Surgical Management of Neoplasms of the Oral Cavity in Dogs and Cats[a]

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KEY WORDS
- oral neoplasia
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INCIDENCE AND BIOLOGIC BEHAVIOR OF ORAL TUMORS

Malignant tumors of the oral cavity are the fourth most common of all cancer types in the dog and cat, representing 5.4% of all malignant neoplasms.[1] The annual incidence rate in dogs and cats in one study was 20.4 and 45.43 cases per 100,000, respectively.[2] Cocker spaniels, poodles, German shepherds, German shorthaired pointers, weimaraners, golden retrievers, and boxers may be at greater risk of developing oral tumors.[2–4] The most common site for oral tumors is the gingiva, although the buccal or labial mucosa, hard or soft palate, and tongue are also affected.

Canine Oral Neoplasia

Nonodontogenic tumors arise from structures of the oral cavity excluding the dental tissues. They are usually malignant, and melanomas, squamous cell carcinomas, and fibrosarcomas are the most common types. Benign tumors have been reported and include papilloma, fibroma, chondroma, osteoma, and hemangioma. Odontogenic tumors arise from epithelial or mesenchymal dental structures. These tumors are uncommon; epulides, odontomas, and ameloblastomas are the ones most frequently seen.

Malignant melanomas are the most common oral tumor in dogs, representing approximately one-third of the oral neoplasms.[2–5] The tumor is usually a solid mass that may be pigmented, partially pigmented, or nonpigmented. The gingival area is the most common location (42% to 63%), followed by the buccal or labial mucosa (15% to 33%), hard or soft palate (10% to 16%), and tongue (1.5% to 3.3%).[2–5] Older dogs are at risk (average age is 10.4 years), although amelanotic tumors tend to occur in young dogs.[5] Males are affected 1.6 to 6 times more frequently than females.[3,4,6,7] Malignant melanomas are usually rapidly growing tumors that are locally invasive. Bone invasion has been seen radiographically in 57% of the gingival melanomas.[4] Metastasis to the regional lymph nodes has been reported to occur in 59% to 74% of cases.[4,5] Pulmonary metastases occurred in 65% of dogs necropsied in one study.[5] Approximately 90% of dogs treated for this neoplasm die or are euthanatized due to recurrence of disease.[8]

Squamous cell carcinoma (SCC) is the second most frequent oral neoplasm in the dog, accounting for approximately 20% of oral tumors.[2–6] Nontonsillar SCC may occur in the gingival area (35% to 42%), labial mucosa (4.9% to 7.3%), hard or soft palate (1.9% to 3.1%), tongue (1.2% to 4.3%), or pharynx (1.2% to 1.9%).[2–5] Grossly, these tumors appear reddened, friable, and vascular and may be ulcerated. Most SCCs are locally invasive, and 77% of cases in two reports showed bone involvement radiographically.[4,9] Distant metastasis is uncommon with nontonsillar SCC; less than 10% of dogs with SCC have evidence of regional lymph node involvement.[10] Although this tumor is slow to metastasize, the more extensive the tumor burden, the poorer the prognosis.[9]

The third most common canine oral tumor is fibrosarcoma, accounting for approximately 17% of oral tumors.[2–6] This tumor is usually located in the gingival region (56% to 87%), but may also occur in the palate (7% to 17%), labial or buccal mucosa (4% to 22%), and tongue (1.3% to 3.2%).[3–5] Fibrosarcomas are usually firm, fleshy, pink masses that widely infiltrate the adjacent tissues. Although there is no breed predilection, large dogs (≥23 kg) have a higher incidence of this tumor.[2] These tumors are locally invasive, and, in one report, 68% of cases showed bone involvement radiographically.[4] Metastases to regional lymph nodes and distant sites have been reported in 35% of dogs necropsied in one study; however, another study reported only 5% with metastases.[4,5] Because of the rapid, infiltrative nature of this tumor, local recurrence is common and the prognosis is poor.

Epulides are frequently found in dogs.[10] These benign tumors arise from the periodontal ligament and are histologically characterized into three groups:

- Fibromatous or fibrous epulis, which consists primarily of stroma of the periodontal ligament
- Ossifying epulis, which has an osteoid matrix with-

[a]All figures drawn by Ron McLean.

in the stroma
- Acanthomatous or squamous epulis, which is characterized by epithelial cells arranged in sheets or cords within the stroma

Grossly, these tumors appear as firm, solid masses that arise from the gingiva. The acanthomatous epulis readily invades bone and may recur locally.[11] Although these tumors are radiosensitive, malignant transformation into squamous cell carcinoma, fibrosarcoma, and osteosarcoma has been reported following radiotherapy.[12] Postsurgical recurrence of tumor has been reported in 8% of 25 dogs in one study, and malignant transformation to osteosarcoma occurred in one dog.[7]

