**Bilateral Rostral Maxillectomy and Nasal Planectomy for Large Rostral Maxillofacial Neoplasms in Six Dogs and One Cat**

This paper describes in detail an aggressive rostral maxillectomy procedure in one cat and six dogs, and the postoperative complications and outcomes are reported. The surgeries were performed to attempt complete excision of large and extensive rostral maxillary fibrosarcomas (n=4), squamous cell carcinomas (n=2), or poorly differentiated mesenchymal neoplasia (n=1). The surgeries involved transection of the maxilla at the level of premolar (PM)1 and PM2 in a cat and two dogs, and between PM2 and PM3 in four dogs. There were no intraoperative complications. Complete margins of resection were obtained in all cases. The postoperative appearance was acceptable to owners. Local recurrence was only observed in one dog (10 months after surgery) during a follow-up period of 11 to 66 months (median, 21.5 months).


**Introduction**

During the late 1970s and early 1980s, the surgical approach for treating oral neoplasms shifted from conservative partial ablation\(^1,2\) to aggressive *en bloc* resection.\(^3-5\) For malignant neoplasms of the mandible, this shift correlated with reported 1-year survival rates increasing from approximately 15%\(^2,4\) to >50%\(^6\) due to improved local control. Reports of aggressive *en bloc* resections of the maxilla lagged behind reports of mandibulectomy,\(^7-9\) but the median 1-year survival rate for these cases was <50% with aggressive *en bloc* resections.\(^10,11\)

This was partially related to the relative ease of performing rostral mandibulectomies and the fact that the procedure resulted in a defect that was hidden by the maxilla.

Many studies\(^9-14\) have stated that tumor-free margins are associated with a more favorable prognosis; however, only one study\(^10\) correlated outcome with completeness of excision in canine maxillectomies. In that study, it was found that dogs with tumor-free resection margins had significantly longer survival times than those in which tumor-free margins were not obtained. Furthermore, it has been argued that for nasal planum squamous cell carcinoma (SCC), a more aggressive nasal maxillectomy might result in an additional subset of animals that have greater long-term survival rates.\(^15-17\)

The present report describes the rationale, detailed methods, and outcomes for radical rostral maxillary resection in one cat and six dogs. This is a technique that may increase the opportunity to obtain “complete” resection of the tumor and thus allow prolonged survival of animals with malignant rostral maxillary neoplasms.

**Materials and Methods**

Seven cases (one cat and six dogs) presented for treatment of rostrally positioned maxillary masses, which were diagnosed based upon prior biopsy and histopathology. The animals were assessed for possible surgical treatment, because the owners had declined radiation therapy. The cat and
three dogs had fibrosarcomas (FSA), two dogs presented with SCC, and one dog had a poorly differentiated mesenchymal neoplasm. In each case, preoperative evaluation consisted of a routine serum biochemistry screen, hematology profile, thoracic radiographs, and aspiration of regional (i.e., submandibular) lymph nodes. In all but one case (case no. 3), the extent of the tumor was defined using computed tomography (CT).

**Excision**

Each animal was positioned in ventral recumbency. The mouth was held slightly open with a mouth gag, and the pharynx was packed with gauze sponges to minimize aspiration of blood or lavage fluid. The first drape was placed in the mouth over the mandible, tongue, and endotracheal tube, but not pressed tightly against the commissures. Mobile commissures are necessary for labial advancement during reconstruction. Additional drapes were placed around the maxilla (with eyelids exposed for orientation). The surgical technique varied slightly between the seven cases because of patient size, location and size of the tumor, and relative availability of tissues for reconstruction. For the cat (case no. 1), the incision included a minimum of 1 cm grossly normal tissue beyond the margin of the mass [see Table]. For case nos. 2 through 7, a 1.5-cm margin (minimum) of grossly normal tissue was removed with the mass. The preoperative CT scan defined the extent of tissue infiltrated with tumor, and its relation to the dentition. The teeth were used as landmarks to allow the approximate edges of the tumor to be marked on the animal using a sterile marker pen. A sterile ruler was used to mark 1 or 1.5 cm beyond the borders of the tumor so that a line of “planned complete resection” could be drawn on the animal. For all cases, the line of bone excision was level with or slightly caudal to the caudal-most aspect of the soft-tissue resection. This resulted in sufficient soft tissues to reconstruct a lip rostrally and cover the exposed maxilla.

