Incisions were continued through the submucosa and underlying musculature (primarily the orbicularis oris muscle) deep to the flap. The musculomucosal flap was then dissected away from the underlying tissue using a combination of blunt and sharp dissection, starting from the most rostral aspect and moving caudally (Figure 3). The plane of dissection was maintained between the orbicularis oris muscle and the skin of the lip, as well as between the periosteum and the underlying maxilla in the portion of the flap approaching the mucogingival junction. The superior labial vein was preserved and included in the full length of the flap after rostral ligation with 4-0 poligecaprone 25 (Monocryl, Ethicon, Sommerville, New Jersey, USA). At the level of the infraorbital foramen, the neurovascular bundle was transected after the vessels were doubly ligated with 4-0 poligecaprone 25. Once the caudal limit of the flap was reached, a bridging incision was made in the mucoperiosteum of the hard palate to the extent of the palatal defect. Approximately 3–5 mm of mucoperiosteum was elevated off the hard palate along the edges of the bridging incision to accommodate the flap. The perimeter of the palatal defect was excised. The flap was rotated approximately 90 degrees and sutured to the edges of the bridging incision and palatal defect in a two-layer closure using a simple interrupted pattern of 4-0 poligecaprone 25 (Figure 4). The edges of the donor site were then apposed and sutured in a simple interrupted pattern of 4-0 poligecaprone 25. No dental extractions were necessary. An esophagostomy tube was placed postoperatively. An Elizabethan collar was also placed to prevent self-trauma. Recovery from anesthesia was uneventful. The patient was discharged with appropriate analgesics and the clients were instructed to not allow any hard food, treats, toys, or objects per os for 4-6 weeks.

2.3 | Clinical Case 2

A 5-year-old, spayed female domestic short hair presented with the complaint of a chronic oronasal fistula after originally sustaining a bite wound from a dog through the hard palate which resulted in a 5 mm full-thickness palatal

FIGURE 5 Case 2. Preoperative clinical photograph of the recurrent palatal defect. Note the fibrosis and lack of palatal rugae surrounding the defect

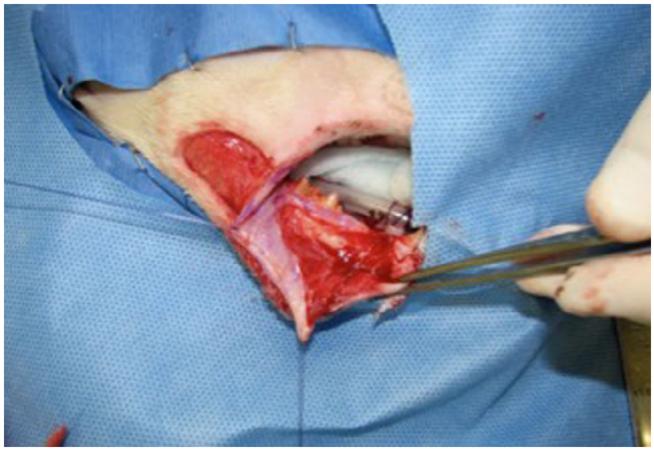

FIGURE 6 Case 2. Intraoperative clinical photograph showing dissection of the musculomucosal flap away from the underlying mandibular body. The patient's nose is to the right and the caudal oral cavity is to the left of the image

defect. The palatal defect was originally repaired by a single-layer vestibular flap, which failed. This was followed by an auricular cartilage graft several weeks later, which also failed. The patient was then referred to our hospital for further reconstruction.

On presentation, physical examination revealed a mild, mucopurulent left-sided nasal discharge. An approximately 1 cm × 1 cm oronasal fistula was noted on the left lateral hard palate extending almost to midline, palatal to the previous site of the left maxillary third premolar. A thorough oral examination under general anesthesia revealed the previously described palatal defect (Figure 5), loss of palatal rugae and fibrosis of the majority of the hard palate, and an edentulous left maxillary quadrant caudal to the canine tooth. The left superior lip mucosa was fibrotic and contracted from previous surgical interventions.

The patient was prepared for surgery in a routine manner. Transillumination of the left mandibular vestibular mucosa revealed the presence of the inferior labial vessels (probably the vein); the location and course were consistent with the findings of the preceding cadaveric study. The perimeter of the planned axial pattern flap was outlined using a surgical marking pen, ensuring 2–3 mm of vestibular or alveolar mucosa remained on all sides to facilitate closure of the donor site. Minimum flap dimensions were determined using a surgical ruler in the same manner as in Case 1.