Feline Oral Neoplasia

Most oral tumors in cats are malignant, and older cats are at greatest risk.[13,14] Squamous cell carcinomas are the most common tumor, representing 75% of feline oral malignant tumors.[13] These tumors commonly are located in the gingiva, palate, lips, pharynx, and tongue and may appear as firm, ulcerated masses that cause facial deformity. Although they are extremely locally invasive, squamous cell carcinomas rarely metastasize to regional lymph nodes or distant sites.[15] The second most common oral tumor is fibrosarcoma, accounting for 16% of malignant neoplasms.[13] This tumor usually occurs on the gingiva or palate. Metastasis is uncommon; however, local invasion of surrounding tissue is present.[15] Other malignant tumors are uncommon and include undifferentiated sarcomas, lymphomas, hemangiosarcomas, melanomas, and adamantinomas. Benign tumors such as fibromas, papillomas, hemangiomas, epulides, sebaceous adenomas, and basal cell tumors are reported infrequently.[13,15]

DIAGNOSIS

As with any disease, the diagnosis begins with a thorough history and physical examination. Common complaints associated with oral tumors in dogs and cats are difficulty or reluctance to eat because of oral discomfort, excessive drooling that may be blood tinged, strong odor from the mouth, lethargy, and weight loss. Frequently, there is a history of dental problems, such as loose or "infected" teeth, which may have resulted from tumor invasion of the alveolus.

Physical examination may reveal an oral mass that is palpable from the outside of the oral cavity, especially if there is bone involvement. Pain may be elicited on palpation or opening and closing of the mouth. Because of the discomfort associated with oral tumors, sedation or general anesthesia may be required to fully assess the extent of tumor growth. The entire mouth and pharynx should be carefully examined. Gloves should be worn during oral examination because necrotic or infected tissue is frequently found in these tumors. In addition to the buccal and oral mucosa and all teeth, the lips, tonsils, tongue, and frenulum should be examined. All bony structures should be palpated. This complete oral examination is very important for the surgeon to begin making his or her plan for resection and subsequent reconstruction and to properly educate the client about the surgery and potential complications. A complete general physical examination is also important to rule out other serious illnesses that may complicate treatment of the primary problem. Thoracic radiographs should always be obtained to check for distant metastases.

Preoperative biopsy of the oral mass is recommended as the best way to plan appropriate therapy. A true-cut needle, biopsy punch, or scalpel blade can be used to obtain tissue. Direct pressure with gauze is usually used to control bleeding. Fine-needle aspirate of any enlarged lymph nodes can also be done at this time.

Radiographs of the involved area of the oral cavity should also be obtained (with the patient under anesthesia). These films allow the clinician to determine the degree of bone involvement and help in the determination of how much bone to remove along with the tumor. Client education prior to doing the surgery is extremely important. The surgical procedure, complications, and especially your expectations of the surgical treatment should be thoroughly discussed with the owner. Showing the owner pictures of other animals that have undergone a similar procedure may be very helpful.

PREOPERATIVE CARE

Because bacteria are present in the mouth and aseptic preparation is not possible, oral surgery is considered contaminated and prophylactic antibiotics are therefore used. We prefer cefazolin (20 mg/kg) given intravenously just before surgery begins and then continued (tid) for 24 hours postoperatively. Metronidazole[a] is used if anaerobic contamination is suspected (e.g., severe tissue necrosis and malodorous discharge from the mouth). It is imperative that the antibiotic be present in the bloodstream at the time of surgery.

SURGICAL PROCEDURES

Mandibulectomy (Figures 1 through 7)

Several major muscle groups attach to the mandible both on the lateral and medial surface of the body and vertical ramus. The masseter muscle attaches to the caudolateral portion of the mandible (vertical ramus),

[a]Flagyl—G.D. Searle & Co.

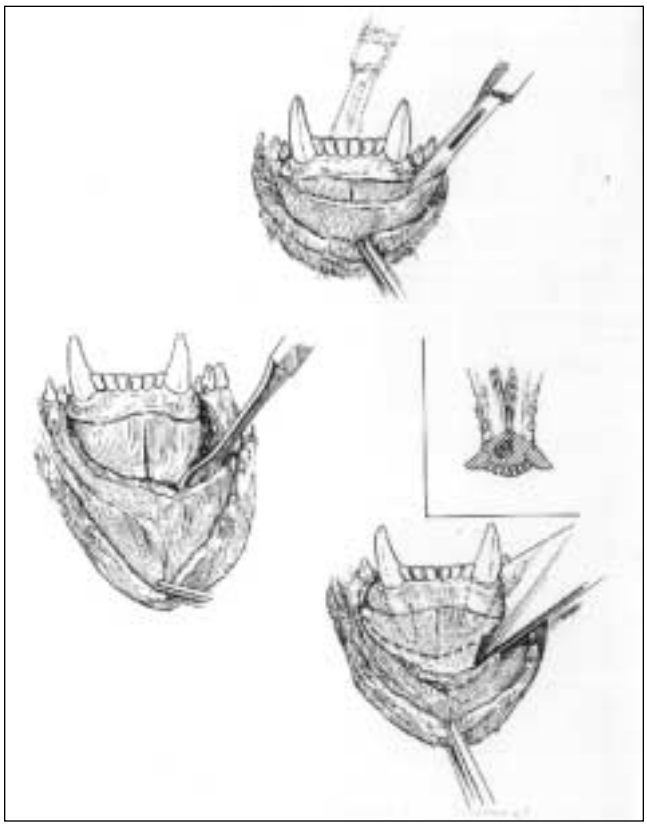

Figure 1. Surgical technique for rostral mandibulectomy. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