Full-thickness, initial labial incisions were made perpendicular to the labial margin. The incisions continued perpendicular from the labial margin for a minimum of 1 to 2 cm and then curved to meet on the midline of the maxilla. Once the skin was scribed with a scalpel, electrocautery was used for most of the tissue division, and hemostasis was maintained by electrocoagulation and vascular clips. The incisions were continued deeper through the subcutis and nasolabial muscles and fascia to the maxillary bone at predetermined resection levels. For case no. 1, this was the rostral zygomatic arch on the affected side where the infraorbital neurovascular bundle was ligated and severed, and near the canine tooth on the contralateral side such that the skin, subcutis, nasolabial muscle, and labium were reflected while preserving their vascular support from the infraorbital neurovascular bundle. These soft tissues and labium were reflected to the rostral zygomatic arch, exposing the maxilla. For case no. 2, the soft-tissue incision extended from the first premolar (PM1) on the affected left side to the canine on the unaffected side, and for case no. 3 the incision extended from PM2 to just lateral to the nasal planum on the affected and unaffected sides. For case nos. 4 through 7, the excision of soft tissues was bilaterally and symmetrically level with PM1 or PM2, just rostral to the planned maxillary resection [Figure 1].

Once exposed, the rostral maxilla, nasal turbinates, and bony palate were amputated with a reciprocating saw. The transection was perpendicular to the maxillary axis [Figure 2]. The rostral maxilla could then be removed following transection of the palatine mucosa parallel to and at the level of the hard palate. Hemorrhage was controlled with vascular clips (on the palatine and sphenopalatine arteries), electrocoagulation, or digital pressure. For case nos. 1, 2, and 4, maxillectomy was performed between PM1 and PM2, and for case nos. 3, 5, 6, and 7, between PM2 and PM3.
The surgical margins were demarcated by painting their caudal surfaces with India ink or tissue-marking dyes and the specimens were submitted for histopathological examination.

**Reconstruction**

Labial reconstruction was performed by transposing either a unilateral labial flap (case nos. 1, 3) or bilateral labial flaps (case nos. 2, 4-7). Regardless of whether a unilateral or bilateral flap was used, the lip and palate were united first. Labial reconstruction dehisced in case no. 3 and was repaired using bilateral advancement flaps.

In case no. 1, the labiogingival reflection was incised as necessary to mobilize the labial flap. The mucosa of the labial flap was removed except for a 0.5- to 1.0-cm width adjacent to the labial margin. This distance was determined by bringing the tissues together and identifying the contact point of the palatine mucosa and labium, and then assessing how much “new lip” there would be projecting ventrally from the palatine mucosa. This margin was overly large for the cat and initially interfered with food transfer into the oral cavity. Once the mucosa was excised, the remaining mucosal margin was sutured to the palatine mucosa with interrupted 4-0 absorbable sutures, thus providing strong support and preventing mucosal inversion.

Bilateral advancement flaps were also prepared by incision of the labiogingival borders as necessary to permit tension-free advancement of the flaps on the approximate midline. The labial mucosa was once again debrided as in case no. 1 [Figure 3], leaving only a 0.75- to 1.0-cm margin of labial mucosa to be sutured to the palatine incision as a palatobuccal recess. This length of recess was chosen to ensure the margin would not be trapped between the teeth during chewing or interfere with food transfer into the mouth. Prior to suturing, the left and right lips were aligned toward the midline using temporary sutures. As the palatal labial suturing progressed from lateral to medial, the labial margins were drawn into apposition.

