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Lip-to-nose flap for nasal plane reconstruction in dogs: a cadaveric and in vivo feasibility study.

Chiti, Lavinia E ; Montinaro, Vincenzo ; Lisi, Marta L P ; Asta, Andrea G ; Marches, Silvia ; Sommaruga, Paolo ; Massari, Federico

Abstract: **OBJECTIVE:** To describe a local interpolation flap based on the upper lip for the reconstruction of the dorsal aspect of the nasal plane in dogs. **STUDY DESIGN:** Ex vivo and in vivo case report. **ANIMALS:** A 2-year-old medium-sized spayed female mixed-breed dog and a canine cadaver of a medium-sized mixed-breed dog. **METHODS:** A dorsal defect of the nasal plane of uncertain origin in a dog was reconstructed with a unilateral interpolation flap obtained from the caudal upper lip skin and mucosa (lip-to-nose flap). The procedure was first performed in a cadaveric model to assess its feasibility. **RESULTS:** The lip-to-nose flap allowed the reconstruction of a dorsal nasal plane defect with a satisfactory cosmetic outcome. The incorporation of the labial mucosa guaranteed a complete and uncomplicated wound healing of the flap; a small area of necrosis occurred at the donor site, which resolved in a few days. **CONCLUSION:** The use of a lip-to-nose flap was feasible in these 2 medium-sized dogs and led to satisfactory cosmetic outcome. **CLINICAL SIGNIFICANCE:** A lip-to-nose flap may be considered to reconstruct dorsal nasal plane defects in dogs and allows for a cosmetic outcome.

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1 Lip-to-nose flap for nasal plane reconstruction

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3 **LIP-TO-NOSE FLAP FOR NASAL PLANE RECONSTRUCTION IN DOGS: A CADAVERIC**
4 **AND IN-VIVO FEASIBILITY STUDY**

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6 Lavinia E. Chiti¹, DVM, Vincenzo Montinaro¹, DVM, Lisi Marta¹, DVM, PhD, Andrea G. Asta¹,
7 DVM, Paolo Sommaruga¹, DVM, Federico Massari¹, DVM, Diplomate ECVS

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9 ¹Clinica Veterinaria Nervianese, Nerviano, Italy.

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25 **Abstract**

26 **Objective** – To describe a local interpolation flap based on the upper lip for the reconstruction of the
27 dorsal aspect of the nasal plane in dogs.

28 **Study Design** – Ex-vivo and in-vivo case report.

29 **Animals** – 2-years medium-sized spayed female mixed-breed dog and a canine cadaver of a medium-
30 sized mixed-breed dog.

31 **Methods** – A dorsal defect of the nasal plane of uncertain origin in a dog was reconstructed using a
32 unilateral interpolation flap obtained from the caudal upper lip skin and attached labial mucosa (lip-to-
33 nose flap). The procedure was first performed in a cadaveric model in order to assess its feasibility.

34 **Results** – The lip-to-nose flap allowed the reconstruction of a dorsal nasal plane defect with a
35 satisfactory cosmetic outcome. The incorporation of the labial mucosa guaranteed a complete and
36 uncomplicated wound healing of the flap, while a small area of necrosis occurred at the donor site,
37 which solved in few days.

38 **Conclusion** – The lip-to-nose flap is feasible for the reconstruction of dorsal nasal plane defects in
39 dogs and allows for a cosmetic outcome.