Using a no.15 blade on a scalpel handle, an incision was created through the skin at the mucocutaneous junction of the lip commissure and continued caudally for 3–4 cm; its purpose was to improve visualization and access. An incision was then made through the vestibular mucosa 2–3 mm from the mucocutaneous junction. A second incision, relatively parallel to the first, was created 2 mm apical to the mucogingival junction. A third incision was made perpendicular to the first two incisions, through the alveolar mucosa and vestibular mucosa at the caudal aspect of the lower lip frenulum. The parallel incisions were continued to the intended caudal extent, or pivot point, of the flap which was located in the caudal oral mucosa just ventral to the maxillary dental arch.

Incisions were continued through the submucosa and underlying musculature (including the orbicularis oris and buccinator muscles) deep to the flap. The musculomucosal flap was then dissected away from the underlying tissue using a combination of blunt and sharp dissection, starting from the most rostral aspect and moving caudally (Figure 6). The plane of dissection was maintained between the orbicularis oris muscle and the skin of the lip, as well as between the periosteum and the underlying mandible in the portion of the flap approaching the mucogingival junction. The inferior labial vein was preserved and included in the full length of the flap after rostral ligation with 4-0 poligecaprone 25. At the level of the middle and caudal mental foramina, the neurovascular bundles were transected after the vessels were doubly ligated with 4-0 poligecaprone 25. Once the caudal limit of the flap was reached, a bridging incision was made in the immediate buccal mucosa and the mucoperiosteum of the hard palate to the extent of the palatal defect. Approximately 3–5 mm of mucoperiosteum was elevated off the hard palate along the edges of the bridging incision to accommodate the flap and the perimeter of the palatal defect was excised. The flap was rotated towards midline approximately 30 degrees, twisted about its axis so the muscular surface was facing dorsally, and sutured to the edges of the bridging incision and palatal defect in a two-layer closure using a simple interrupted pattern of 4–0 poligecaprone 25 (Figure 7). The donor site was closed in

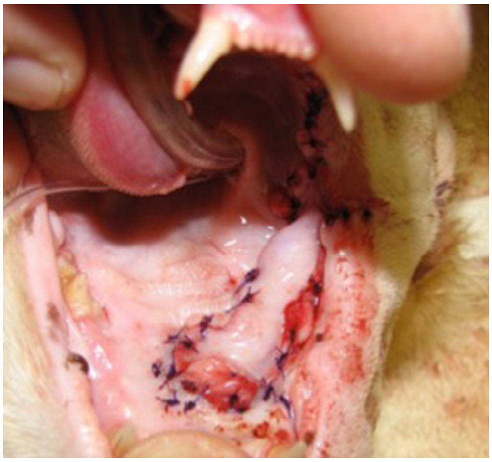

FIGURE 7 Case 2. Postoperative clinical photograph showing reconstruction of the palatal defect using a musculomucosal axial pattern flap incorporating the inferior labial artery

FIGURE 8 Case 1. Two-week postoperative clinical photograph showing complete survival of the flap and healing of the reconstruction. Note denuded areas of the donor flap and surrounding recipient bed with presence of healthy granulation tissue, probably due to contact with the abrasive dorsal surface of the feline tongue

the same manner as in Case 1. No dental extractions were performed. Postoperative care and home care instructions were the same as in Case 1, with the exception that an esophagostomy tube was not placed in this case.

3 | RESULTS

3.1 | Cadaveric study

In all cadavers, the angiograms of the superior and inferior labial arteries were consistent between the left and right sides and were also consistent among cadaver specimens. The facial artery branched off the external carotid artery along the lateral surface of the styloglossus muscle near the angle of the mandible. Near the commissure of the lip, the facial artery gave off a rostroventrally oriented artery, consistent with the inferior labial artery. The facial artery then continued dorsally for a short distance before giving off a rostrally directed branch at the level of the commissure of the lip, consistent with the angularis oris artery. Finally, it terminated as a rostrodorsally directed branch consistent with the superior labial artery. Thus, the labia were perfused by three distinct major arteries consistent with the superior labial artery, the angularis oris artery, and the inferior labial artery (Figure 1B).