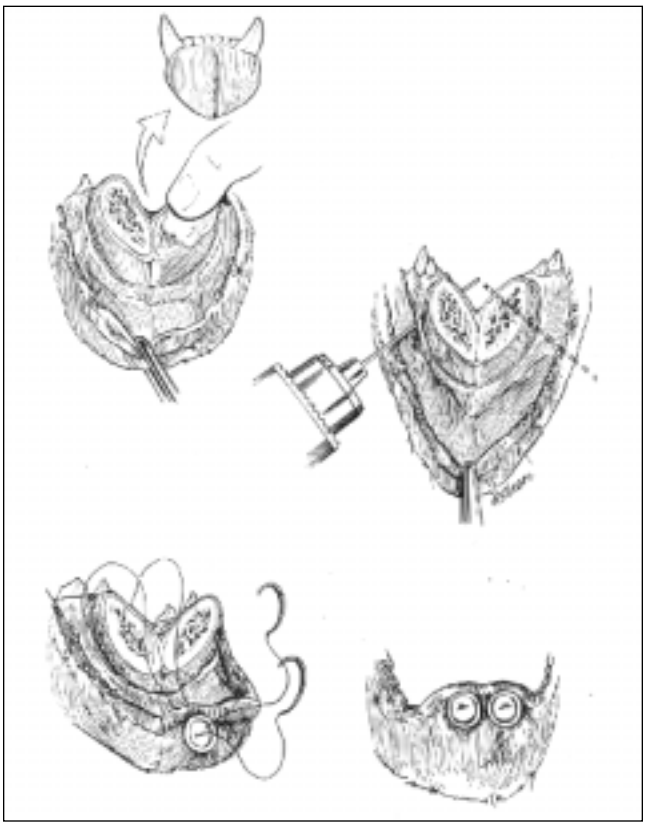

Figure 2. After removal of the bone, bone wax is used for hemostasis of the cut surface of mandible and button stents are used to facilitate reconstruction of the lower lip. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

and the digastric muscle attaches to the caudoventral aspect of the body of the mandible.[16] The geniohyoid and mylohyoid muscles attach to the medial aspect of the body of the mandible, and the pterygoid muscles attach to the medial aspect of the vertical ramus. The temporal muscle attaches to the medial aspect of the coronoid process.

The major blood supply to the mandible is via the mandibular alveolar artery, a branch of the maxillary artery.[16] This artery branches off the maxillary artery just medial to the temporomandibular joint and enters the medial aspect of the mandible through the mandibular foramen. The artery then exits the mandible rostrally (as the mental arteries) through the various mental foramina. Other important structures located medial to the body of the mandible are the lingual nerve and sublingual salivary duct, located at the base of the tongue just lateral to the frenulum.

The dog is placed in lateral recumbency with an oral speculum in place to keep the mouth open slightly. A wide area of skin over the mandible, maxilla, and lateral neck is prepared for aseptic surgery. Although it is impossible to aseptically prepare the inside of the mouth, the oral cavity is flushed with chlorhexidine and the teeth are cleaned if severely covered with calculus. Loose teeth are also removed.

Regardless of the portions of mandible to be removed, the sequence of surgical steps is similar. The lips and associated mucosa and other soft tissues are reflected off the mandible by incising the buccal mucosa. A standard scalpel or electroscalpel can be used. The lateral and ventral muscle attachments (e.g., digastric muscle, masseter muscle) are then incised. Depending on which portion of mandible is to be removed, either the bone is cut with an oscillating saw or osteotome or the mandibular symphysis is split with an osteotome. The end of the mandible can then be grabbed with a bone-holding forceps (e.g., Kern forceps). The bone is retracted laterally to allow dissection of the medial oral mucosa and medial muscle attachments to the bone. The caudal mandible is then either disarticulated or cut depending on the extent of tumor involvement. Bleeding from the cut surface of the bone is controlled with bone wax. If the tumor is located at the cranial or mid-body of the mandible, a cut in the body is made 3 cm caudal to the tumor and

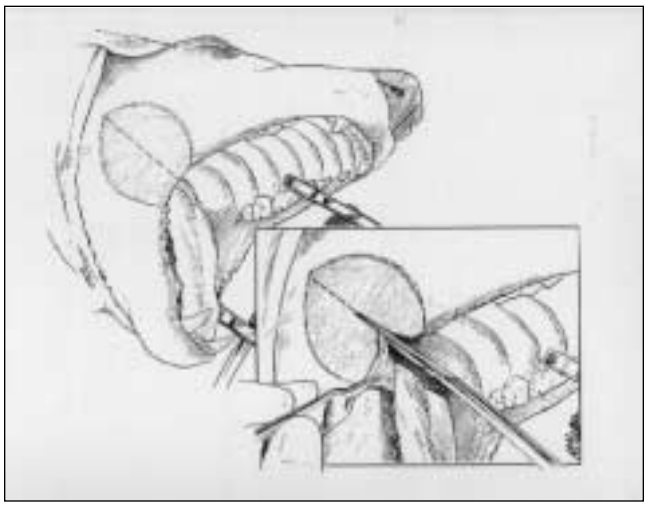

Figure 3. Hemimandibulectomy is begun by incising through the commissure. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.).