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49 **Introduction**

50 Defects of the external nose in dogs are often caused either by traumatic injuries or by surgical
51 resections of neoplasms such as squamous cell carcinoma.^{1,2} Reconstruction of the nasal plane is
52 particularly challenging in dogs because of the lack of free local tissue that can be used to reconstruct
53 the original appearance of the nose.³ The canine nose is a highly specialized structure and contributes
54 to the appearance of the dog.⁴ Thus, cosmetic and functional outcome are a great concern, and may
55 limit the extent of the surgical excision in dogs with nasal neoplasia. For the same reasons, surgeons
56 are cautious in performing nasal plane reconstruction in patients with traumatic injuries of the external
57 nose. In Veterinary literature, several techniques based on local flaps have been proposed to allow
58 primary closure of nasal defects. These techniques range from advancement flaps such as the dorsal
59 muzzle and labial advancement, to composed flaps such as the bilateral alar cartilage and the
60 musculofascial island labial flap.⁴ Gallegos and colleagues reported a labial mucosal technique for
61 reconstruction of defects involving the nasal plane and the rostral labial tissue.⁵ The labial mucosal
62 inversion technique improves cosmetic outcome and provides a labial mucosal antechamber protecting
63 the nasal mucosa from direct exposure. This technique involves excision of a large portion of the upper
64 lip adjacent to the nasal plane; it is thus not ideal for the reconstruction of dorsal defects without
65 involvement of the rostral aspect of the nasal plane and upper lip. Recently a modified nasal rotational
66 flap has been described for the reconstruction of a rostral nasal defect involving the lateral nasal plane
67 in a dog.³ Although the good cosmetic and functional outcome obtained, this technique can be hardly
68 applied to nasal defects involving the very dorsal surface of the nasal plane.

69 The lip-to-lid flap is a local interpolation flap based on the caudal upper lip skin and the attached labial
70 mucosa which has been successfully applied to replace the lower eyelid in dogs and cats.^{6,7,8} The aim
71 of this study is to report a modification of the lip-to-lid flap for the reconstruction of dorsal nasal
72 defects in dogs and to assess its feasibility in a cadaveric and in-vivo model. The technique described

73 consists in a lip-to-nose interpolation flap based on the subdermal plexus, which allows direct mucosal
74 apposition in order to obtain a good functional and cosmetic outcome.

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97 **Clinical Report**

98 A 2-year-old mixed-breed, spayed female dog, weighting 21 kg was referred to Clinica Veterinaria
99 Nervianese in February 2017, for a defect of the dorsal aspect of the nasal plane. The dog was found by
100 a rescue association 10 days before with remote and recent history unknown. At clinical examination
101 the dog presented a large defect of the nasal plane involving the rostral third of the nasal bones, the
102 philtrum, and the dorsal lateral cartilages bilaterally. The lateral part of the alar cartilages and the
103 ventral lateral cartilages were preserved (Figure 1). The rostral portion of the dorsal meatus was
104 exposed, causing a chronical inflammation of the nasal mucosa. No other abnormalities were identified
105 through physical examination. Haematological analysis revealed regenerative anaemia, neutrophilic
106 lymphocytosis and hypoalbuminemia. Serum proteins electrophoresis pattern was consistent with a
107 protozoarian infection and *Hepatozoon canis* was detected in the blood smear. Imidocarb dipropionate
108 was thus administered at the dose of 6 mg/kg subcutaneously twice 14 days apart. A CT scan of the
109 nose was performed and no other abnormalities were detected. Although no biopsy of the nasal tissue
110 was performed in this case, we hypothesized that the nasal plane defect in this dog was of traumatic
111 origin.

112 A decision was made to close the nasal defect with a lip-to-nose flap. The procedure was first
113 performed on a canine cadaver of similar size in order to assess its feasibility (Figure 2). The cadaver
114 was placed in sternal recumbency and the nose and lip were clipped. The flap was obtained from the
115 upper lip as described by Pavletic for the lip-to-lid technique.⁶ Two full-thickness incisions of the right
116 upper lip were made starting from the medial cantus of the ipsilateral eye with a 45° angle form a line
117 drawn between the medial and lateral canthi (Figure 2A-C). The two incisions were convergent and
118 outlined so that the distance between the rostral and caudal edge of the flap corresponded to the minor
119 diameter of the nasal plane lesion, with the caudal edge of the flap 3 cm rostral from the commissure
120 (Figure 2A,B). The buccal mucosa was divided from the gingival mucosa and the whole buccal mucosa

121 was preserved to reconstruct the dorsal nasal mucosa. The skin was then undermined dorsally under the
122 platysma muscle, and the skin flap with the attached lip margin was transposed to cover the nasal plane
123 defect (Figure 2D-F). A bridging incision was created just proximal to the nasal plane lesion (Figure
124 2D). The mucosal edge of the flap was sutured to the remaining nasal mucosa with a simple interrupted
125 pattern using monofilament absorbable sutures (Polidioxanone USP 3-0) (Figure 2G). The skin edge of
126 the flap was then sutured to the nasal plane in two layers and the defect at the donor site was routinely
127 closed in three layers with monofilament absorbable sutures (Figure 2G,H).