In case nos. 4 through 7, the labial submucosa was first sutured to the severed edge of the palatine bone using small holes drilled in the palatine bone with a 0.0625-inch Kirschner wire [Figure 4]. The remaining lip union was reconstructed beginning along the ventral aspect, aligning the labial margin with a nonrolling figure-of-eight suture [Figure 5]. Suturing progressed using the same suture pattern in the submucosa, muscle, subcutaneous, and dermal layers. Case no. 3 was closed similarly to case no. 1 (i.e., drawing tissue across from the left to create the new rostral lips), but there was more tension present along the suture

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**Figure 3**—A portion of labial mucosa was necessarily removed (X) to establish a neolabiopalatine margin about 1 cm wide (A’ to a’ when sutured in place). A’ to a’ is the distance that the new lip will hang over the palatine mucosa at the rostral end of the maxilla, and this creates the new palatobuccal recess rostrally. The flap will be transposed and sutured (A’ to A and a’ to a, b to b’ and c to c’).

**Figure 4**—Cadaver specimen showing alignment of left lip to hard palate and the suture attaching labial submucosa to palatine bone using a bone tunnel (arrow).

**Figure 5**—Figure-of-eight suture. The lip margins from the left and right sides were aligned with a figure-of-eight suture (A). A horizontal mattress pattern is used to accurately align the lip margin, and the suture is tied away from the lip margin. The rest of the skin is apposed with simple interrupted sutures (B).
line and it subsequently dehisced. The wound was closed after debridement by incising the gingivolabial margin, undermining the area, and advancing bilateral flaps similar to case no. 2.

Leaving the dorsal and rostral portions of the incision open formed a nasal orifice. The authors’ previous experience with surgery of this type had revealed that considerable contraction of the orifice could take place over time. Therefore, an orifice approximately twice the desired final size was created to compensate for the expected contraction during healing. This was determined subjectively by the individual surgeon. The nasal orifice was managed differently in each case. In case no. 1, the nasal orifice was intentionally offset to the right side to spare as large a flap base as possible for the vitality of the single labial flap. The 1.5-cm nasal orifice was formed using “rolling” figure-of-eight sutures. In case no. 2, bilateral advancement of the labial flaps placed the nasal orifice on the midline. Once again, figure-of-eight rolling sutures were used. In case no. 3, the rolling figure-of-eight sutures were used, but they were placed through holes drilled in the margin of the maxilla so that, when the rolling suture was tied, the edge of the maxilla was covered with skin [Figure 6]. In case nos. 4 and 5, a purse-string type pattern of suture was used to create the desired size of nasal orifice. In case nos. 6 and 7, the skin was sutured directly to the nasal maxillary bone using simple interrupted sutures placed through holes drilled in the bone [Figure 7]. When completed, the reconstruction resulted in the continuous exposure of the mandible from the canine teeth rostrally (case nos. 1, 2, 4) or from the PM2 rostrally (case nos. 3, 5-7). In case no. 7, a triangle of skin, with the base oriented rostrally, was removed from the lateral lip prior to reconstruction to decrease the amount of excess lip present.

**Figure 6**—Rolling figure-of-eight suture was used to roll the skin around the edge of the maxilla bone, in order to hasten mucocutaneous healing and to cover the exposed edge of the maxilla. The suture is placed using a bone tunnel in the edge of the maxilla.

**Figure 7**—Holes are drilled in the bone of the maxilla to place either rolling or simple interrupted sutures to attach the skin to the maxilla for reconstruction of the nasal orifice (case no. 6). Note the size of the new rostral opening (arrow), which is approximately twice the eventual desired size.