The angiosome of the superior labial artery encompassed approximately the caudal 60% of the upper lip. There were extensive branches and anastomoses along the length of the upper lip, most notably between the superior labial artery and tributaries from the lateral nasal artery, a terminal branch of the infraorbital artery. The angiosome of the inferior labial artery encompassed approximately the caudal 75% of the lower lip. Similarly, there were extensive branches and anastomoses along the length of the lower lip, most notably to perforating caudal and middle mental arteries (Figure 1B).

Overall, a robust arterial blood supply perfused both the upper and lower lips. Both the intact skin from the lips and the excised musculomucosal tissue from the lips showed the same angiographic pattern (Figure 1B), indicating that the arterial vasculature was located primarily within the musculomucosal layer.

In all cadavers, the superior and inferior labial veins were found to extend along the majority of the length of the upper and lower lips on gross dissection; the veins were not visible on the angiograms.

3.2 | Clinical Case 1

Re-examination of the oral cavity at 1-, 2-, and 6- weeks postoperatively did not reveal any signs of distal tip necrosis, dehiscence or oronasal fistula. The esophagostomy tube was dislodged by the patient and subsequently replaced 1 week after surgery. At the 2-week postoperative examination, much of the vestibular mucosa now positioned over the hard palate had been denuded, probably due to abrasion from the tongue, but was fully covered in healthy granulation tissue (Figure 8). The esophagostomy tube was removed 2 weeks postoperatively as the patient was voluntarily eating well per os. The 6-week postoperative examination showed complete survival of the flap and the previously denuded epithelium had undergone reepithelialization (Figure 9). Mild retraction of the upper

FIGURE 9 Case 1. Six-week postoperative clinical photograph showing a healed reconstruction. The previously noted granulation tissue has re-epithelialized

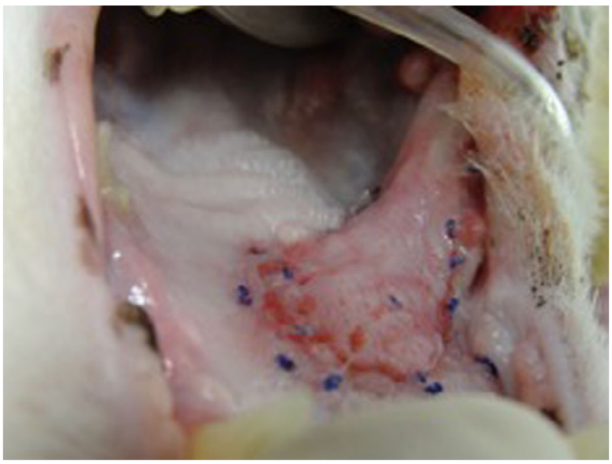

FIGURE 10 Case 2. Two-week postoperative clinical photograph showing complete survival of the flap and healing of the reconstruction

lip resulted in exposure of the coronal third of the maxillary canine. The cat was able to fully open and close his mouth without hindrance. No overt cutaneous sensory deficits were noted. The cat's owner reported resolution of all previous clinical signs.

3.3 | Clinical Case 2

Re-examination of the oral cavity at 2-weeks postoperatively did not reveal any signs of distal tip necrosis, dehiscence or oronasal fistula (Figure 10). There was significantly less granulation tissue present along the flap than in Case 1. Re-examination 8-weeks postoperatively showed complete survival of the flap and complete coverage of the defect (Figure 11). The cat was able to fully open and close her mouth without hindrance. No overt cutaneous sensory deficits were noted. The cat's owner relayed resolution of all previous clinical signs.