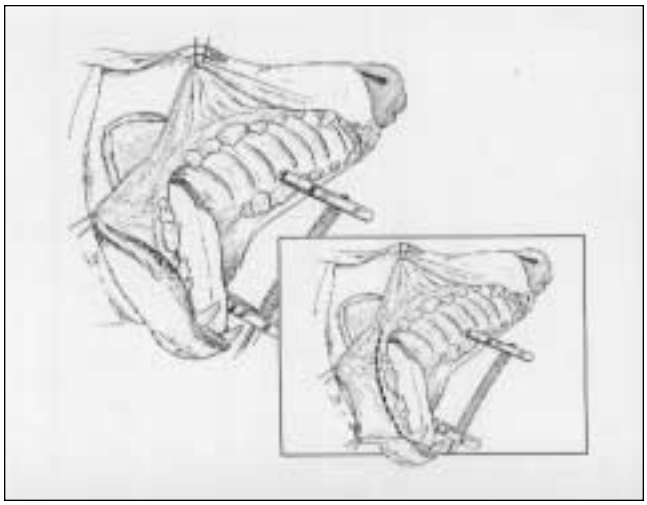

Figure 4. Retraction of the oral mucosa exposes the mandible. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

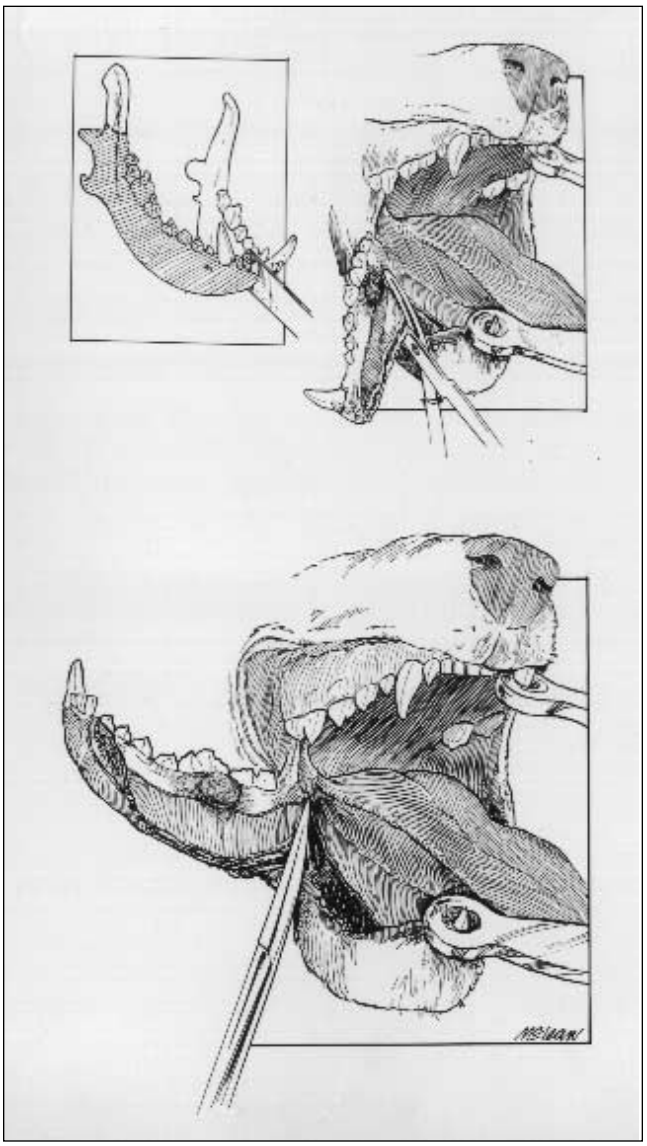

Figure 5. The mandibular symphysis is split with an osteotome and the mandible dissection is continued. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

the remainder of the mandible is left intact. Exceptions to leaving part of the mandible intact would be with melanoma or fibrosarcoma. Aggressive resection of these tumors requires removal of liberal amounts of bone and soft tissue regardless of location. Disarticulation of the temporomandibular joint is facilitated by lateral retraction of the body of the mandible.[17] Great care is taken to identify and ligate the mandibular alveolar artery. The joint is opened and the mandible disarticulated. Unless the tumor involves the coronoid process, we usually cut this process at its base with the oscillating saw and leave it intact. This greatly simplifies final removal of the mandible since dissection of the large muscle groups from this process is tedious and time consuming. Remaining soft tissue attachments to the mandible are incised and the mandible is removed.