**Analgesia**

Each animal received different analgesic medications depending upon surgeon preference and subjectively perceived requirements. In each case, premedications included an opioid (i.e., oxymorphone at 0.2 to 0.5 mg/kg intramuscularly [IM] or morphine at 0.2 to 0.6 mg/kg IM), and in case nos. 4-7, infraorbital nerve blocks were performed bilaterally prior to surgery using bupivacaine (0.5 to 1.0 mL of a 0.75% solution used per site). During general anesthesia, constant-rate infusions of fentanyl (0.01 mg/kg per hour) were administered to case nos. 4-7. At the time of extubation, the opioid administered preoperatively was repeated, and a postoperative analgesic opioid protocol was instituted. For case no. 1, buprenorphine (0.07 mg IM q 6 hours) was continued for 60 hours. For case nos. 2-7, following a loading dose of the appropriate opioid (i.e., morphine 0.5 mg/kg intravenously [IV]; oxymorphone 0.2 mg/kg IV; or fentanyl 0.002 mg/kg IV), the dogs received constant-rate infusions of morphine (0.05 mg/kg per hour), oxymorphone (0.13 mg/kg per hour), or fentanyl (0.002 to 0.006 mg/kg per hour) for 24 hours to provide a constant level of analgesic drug. Carprofen (2.0 mg/kg per os [PO] q 12 hours) was initiated 12 hours after surgery for case nos. 2, 3, 6, and 7 and was continued for 10 to 21 days postoperatively. Case no. 1 received carprofen at 0.5 mg/kg PO daily for 1 week. Case no. 4 did not receive nonsteroidal anti-inflammatory drugs (NSAIDs) postoperatively (only opioids), and case no. 5 received piroxicam (0.3 mg/kg PO q 24 hours) for 7 days and then an acetaminophen/codeine combination (20 mg/kg of acetaminophen PO q 24 hours) for 10 days.

**Postoperative Care and Feeding**

An Elizabethan collar was used until healing was complete. For case no. 1, oronasal suction was applied as needed to keep the nasal passages clear, using a pediatric suction
### Table
Clinical Data on Six Dogs and One Cat Undergoing a Radical Resection of the Nasal Planum and Rostral Maxilla

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Signalment</th>
<th>Tumor Type and Grade</th>
<th>Tumor Size (cm)</th>
<th>Tumor Location</th>
<th>Extent of Surgical Resection of Maxilla</th>
<th>Resection Margins</th>
<th>Adjunctive Therapy</th>
<th>Postoperative Problems</th>
<th>Follow-up §</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8-y-old, 4.3-kg, FS DSH</td>
<td>Low/high-grade</td>
<td>5.7 x 5.7</td>
<td>Right rostral maxilla, lip, and nasal planum</td>
<td>Bilaterally between PM1 and PM2; overlying soft tissue and infraorbital neurovascular bundle preserved on left</td>
<td>Clean</td>
<td>None</td>
<td>Anorexia postop; pharyngostomy tube for 6 d postop</td>
<td>No recurrence at 66 mo postop; normal behavior and eating</td>
</tr>
<tr>
<td>2</td>
<td>6-y-old, 18.5-kg, FS mixed-breed dog</td>
<td>Poorly differentiated mesenchymal neoplasm</td>
<td>7 x 5</td>
<td>Left rostral maxilla and lip</td>
<td>Bilaterally between PM1 and PM2; overlying soft tissue on right preserved to level of right canine</td>
<td>Clean</td>
<td>None</td>
<td>None</td>
<td>No recurrence at 30 mo postop; normal behavior and eating</td>
</tr>
<tr>
<td>3</td>
<td>14-y-old, 34-kg, FS Labrador retriever</td>
<td>Well-differentiated SCC</td>
<td>14 x 11</td>
<td>Right rostral maxilla</td>
<td>Bilaterally between PM2 and PM3; overlying soft tissues preserved to just lateral to nasal planum on left</td>
<td>Clean</td>
<td>None</td>
<td>Dehiscence 3 d postop, requiring debridement and resuturing</td>
<td>No recurrence at 12 mo postop; eats soft food normally but not dry food; euthanized at 12 mo due to osteoarthritis</td>
</tr>
<tr>
<td>4</td>
<td>9-y-old, 30-kg, FS Samoyed</td>
<td>Moderately differentiated SCC</td>
<td>7 x 7</td>
<td>Left rostral maxilla and nasal planum, around left canine, and crossing midline</td>
<td>Bilaterally between PM1 and PM2</td>
<td>Clean</td>
<td>None</td>
<td>Pain and irritation for 4 wks; stenosis of nasal orifice by 12 wks; reoperation to enlarge orifice; recurrent stenosis but no respiratory difficulties</td>
<td>No recurrence at 47 mo postop; normal behavior and eating</td>
</tr>
<tr>
<td>5</td>
<td>11-y-old, 27-kg, FS basset hound</td>
<td>Moderately differentiated SCC</td>
<td>7 x 6</td>
<td>Bilaterally associated with nasal planum and rostral maxilla</td>
<td>Bilaterally between PM2 and PM3</td>
<td>Clean</td>
<td>None</td>
<td>Pain for 3 wks; hand-fed for 3 wks; dehiscence of lip from rostral hard palate at 2 wks postop, requiring resuturing</td>
<td>No recurrence at 11 mo postop; normal behavior and eating; death at 11 mo postop due to metastatic synovial cell sarcoma</td>
</tr>
<tr>
<td>6</td>
<td>10-y-old, 43-kg, MN golden retriever</td>
<td>Low/high-grade</td>
<td>10 x 6</td>
<td>Rostral bilateral diffuse mass</td>
<td>Bilaterally between PM2 and PM3</td>
<td>Clean</td>
<td>None</td>
<td>Hand-fed for 3 wks; required resection of some of rostral lip as</td>
<td>No recurrence 13 mo postop; normal behavior and eating;</td>
</tr>
</tbody>
</table>