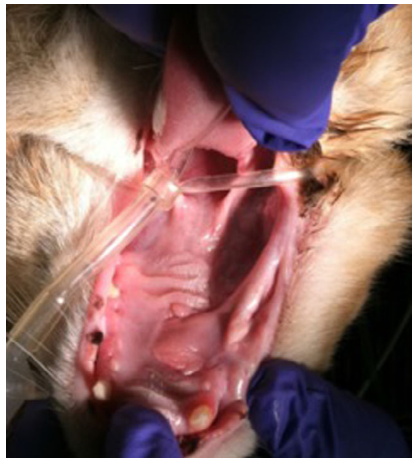

FIGURE 11 Case 2. Eight-week postoperative clinical photograph showing a healed reconstruction

4 | DISCUSSION

A comprehensive understanding of the regional anatomy is necessary to maximize the chances of successful repair of a palatal defect. The objective of this study was to visualize the vascular supply of the lips in the cat using cadaveric positive contrast angiograms which were then used to guide labial musculomucosal axial pattern flap design. The angiograms demonstrated a rich vascular network which offers an excellent basis for axial pattern flaps. Because such flaps remain attached to the donor site at their base, survival is less reliant on the recipient bed's ability to neovascularize the flap.[31] This attribute is especially beneficial in cases of palatal defects as compromise of the vascular supply, infection, friable tissue, necrosis of the involved bone, and significant scarring are often present.[3] These challenges are compounded with subsequent attempts at repair and after radiation therapy.[6,26]

The second series of positive contrast angiograms in this study revealed that the vascular supply of interest is located within the musculomucosal layer of the lips. With the skin removed from the musculomucosal layer, the angiograms were highly similar to those including the skin in all cadavers. Thus, we conclude this indicates that the vascular supply is located primarily within the musculomucosal layer for the entire length of the proposed flaps and not within the skin. It follows that mobilizing the underlying submucosa and musculature deep to the mucosal layer is essential for survival of the flaps. Similar conclusions have been reached in studies of labial artery position in humans. In a study of human cadavers, the superior and inferior labial arteries were found to reside in the submucosa (between the oral mucosa and the orbicularis oris muscle) in 78.1% of cases, intramuscular (between the superficial and deep layers of the orbicularis oris muscle) in 17.5% of cases, and in the subcutaneous tissue (between the skin and the orbicularis oris muscle) in 2.1% of cases.[32] While no such studies in cats are available, the positioning of the labial arteries may be similar and harvesting the flap deep to the orbicularis oris muscle is probably necessary. Although not investigated in this study, collateral blood supply from adjacent perforating cutaneous vessels likely supplies the skin overlying the donor site after this flap is harvested. In addition, we found that including the musculature forms a thick, robust flap that is well-suited to withstand the stresses typical of the oral cavity. In the inferior lip, the muscular portion probably includes the orbicularis oris and buccinator muscles. In the superior lip, it is possible that only the orbicularis oris muscle is included, as a comparative anatomic study of the buccinator muscle was unable to identify a maxillary portion of this muscle in the cat.[33]

The labial musculomucosal axial pattern flaps described in this report offer additional surgical options for the repair of palatal defects in the cat. In both clinical cases reported here, the tissues surrounding the palatal defects had become severely compromised from previous treatments. This compromise led to significant concerns regarding the use of reconstruction techniques which rely on adjacent tissues and local blood supply. The flaps investigated in this report have several advantages: a robust blood supply, a large surface area, use of healthy donor tissue distant from potentially compromised tissue surrounding a palatal defect, ability to harvest donor tissue from ipsilateral or contralateral to the defect in the case of the superior labial artery flap, a relatively low arc of rotation, a mucosal epithelium, and minimal cosmetic alteration.

In Case 1, the superior labial flap reached the contralateral lateral aspect of the hard palate. In Case 2, the inferior labial flap extended to the ipsilateral maxillary second premolar and probably could have reached the level of the canine tooth if necessary. Additionally, we found that the muscular portion of the flap adds significant width to the flap and may be useful to provide additional coverage for larger defects. Ultimately, the width of the combined alveolar and vestibular mucosa is the limiting factor in the width of the flap that can be harvested.[34]

Distal ischemic necrosis is a concern with all axial pattern flaps and is the primary concern for the labial musculomucosal axial pattern flaps presented here, although this complication did not occur in either clinical case. Interestingly, it has been shown that venous drainage of flaps is more important than a larger arterial supply for flap survival.[35] Inclusion of the superior labial vein for the superior labial flap and the inferior labial vein for the inferior labial flap is likely to be critical to each flap's survival. The authors recommend utilizing intraoperative transillumination to visualize the vascular anatomy in the region of interest and guide donor site planning. Meticulous dissection to preserve the vascular base and tension-free closure are also paramount to a successful outcome.