The remaining defect is copiously lavaged with warm saline. Blood clots are removed. Dead space is obliterated wherever possible by suturing the available tissues, especially in the caudal aspect of the defect using the masseter muscle. Penrose drains should be placed in areas where dead space remains. The oral mucosa is closed with absorbable suture in a simple continuous pattern. The buccal mucosa is reconstructed by first debriding a strip of skin and buccal mucosa off the upper and lower lip to create a new commissure at the level of the first premolar tooth.[17] This is necessary to prevent the tongue from hanging out of

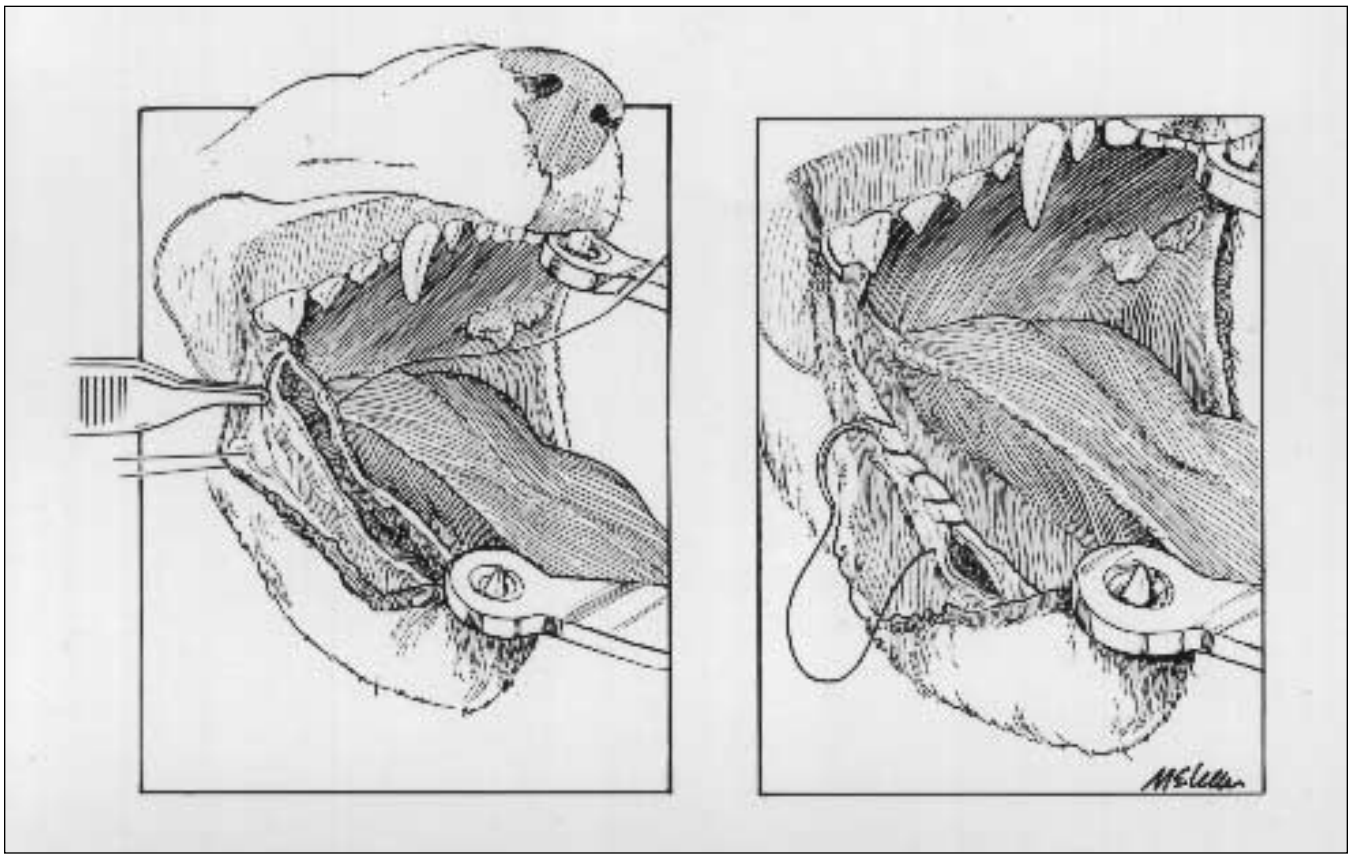

Figure 6. Closure of the oral mucosa after removal of the mandible. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

the mouth. The buccal mucosa and subcutaneous tissues are closed using absorbable suture, and the skin is closed with nonabsorbable suture. Stents or buttons are placed at the commissure to prevent dehiscence of this area.

This technique of hemimandibulectomy can be modified in many ways. Rostral mandibulectomy can be performed for tumors of the most rostral aspect of the mandibles.[18] In this procedure the dog is put in dorsal recumbency. After the soft tissues are reflected off the bone, cuts are made in both mandibles 2 to 3 cm caudal to the tumor. Bleeding is controlled, and the soft tissues are reconstructed. The oral mucosa is sutured to the buccal mucosa with simple interrupted absorbable sutures. In addition, tension-relieving sutures are placed through the rostral portion of the lip and through holes drilled in each mandible. Buttons can be placed under the sutures at the rostral aspect of the skin to prevent pressure necrosis. Although recommended by some authors, I do not attempt to stabilize the two mandibles with screws or pins. In our experience fewer complications have been seen by *not* stabilizing the mandibles than by implanting some type of fixation device.

In treating large rostral mandibular tumors, the question frequently arises as to how much of both mandibles can be removed without compromising function. We have resected up to and including the third premolar bilaterally (in both dogs and cats) with retention of function. Also, we have performed a hemimandibulectomy on one side in addition to a partial mandibulectomy (up to but not including the third premolar) on the opposite side on both dogs and cats without causing permanent functional problems.