(continued on next page)
Table (cont'd)
Clinical Data on Six Dogs and One Cat Undergoing a Radical Resection of the Nasal Planum and Rostral Maxilla

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Signalment*</th>
<th>Tumor Type and Grade†</th>
<th>Tumor Size (cm)</th>
<th>Tumor Location</th>
<th>Extent of Surgical Resection of Maxilla‡</th>
<th>Resection Margins</th>
<th>Adjunctive Therapy</th>
<th>Postoperative Problems</th>
<th>Follow-up§</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 (cont'd)</td>
<td>6-y-old, 35-kg, M golden retriever</td>
<td>Low/high-grade FSA</td>
<td>6 x 7</td>
<td>Rostral, bilateral, involving incisive bone and soft tissues in nasal passages</td>
<td>Bilaterally between PM2 and PM3</td>
<td>Clean</td>
<td>None</td>
<td>Interfering with feeding</td>
<td>Euthanized at 17 mo postop due to metastatic HSA</td>
</tr>
<tr>
<td>7</td>
<td>6-y-old, 35-kg, M golden retriever</td>
<td>Low/high-grade FSA</td>
<td>6 x 7</td>
<td>Rostral, bilateral, involving incisive bone and soft tissues in nasal passages</td>
<td>Bilaterally between PM2 and PM3</td>
<td>Clean</td>
<td>None</td>
<td>None</td>
<td>Recurrence at 10 mo postop; normal behavior and eating up to that time; still alive at 14 mo</td>
</tr>
</tbody>
</table>

* FS=female spayed; DSH=domestic shorthair cat; MN=male neutered; M=male
† FSA=fibrosarcoma; Low/high-grade FSA=histologically low-grade, biologically high-grade fibrosarcoma; SCC=squamous cell carcinoma
‡ PM1=premolar 1; PM2=premolar 2; PM3=premolar 3
§ HSA=hemangiosarcoma
device. This cat did not eat readily, and feeding was supplemented with a food gruel administered through a pharyngostomy tube, in divided feedings for 7 days. Topical petrolatum-based antibiotic ointment was placed around the nasal orifice wounds of case nos. 2 and 3 to reduce wound crusting and debris. Additionally, case no. 3 received topical misting of physiological saline via a conventional spray bottle to humidify and cleanse the nasal turbinates. Case nos. 2-7 were able to eat soft food offered on a plate between 12 and 30 hours after surgery. They were discharged to their owners once eating on their own. For case nos. 4-7, the owners were advised to keep the new rostral orifice patent and clean using saline-soaked cotton balls for 1 month postoperatively. Preoperative antibiotics (i.e., cefazolin 20 mg/kg IV given preoperatively and every 90 minutes during surgery) were administered in all cases, but postoperative antibiotics (i.e., cefadroxil 20 mg/kg PO q 12 hours) were only administered in one case (case no. 3).