128 The cosmetic outcome was considered satisfactory and the same procedure was thus performed in-vivo.
129 Total anesthesia was induced with propofol (6 mg/kg intravenously [IV]) and maintained with
130 isoflurane in oxygen after intubation. Saline solution 0.9% was administered IV at the rate of 5
131 mL/kg/h during surgery. The dog was positioned in sternal recumbency. The nose and upper lip were
132 clipped and aseptically prepared for surgery (Figure 3A). A composite flap was obtained following the
133 technique as described in the cadaveric model, and the nasal plane defect was reconstructed using the
134 lip-to-nose flap (Figure 3B-D). Great care was taken to preserve the subdermal plexus and to perfectly
135 appose the skin edges of the flap. A vacuum drain (Emodren – Medicalplastic s.r.l., Milan, Italy) was
136 placed to prevent seroma formation (Figure 3D). The defect at the donor site was closed with a labial
137 advancement flap to avoid the exposure of the canine tooth. Pain was managed by fentanyl (5 mcg/kg/h
138 continuous rate infusion IV) and local nerve block (bupivacaine 0.5% 1 mL) intraoperatively, and by
139 methadone 0.1 mg/kg IV twice daily until discharge. Cefazolin (25 mg/kg IV twice daily) and
140 Meloxicam (0.2-0.1 mg/kg IV once daily) were administered for 7 and 5 days respectively after
141 surgery. The drainage was removed 2 days later and the patient was discharged 7 days postoperatively.
142 Drug therapy for treatment of *Hepatozoon canis* infection was discontinued 14 days later.
143 Although the lip-to-nose flap did not allow for the reconstruction of the philtrum, the cosmetic outcome
144 was improved and the motility of the external nose was preserved.

145 At discharge a small area of necrosis was noted at the donor site, probably due to the use of the
146 monopolar electrosurgery, while the lip-to-nose flap appeared to be healed completely (Figure 4A,B).
147 Necrosis at the donor site was treated with topic argentic sulfadiazine and healed completely in 7 days.
148 The patient showed minimal nasal discharge which resolved spontaneously 48 hours postoperatively. A
149 small dog ear resulted from the transposition of the flap, which underwent a partial regression during
150 the initial phase of the healing process. Fifteen days after surgery there were no signs of flap failure and
151 both the nasal plane and the donor site were perfectly healed without evidence of nasal orifice stenosis.
152 At 45 days, the patient had recovered uneventfully and the cosmetic and functional outcome were
153 satisfactory (Figure 5A-C).

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169 **Discussion**

170 In the case reported, a dorsal defect of the nasal plane in a dog was successfully reconstructed using a
171 lip-to-nose interpolation flap based on the subdermal plexus. Primary closure techniques for a cosmetic
172 reconstruction of the canine nasal plane are a great concern in Veterinary reconstructive surgery, and
173 several techniques based on local flaps have been previously described.^{3,5} However, none of these
174 technique is ideal for the closure of dorsal defects. To the Authors' knowledge, no paper has yet
175 reported a surgical technique based on a subdermal plexus flap specifically designed to cover dorsal
176 nasal plane defects. The lip-to-lid flap has been largely employed for the reconstruction of the lower
177 eyelid in dogs and cats and has showed a high rate of success.^{6,7,8} The lip-to-nose flap here described
178 similarly relies on the subdermal plexus and permits first intention healing with minimal tension. The
179 upper lip represents a highly vascularized structure, with contribution from the infraorbital and lateral
180 nasal artery; this may result in an improved success rate of the flap.⁹

181 The incorporation of the buccal mucosa permits a mucosal apposition which promotes primary wound
182 healing with minimal scar tissue formation. This may prevent stenosis of the nostril as well as changes
183 in the appearance of the external nose. Furthermore, the apposition of the buccal mucosa is crucial in
184 protecting the nasal mucosa from the external environment, thus limiting the inflammation and the
185 associated respiratory signs. In the case reported, the lip-to-nose flap healed completely without
186 complications, no stenosis of the nostril was observed and a total remission of the nasal discharged due
187 to the respiratory mucosa inflammation was achieved shortly after surgery.