Other modifications of the hemimandibulectomy are the segmental mandibulectomy (removal of the mid-portion of the body of the mandible) and caudal mandibulectomy (removal of the caudal half of the mandible, leaving the symphysis intact). These more conservative types of resections are used to remove benign tumors or malignancies that are not considered aggressive and that are relatively small.

Maxillectomy (Figures 8 through 10)

The major anatomic structures of importance during maxillary resection are the maxillary artery and its branches, infraorbital nerve, maxillary sinus, nasal bone and turbinates, and the incisive bone.[16] The in-

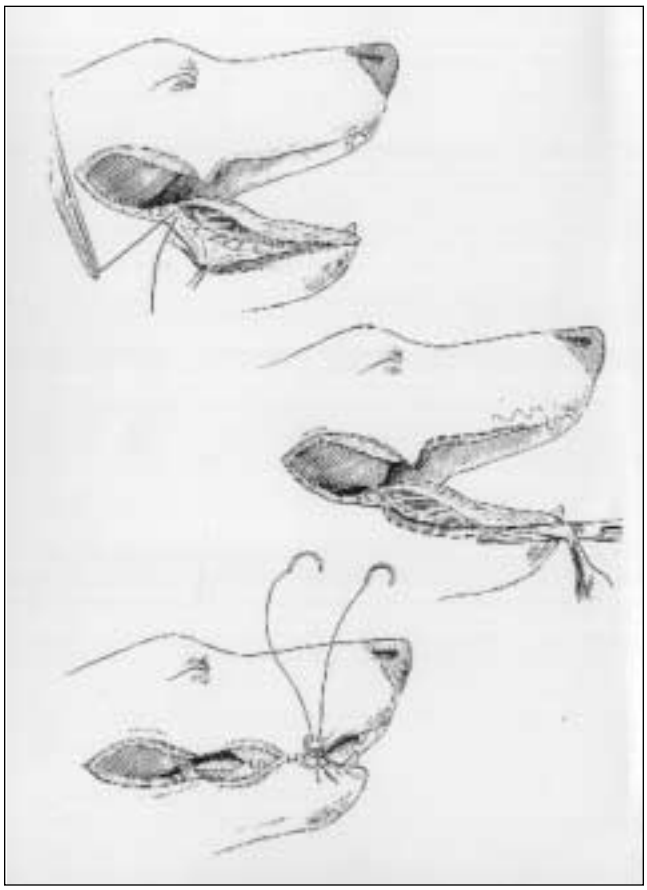

Figure 7. Closure of the lip after hemimandibulectomy. The commissure is advanced rostrally to prevent excessive drooling and drooping of the tongue. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4): 1117–1139, 1990. Used with permission.)

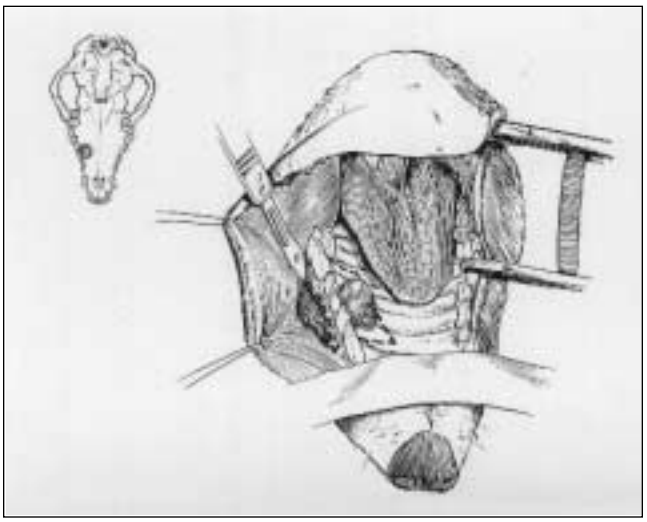

Figure 8. Initial incisions of the oral mucosa for partial hemimaxillectomy. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

fraorbital artery and nerve pass through the infraorbital foramen at the midpoint of the maxilla. These structures are usually encountered and may have to be sacrificed during resection. The major palatine artery is located just under the mucosa of the hard palate and can usually be reflected medially during maxillectomy.

The preparation of the surgical field is similar to that with mandibulectomy except that the skin of the upper lip and nose is clipped and prepared for aseptic surgery. In addition to an oral speculum to keep the mouth open, stay sutures are placed in the upper lip adjacent to the tumor and used to retract the lip laterally. The same principles of dissection used in mandibulectomy are used in maxillectomy. The soft tissues are first dissected off the bone. The buccal mucosa of the upper lip is incised, staying 2 to 3 cm away from the mass. Additional stay sutures can then be placed in the mucosa to help expose the bone of the maxilla. The mucosa of the hard palate is then incised and reflected medially. Care is taken to avoid cutting the major palatine artery. When the bone of the maxilla and hard palate has been sufficiently exposed, cuts are made using either an oscillating saw or osteotome. Cranial-to-caudal cuts are made in the bone lateral and medial to the tumor, and lateral-to-medial cuts are made between the teeth cranial and caudal to the tumor, forming a square or rectangle. The tumor and associated bone and soft tissue are then removed en bloc. Nasal turbinates that appear invaded by tumor should also be removed. Considerable hemorrhage usually occurs during turbinate debridement and is treated by direct pressure with gauze followed by implantation of Gelfoam if necessary.