Thoracic radiography was performed every 3 months for the first year and then every 6 months thereafter. The site of surgical resection was inspected at each reexamination for visible signs of recurrence, and continuous monitoring of the surgery site was performed by the owners at home.

Outcomes and Complications

No intraoperative complications occurred. Blood loss was considered minimal in each case. Histopathological examination confirmed the preoperative diagnosis in all seven cases. In each instance, the surgical margins were judged to be free of neoplastic cells. Local recurrence was documented histopathologically in case no. 7 at 10 months following surgery. The dog received no further treatment and is still alive 4 months later. Local recurrence or metastatic disease has not been observed in any other case, with follow-up times of 11 to 66 months (mean, 29 months). Case no. 5 died from an unrelated synovial cell sarcoma 11 months after rostral maxillary surgery, and case no. 6 was euthanized for a metastatic hemangiosarcoma 13 months after rostral maxillary surgery. The case details are presented in the Table.

In the cat, a pharyngostomy tube was placed at the time of the maxilla resection, as postoperative anorexia was considered likely. Case nos. 5 and 6 appeared reluctant to eat following the first few feedings postoperatively. These cases were hand-fed for about 3 weeks, after which time they ate normally. Eating and drinking for all the dogs was messy postoperatively, with about two-thirds of the offered food being swallowed and the rest scattered around the bowl. The dogs seemed to have the most difficulty eating dry food. Case no. 6 was fed from a raised, flexible feeding bowl, which seemed to facilitate the feeding process, especially with dry food. Drinking was not a problem for any of these animals, although it was rather messy, with water splashed both onto the animal and the surrounding environment.

In each case, the surgical site oozed serosanguineous fluid and became crusty and contaminated with food material and saliva. This was managed differently in each case and was a persistent problem until healing was complete. Following healing, there was no soiling of the area with food material. Each case continues to have a mild, persistent, clear nasal discharge. This does not seem to bother the animals and has not resulted in dermatitis on the new rostral lip. Rhinitis, a concern because of the exposed turbinates, has not occurred in any case. Hair regrowth around the orifice has not caused any problems, and there has been no evidence of self-trauma of the new orifice from the tongue.

Two cases suffered dehiscence postoperatively, one (case no. 3) a few days after surgery and the other (case no. 5) 2 weeks after surgery. Both required debridement and resurfacing. In one dog (case no. 4), progressive stenosis of the new nasal orifice occurred, necessitating a second surgery 12 weeks later. Apparent complete stenosis subsequently occurred a second time, but no respiratory distress was noted, and no further surgery was performed. The dog appeared to breathe comfortably through its mouth.

Despite the dramatic postoperative change in appearance [Figures 8, 9, 10], the owners indicated that within a few weeks their pet’s behavior was otherwise normal, and that they do not often think about the appearance of their pet. For case no. 2, the children in the family had difficulty accepting the altered appearance of the dog, and in subsequent cases, the whole family was involved in any discussions held prior to surgery. In each case, the owners reported that the only constant reminder of the animal’s altered appearance is the curiosity of the uninitiated passerby or visitor.

Owners were specifically asked about their pet’s activities following surgery. They all reported that following surgery, their pets engaged in most of the activities (e.g., running, playing) they had enjoyed prior to surgery. However, their ability to retrieve certain items (e.g., balls, sticks) and pick up items (e.g., newspapers, bones) was diminished or abolished. No owners noted cold sensitivity in their pets.