188 The pigmented non-haired lip margin resembles the original appearance of the nose, and its
189 incorporation allowed for a better cosmetic outcome. The dog ear resulting from the flap transposition
190 showed a partial regression in the first days after surgery and did not require a surgical correction since
191 it didn't compromise the overall cosmetic result.

192 The creation of the full-thickness flap from the upper lip is relatively simple to achieve and the lip-to-
193 nose technique can be performed in a limited amount of time, thus reducing the risks associated with
194 surgical timing.

195 The lip-to-nose flap is designed to cover dorsal defects of the nasal plane. In the case that we report the
196 defect also involved the philtrum, which was not reconstructed. Nonetheless, the cosmetic appearance
197 was not compromised and a functional reconstruction was achieved, since the motility of the external
198 nose was preserved and no persistent nasal discharged occurred.

199 The defect that we treated was probably of traumatic origin. Nonetheless, it is the Authors' opinion that
200 the lip-to-nose flap might be an effective option for the cosmetic closure of defects caused by surgical
201 resection of neoplasm of the nasal plane. Furthermore, since the lip offers a discrete amount of free
202 tissue, the flap obtained from the upper lip and the attached mucosa can be outlined to cover wider
203 defects of the dorsal nasal plane or lesion which extend laterally.

204 Based on the results of the present study, the lip-to-nose flap is feasible for a single stage reconstruction
205 of nasal plane defects in dogs and allows for a good cosmetic and functional outcome. However,
206 additional studies based on a wider number of cases are needed to investigate further applications of the
207 lip-to-nose flap and to assess its success rate.

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216 **Disclosure**

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

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264 **Figure Legends**

265 Figure 1. Aspect of the defect. Note the exposure of the rostral portion of the dorsal meatus and the
266 subsequent inflammatory hyperemia of the nasal mucosa; rostral (A) and dorsal (B) view.

267

268 Figure 2. Cadaveric model of the lip to nose flap for the reconstruction of dorsal nasal plane defects. A)
269 The dorsal aspect of the nasal plane has been excised, and the rostral part of the resulting defect has
270 been measured. B) The same distance has been measured on the lower lip to obtain the correct width of
271 the mucosal edge of the flap. C) Two full-thickness incision of the upper lip have been made in order to
272 create the flap; The two incisions extend from the medial cantus of the eye to the lower lip margin and
273 form a 45° angle from a line drawn between the medial and lateral canthi. The whole buccal mucosa
274 has been preserved to reconstruct the dorsal nasal mucosa (green arrow). D) A bridging incision has
275 been made just proximal to the nasal plane defect (red arrow). E) The flap has been transposed to cover
276 the nasal plane defect. F) The flap has been sutured in a simple continuous pattern to the recipient site
277 and the lower lip has been reconstructed with an advancement flap. G) Completed reconstruction; right
278 lateral view. H) Completed reconstruction; frontal view.

279

280 Figure 3. Lip-to-nose flap for the reconstruction of a dorsal nasal plane defect in a 2-year-old mixed-
281 breed, spayed female dog. A) The defect involved the rostral third of the nasal bones, the philtrum, and
282 the dorsal lateral cartilages bilaterally, while part of the alar cartilages and the ventral lateral cartilages
283 were preserved. B) The flap has been obtained from the upper lip skin and the attached oral mucosa
284 (blue arrow). C) The flap has been transposed to cover the dorsal defect. D) Oblique view of the
285 muzzle after reconstruction; an active-suction drain has been placed.

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287 Figure .4 Frontal (A) and left lateral view (B) at discharge. Note the small area of necrosis at the donor
288 site (blue arrow).

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290 Figure 5. Appearance of the dog 45 days after surgery; rostral (A) lateral (B) and dorsal view (C).