Reconstruction of the maxillary defect is done by suturing the buccal mucosa to the mucosa of the hard palate.[19] Simple apposition of the buccal mucosa to the hard palate mucosa (horizontal mattress pattern, nonabsorbable suture such as monofilament nylon) is usually satisfactory. When considerable tension exists in the closure, construction of a pedicled mucosal flap may be necessary. The flap is created by undermining the mucosa from the incision toward the lip margin.[19] To preserve blood supply to this flap, the tissue must be handled gently and the plane of dissection should not be too superficial. The stay sutures can be used to retract the flap as it is being created, avoiding unnecessary trauma to the edge of the flap with tissue forceps. The less buccal mucosa available for closure, the greater the indentation of the lip as viewed from the external surface, thus resulting in a less cosmetic appearance. However, with time this cosmetic defect improves in appearance.

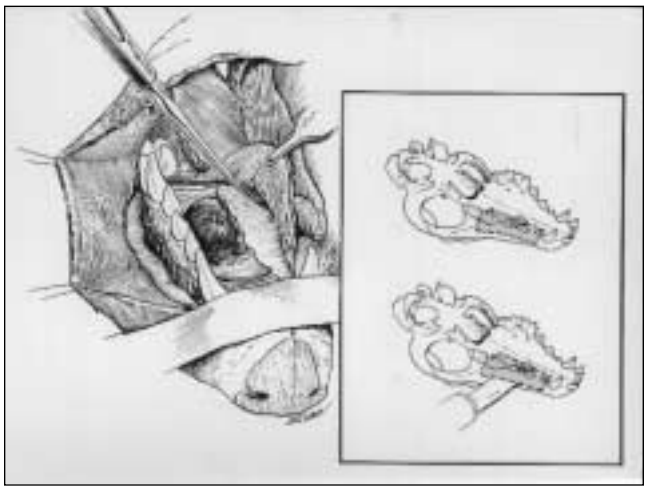

Figure 9. Mucosa is elevated prior to making cuts in the bone. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

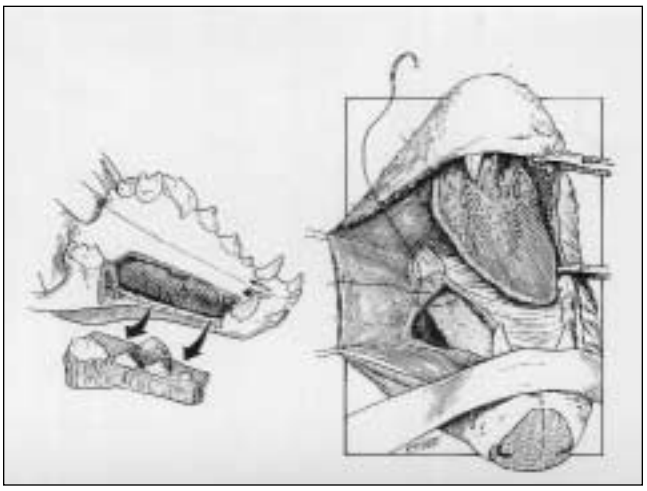

Figure 10. The maxilla is removed and the soft tissues are closed. (From: Birchard S, Carothers M: Aggressive surgery in the management of oral neoplasia. *Vet Clin North Am Small Anim Pract* 20(4):1117–1139, 1990. Used with permission.)

Resection of the premaxilla has also been reported.[20] After soft tissue dissection, the entire premaxilla is removed from incisors to caudal to the canines or first premolars. A double flap of buccal mucosa is used to close the defect.

POSTOPERATIVE CARE AND COMPLICATIONS

The two most important goals of postoperative care after major mandibular or maxillary resection are maintenance of good oral hygiene and nutritional support. Oral care involves frequent flushing of the mouth with warm water, especially after eating. Small meatballs made from canned dog food are hand-fed to minimize need for chewing and impacting food in the incision. Warm compresses (two to three times per day) are used to treat swelling. The incision is checked once a day for evidence of wound complications.

Several complications of oral tumor resection may occur but usually are not serious and resolve with treatment. The animal may drool excessively for several days postoperatively, and the saliva may be blood tinged. This problem usually corrects itself as tissue swelling resolves. Ranula formation is common after extensive mandibulectomy, especially if the tumor involved the sublingual salivary duct. This complication also resolves in most cases with only a "tincture of time."

Dehiscence of the incision is a more serious problem, although conservative therapy is usually effective. Allowing the wound to heal by second intention is satisfactory provided that good wound care and oral hygiene are maintained as previously discussed. Occasionally after maxillectomy a bottom molar will cause a mucosal ulceration in the maxillary mucosal flap, necessitating removal of the tooth. Drifting of the remaining mandible after mandibulectomy may also result in an ulcer of the hard palate caused by rubbing by the canine tooth. This problem, however, usually resolves without canine tooth extraction.