Discussion

Head and neck neoplasms are common in dogs. For rostrally located tumors, the techniques for excising the palatine portion of the maxillary bones and premaxilla (i.e., incisive bone), with or without nasal planum, have been described. Kirpenstein, et al., suggested that combined resection of the nasal planum and maxilla could be performed rostral or caudal to the canine teeth. However, they only presented cases of combined resection of the nasal planum and premaxilla, and they also stated that a contraindication for the use of surgery is tumor extending caudal to the canine teeth. Although the surgery performed in the cases described in this report is generally similar to that described by Kirpenstein, et al., the resection extended much more caudally. The advantage of such a technique is that it has the potential to increase the number of animals in which “complete” resections can be performed. However, the disadvantage of such a surgery is the possibility of interfering with the animal’s ability to eat and drink. This report describes the most extensive rostral maxillectomy technique
to date, and, importantly, shows that dogs and probably cats (only one case was presented here, and further cases are needed to clearly define how cats function after such a surgery) can function well after such a surgery, without a compromise to their welfare.

Tumor-free margins after maxillectomy\textsuperscript{10} or nasal planectomy for nasal-plane SCC\textsuperscript{17} are associated with a more favorable prognosis. In all the cases reported here, tumor-free margins were obtained, and during the follow-up time of 11 to 66 months (median, 21.5 months), only one recurrence was documented. Schwarz, et al.,\textsuperscript{10} reported a 1-year survival rate of 68\% for dogs undergoing maxillectomy (rostral, middle, or caudal location) for malignant oral lesions with complete resections. Radical maxillectomy, as described in the present report, may allow extended survival in a population of dogs with extensive rostral maxillary tumors. Larger case numbers are needed to test this hypothesis.

Prior to this report, the standard of care for large, invasive, rostral maxillary tumors was cytoreductive surgery combined with radiation therapy, or radiation therapy alone. Radiation therapy for large nasal planum and rostral maxillary SCC has been relatively ineffective, with active tumor regrowth occurring within 3 to 6 months of treatment.\textsuperscript{17,19} Oral FSAs are also poorly responsive to radiation, with a mean survival of only 7 months after radiation (in 17 dogs).\textsuperscript{20} Radiation combined with regional hyperthermia improved the 1-year local control rate to 50\% in a series of 10 cases.\textsuperscript{21} Three dogs in this study presented with

\begin{figure}
\centering
\includegraphics[width=\textwidth]{image1.png}
\caption{Frontal (8A) and lateral (8B) immediate postoperative appearance of case no. 1. Note the transposed flap of skin from the left side (arrow) that has been used to reconstruct the rostral lip margin (8A).}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{image2.png}
\caption{Preoperative (9A) and immediate postoperative (9B) appearance of case no. 3. Note the transposed flap of skin (arrow) from the left that was used to reconstruct the rostral lip margin (9B).}
\end{figure}
histopathologically low-grade, but biologically high-grade FSA. Ciekot, et al., first reported on the “histologically low-grade, but biologically high-grade” FSA of the mandible and maxilla in the dog. In the study by Ciekot, et al., it appeared that the ability to gain tumor-free margins using surgery (i.e., complete mandibulectomy) resulted in prolonged tumor-free survival. Radical maxillectomy was performed in the study reported here, because the owners declined radiation therapy. The owners were aware of the uncertain outcome following such aggressive rostral maxillary resection, but they also understood the possibility of long-term remission if tumor-free margins were obtained. However, philosophically, it was difficult to recommend therapy for which the outcome was unknown. Everyone involved agreed that the animals would not be allowed to suffer if the surgery resulted in unacceptable complications or compromised their welfare.

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The principal concerns surrounding the radical maxillectomy as described in this report are the effect on eating, the level of postoperative discomfort, and the cosmetic appearance. Eating was not problematic in dogs; all dogs ate within 36 hours postoperatively. However, there appeared to be a period of adjustment in learning to prehend food effectively. Transient inappetence may have been associated with pain, which emphasizes the need for effective analgesia. Olfaction is important in cats, and some period of anorexia should be expected following radical maxillectomy. Insertion of a feeding tube should be considered prior to or at the time of radical maxillectomy in cats.