Although not specifically investigated in this study, it is reasonable to conclude that these flaps fall in line with the general rule that axial pattern flaps should not be rotated more than 180 degrees to avoid venous congestion and subsequent flap necrosis.[36] In some cases, dental extractions are necessary to reduce or prevent postoperative trauma from occluding teeth and compression of the flap when the mouth is closed.[25,31] While feeding tubes are not typically necessary for postoperative nutrition after palatal repair,[6,13] if warranted, it may be preferable to place an esophagostomy tube prior to surgical reconstruction to prevent undue trauma to the surgical site.

Another inherent disadvantage of this technique is the replacement of sturdy, keratinized palatal mucoperiosteum with more fragile nonkeratinized lining (alveolar and vestibular) mucosa.[6] In our clinical cases, most notably in Case 1, the flap tissue did appear to have been denuded during the initial healing phase, probably due to contact with the abrasive dorsal surface of the feline tongue. Nonetheless, granulation tissue covered the traumatized flap surface and underwent reepithelialization, and probably some degree of fibrosis, leading to a fully healed flap without evidence of inflammation at the final postoperative recheck examinations.

In addition to full healing of the reconstruction and resolution of clinical signs, other postoperative interests include maintenance of the ability to open and close the mouth without hindrance and adequate cosmesis. Due to the taut nature of the feline lip, some degree of inversion of the margin of the lip postoperatively is possible with this technique. Absence of or decreased sensory innervation to the lip, due to the necessary severance of nerves coursing through the flaps, is also likely. Theoretically, one could attempt to transect individual branches of the infraorbital nerve more distally where they enter the flap borders, thus sparing branches coursing more dorsally. However, to prevent iatrogenic damage to the vascular supply along the perimeter of the flap, the authors recommend transecting at, or near, the infraorbital foramen. While not performed in our clinical cases, a maxillary and/or inferior alveolar nerve block could be performed preoperatively in the interest of multimodal analgesia.

Furthermore, transposition of the underlying musculature with the oral mucosa will preclude normal movement of the lip. As this movement is minimal in health, this is not likely to cause clinical issues. Finally, iatrogenic trauma to the parotid and zygomatic ducts and/or papillae, located dorsal to the maxillary fourth premolar and first molar, respectively, is possible and could result in a sialocele, requiring duct ligation or sialoadenectomy. None of these complications were noted in the two cases reported here. Moreover, the authors note that the dissection required for these flaps is subjectively simpler, with less exposure of vital structures required, and thus may be less likely to result in iatrogenic damage and other complications as compared to other axial pattern flaps used for facial and/or oral reconstructive surgery, e.g. the angularis oris axial pattern flap.[27,37–39]

The principal limitation of this study was its reliance primarily on cadaveric investigation instead of live animals. This is important especially in reconstructive techniques in which the normal anatomy of an animal is altered and resultant functional and cosmetic consequences cannot be perceived. In the clinical cases reported here, no significant complications were noted and reconstruction in both cats healed fully with minimal cosmetic alteration. A larger number of clinical cases is necessary to remedy this shortcoming. Furthermore, both cases had relatively long intervals between recheck examinations in which dehiscence and subsequent healing may have occurred unbeknownst to the authors. Also, both cases were lost to follow-up after their last recheck examination, after which dehiscence could potentially have developed. Shorter recheck intervals and longer follow-up times would help to detect this complication if it were to occur.

There are inherent challenges in repair of palatal defects in dogs and cats, and these challenges are especially heightened in cats given the limited labial and buccal tissues present and the inflexibility of those tissues. The angiograms performed in this study show that the musculomucosal portions of the upper and lower lips are well-perfused by the superior and inferior labial arteries and associated tributaries. Additionally, these angiosomes may serve as a prime basis for musculomucosal axial pattern flaps which may be used for palatal defect reconstruction in the cat, especially when other techniques have failed or more local tissues are significantly compromised. Further clinical research is warranted to determine the maximum length of the flap that will reliably survive in live animals and identify other factors that may influence success when utilizing a superior or inferior labial artery musculomucosal axial pattern flap in cats.

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CONFLICT OF INTEREST

The authors declare no conflict of interest related to this report.

AUTHOR CONTRIBUTIONS

Both authors contributed to conception of study, study design, acquisition of data, and data analysis and interpretation. Both authors also drafted, revised and approved the submitted manuscript.

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