PROGNOSIS

The postoperative prognosis for animals with oral neoplasia depends on tumor type and extent of disease at the time of surgery. Predictably, survival rates are highest with benign tumors. For example, median survival after aggressive treatment of epulides in dogs was 29.5 months in one study and 49 months in another.[7,21] Excellent results have also been obtained with mandibulectomy for other benign masses such as osteoma or aneurysmal bone cysts.

Aggressive surgical treatment of malignant oral tumors has had variable results. In one study, Salisbury and Lantz compared results of their own case material of 30 dogs after mandibulectomy with results of several other investigators and found the following mean survival times[21]:

- Fibrosarcoma—7 months
- Malignant melanoma—7.3 months
- Squamous cell carcinoma—15.8 months

Fibrosarcomas frequently recur even with aggressive resection, and melanomas frequently metastasize. A more recent study of mandibular tumors in dogs found very similar results.[22] Median survival in five cats with squamous cell carcinoma was 6 months in one study.[23] Local recurrence of tumor is common with squamous cell carcinomas in cats.

REFERENCES

1. Dorn CR, Taylor DON, Freye FL: Survey of animal neoplasms in Alameda and Contra Costa counties, Calif. I. Methodology and description of cases. II. Cancer morbidity. *J Natl Cancer Inst* 40:295–318, 1968.
2. Dorn CR, Priester WA: Epidemiologic analysis of oral and pharyngeal cancer in dogs, cats, horses, and cattle. *JAVMA* 169:1202–1206, 1976.
3. Cohen D, Brodey RS, Chen SM: Epidemiologic aspects of oral and pharyngeal neoplasms in the dog. *Am J Vet Res* 25:1776–1779, 1964.
4. Todoroff RJ, Brody RS: Oral and pharyngeal neoplasia in the dog: Retrospective survey of 361 cases. *JAVMA* 175(6):567–571, 1979.
5. Brodey RS: A clinical and pathologic study of 130 neoplasms of the mouth and pharynx in the dog. *Am J Vet Res* 21:787–812, 1960.
6. Gorlin RJ, Barron CN, Chaudhry AP, et al: The oral and pharyngeal pathology of domestic animals. A study of 487 cases. *Am J Vet Res* 79(20):1032–1061, 1959.
7. Bjorling DE, Chambers JN, Mahaffey EA: Surgical treatment of epulides in dogs: 25 cases (1974–1984). *JAVMA* 190:1315–1318, 1987.
8. Bostock DE: The biologic behavior of MCT and melanomas in the dog. *Vet Ann* 20:124–128, 1980.
9. Evans SM, Shofer F: Canine oral nontonsillar squamous cell carcinoma. Prognostic factors for recurrence and survival following orthovoltage radiation therapy. *Vet Radiol* 29(3):133–137, 1988.
10. Brodey RS: The biological behavior of canine oral and pharyngeal neoplasms. *J Am Anim Pract* 11:45–53, 1970.
11. Dubielzig RR, Goldschmidt MH, Brodey RS: The nomenclature of periodontal epulides in dogs. *Vet Pathol* 16:209–214, 1979.
12. Thrall DE: Orthovoltage radiotherapy of acanthomatous epulides in 39 dogs. *JAVMA* 184:826–829, 1984.
13. Cotter SM: Oral pharyngeal neoplasms in the cat. *JAVMA* 17:917–920, 1981.
14. Moulton JE: Tumors of the alimentary tract, in Moulton JE (ed): *Tumors in Domestic Animals*. Berkeley, University of California Press, 1978, p 240.
15. Couto GC: Oncology, in Sherding RG (ed): *The Cat, Diseases and Clinical Management*. New York, Churchill Livingstone, 1989, pp 632–633.
16. Evans HE, Christensen GL: *Miller's Anatomy of the Dog*, ed 2. Philadelphia, WB Saunders, 1979, pp 289–296, 665–666.
17. Withrow SJ, Holmberg DL: Mandibulectomy in the treatment of oral cancer. *JAAHA* 19:273–286, 1983.
18. Penwick RC, Nunamaker DM: Rostral mandibulectomy: A treatment for oral neoplasia in the dog and cat. *JAAHA* 23:19–25, 1987.
19. Salisbury SK, Richardson DC, Lantz GC: Partial maxillectomy and premaxillectomy in the treatment of oral neoplasia in the dog and cat. *Vet Surg* 15:16–26, 1986.
20. Withrow SJ, Nelson AWN, Manley PA, et al: Premaxillectomy in the dog. *JAAHA* 21:49–55, 1985.
21. Salisbury SK, Lantz GC: Long-term results of partial mandibulectomy for treatment of oral tumors in 30 dogs. *JAAHA* 24:285–294, 1988.
22. Kosovsky JK, Matthiesen DT, Marretta SM, et al: Results of partial mandibulectomy for the treatment of oral tumors in 142 dogs. *Vet Surg* 20:397–401, 1991.
23. Bradley RL, MacEwen EG, Loar AS: Mandibular resection for removal of oral tumors in 30 dogs and 6 cats. *JAVMA* 184:460–463, 1984.