The perioperative analgesic regimen was different in all cases; however, to minimize the postoperative discomfort, the authors recommend preemptive analgesia and intraoperative analgesia using a multimodal approach. Analgesia may also be needed for at least 3 weeks postoperatively while the tissues heal and the inflammation of the exposed turbinates resolves. Not all cases in this study received such analgesia, however. No studies have examined the most effective analgesic regimen to administer to animals during the weeks following such a surgery. However, the authors believe that a combination of an oral NSAID or acetaminophen (in dogs only) with either a fentanyl patch or oral opioids will provide effective analgesia. Nonsteroidal anti-inflammatory drugs probably provide sufficient anti-inflammatory action and better analgesia than corticosteroids when treating these cases. The authors believe that the key to keeping these animals comfortable is to use a multimodal approach (i.e., use different classes of analgesics), to

Figures 10A, 10B—The 2-week (10A) and 14-week (10B) postoperative appearance of case no. 6. Note the significant amount of discharge and soiling at the new rostral nasal opening and the excessive length of the new rostral lip (10A). A second reconstructive surgery to decrease the length of this tissue resolved problems with transfer of food into the mouth (10B).
continually reevaluate them for pain, and to rely on owner assessments of the level of discomfort.

Prior to surgery, the owners of these cases were counseled on the cosmetic appearance following radical maxillectomy. Cadaver specimens, photographs of cadaver specimens or previous cases, and communication with the owners of animals previously treated with radical maxillectomy were used to thoroughly prepare owners and their family prior to surgery. Without exception, all the owners were pleased they had consented to the surgery, were accepting of the postoperative appearance, and reported the behavior of their animal was the same as before surgery. All owners found it necessary to spend a significant amount of time explaining the appearance of their dog to uninitiated guests and passersby. The owners reported that altered interactions of humans with their pets seemed to “upset” their pets. It is also important to note that the retrieving ability of dogs is likely to be diminished following such surgery.

Postoperative complications were minimal. Stenosis of the nasal opening in case no. 4 was most likely caused by excessive inflammation, inappropriate cleaning, and the use of a purse string to create a nasal orifice. The authors’ preferred technique for creating a new nasal orifice is to employ the method used in case nos. 3, 6, or 7, where the skin is sutured directly to the maxillary bone using simple interrupted sutures or figure-of-eight rolling sutures passed through holes drilled in the maxillary bone. Anchoring the nasal skin to maxillary bone should minimize the risk of stenosis. Dehiscence occurred in two cases, necessitating further surgery. Dehiscence following maxillary resection surgery is a well-recognized problem. Multilayer closures, using relatively long-lasting monofilament suture material (i.e., polyglyconate), and anchoring soft tissues to bone were techniques used to minimize the risk of dehiscence. Dehiscence probably occurred from a number of factors, including soiling of the suture line with food and saliva, and tension on or trauma to the suture line as a result of attempts to eat. The rostral nasal passages were soiled with saliva, nasal discharge, and food particles in all cases. Gentle cleaning of the nasal opening is required for up to 6 weeks postoperatively, starting at four times per day and gradually decreasing in frequency.

Conclusion

Radical maxillectomy as described in this report is indicated for locally invasive, rostral maxillary neoplasms with low rates of distant metastasis. Radical maxillectomy offers the opportunity for prolonged tumor-free remission times for certain neoplasms that involve the rostral maxilla, if tumor-free margins can be obtained. Radical maxillectomy to the level of PM2 or PM3 is well tolerated by dogs and cats and is acceptable to owners.

References


a Hemoclips; US Surgical Corporation, Norwalk, CT
b Maxon; Sherwood, Davis and Geck, St. Louis, MO
c Yellow ink; Shandon Tissue Dyes, Pittsburgh, PA
d Dermalon; Sherwood, Davis and Geck, St. Louis, MO
e Infant Tri-Flo Suction Catheter; Baxter, Deerfield, IL