A 9-month-old sexually intact male Quarter Horse (horse 1) was admitted for evaluation of chronic enlargement of the right mandible. Six months prior to admission, the owner had observed a firm bonelike mass associated with the mandible. According to the owner, the mass had no effect on mastication and the horse was in good body condition (285.5 kg [628 lb]). The referring veterinarian had been contacted to examine the horse. Skull radiographs were performed, and a diagnosis of mandibular fracture was made. The owner was instructed to monitor the mandible for further enlargement and problems with mastication. However, the mass did not change in size, and the owner requested referral to the Purdue University Veterinary Teaching Hospital.

Abnormal physical examination findings at admission included a 10 x 10 x 10-cm firm, nonpainful swelling on the mid portion of the horizontal ramus of the right mandible. The swelling extended axially along the ventral aspect of the mandible. There was no soft tissue swelling surrounding the mass. An oral examination was performed, and a diagnosis of mandibular fracture was made. The owner was instructed to monitor the mandible for further enlargement and problems with mastication. However, the mass did not change in size, and the owner requested referral to the Purdue University Veterinary Teaching Hospital.

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Standing dorsoventral, lateral, and oblique radiographic views of the skull were taken. Abnormal radiographic findings included a well-marginated osseous-like mass involving the right mandible (Figure 1). The mass encircled the alveolus of 2 teeth (408 and 409), both deciduous (408) and permanent teeth (408 and 409) underneath were involved with the mass. There was no evidence of mandibular fracture, tooth root lysis indicative of infection, or lysis of the mandible. On the basis of the physical examination and radiographic findings, differential diagnoses for the mass included a primary bone tumor such as osteoma or ossifying fibroma or a primary dental tumor such as complex or compound odontoma, ameloblastoma, or ameloblastic odontoma. Complete surgical removal was recommended. The horse was anesthetized and positioned in dorsal recumbency. A 15-cm incision was made over the mass through the skin and subcutaneous tissues. The mass was extensive and extended into the medial cortex of the mandible. Adjacent to the deciduous and permanent 408 and 409 teeth, a collection of toothlike structures (denticles) was identified. All these structures were surgically removed but resulted in an iatrogenic fracture of the lateral cortex of the mandible. Because of the radical dissection required to remove the entire mass, the lateral aspect of the tongue within the oral cavity was exposed. The final mandibular defect measured 10 x 5 x 5 cm. The fractured mandible was stabilized with a type I external fixator. The surgical defect could not be closed and was packed with rolled gauze. The skin was loosely apposed over the gauze packing, and the horse recovered from general anesthesia.

Histologically, the mass consisted of multiple toothlike structures and foci of normal bone. The denticles were characterized by a core of primitive mesenchyme resembling dental pulp, surrounded by a disorganized layer of odontogenic epithelium and a distinct zone of brightly eosinophilic dentin. On the outer border of the dentin was a disorganized and discontinuous layer of polarized elongated epithelial cells resembling primitive ameloblasts (Figure 2). On the basis of gross and histologic features, the neoplasm was identified as a compound odontoma. Procaine penicillin G (22,000 U/kg [10,000 U/lb], IM, q 12 h) and phenylbutazone (2.2 mg/kg [1.0 mg/lb], IM, q 12 h) were administered for 7 days.

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IV, q 12 h) were administered to the horse preoperative-ly and continued after surgery. Because of the extensive surgical defect involving the right mandible and the oral cavity, a standing midcervical esophagostomy was performed to provide extraoral alimentation until the oral cavity defect closed and the mandibular fracture healed.6

Extraoral alimentation was provided with a prepared diet7 that consisted of an electrolyte mixture, b dextrose, dehydrated cottage cheese, c dehydrated alfalfa meal, d corn oil, and water. This mixture was made daily. The maintenance caloric intake was calculated as described.7 The diet was given to the horse via esophagostomy tube 3 times daily for 22 days. After days 1 to 7 of extraoral alimentation, the horse had lost 23 kg (51 lb) of body weight while the diet was gradually increased to a maintenance level. Introduction of this alimentation protocol takes approximately 1 week. After day 7 of extraoral alimentation, body weight was maintained at 263 kg (579 lb) during the remainder of the diet administration. No complications developed while the horse was receiving extraoral alimentation. The gauze packing in the mandibular and oral cavity defect was removed and replaced twice weekly until day 14 after surgery. Each time the packing was removed, the defect was lavaged with tap water. Procaine penicillin G and phenylbutazone administration were discontinued 14 days after surgery, and the horse was administered trimethoprim sulfamethoxazole (30 mg/kg [13.6 mg/lb], PO, q 12 h) for 30 days.

Twenty-two days after surgery, the mandibular external fixator had become loose and was removed. The mandibular fracture was palpably stable, and the oral defect was filled with granulation tissue. The esophagostomy tube was removed, and the horse was given a complete pelleted feed.8 Standing lateral and oblique skull radiographs were taken. The mandibular fracture was not completely healed, but there was no evidence of mandibular osteomyelitis. It was noted that a ring sequestrum had formed at the most rostral pinhole site from the previously placed external fixator. The sequestrum was subsequently removed with curettage via general anesthesia. The horse was discharged on day 49 after the initial surgery.

Follow-up examination was performed 6 months after surgery. Physical examination revealed no problems with the esophagostomy site, and there was no gross evidence of tumor reoccurrence. Standing lateral radiographic views of the mandible were made. The pin tracts associated with the external fixator had healed, and the mandible had radiographic evidence of bony healing. At 3 years after surgery, there was no evidence of tumor reoccurrence and the cosmetic result of the mandible and the esophagostomy site were satisfactory to the owner. The owner reported no problems with mastication, despite the loss of 2 permanent teeth.

An 11-month-old female Quarter Horse (horse 2) was admitted for evaluation of a firm mass centered over the left maxilla. Initially, the mass was 3 to 4 cm in size and had been first observed 7.5 months prior to admission. However, within 30 days of admission, the mass had enlarged in size and a left-sided mucopurulent nasal discharge had developed.

Abnormal physical findings at admission included a firm, nonpainful swelling centered over the left maxillary sinus and dental arcade. A small amount of left-sided mucopurulent nasal discharge was evident. There was a subjective decrease in airflow through the left nostril, compared with airflow from the right nostril. Other abnormalities included dull sounds from the left frontal sinus via percussion, mild left masseter muscle atrophy, and left mandibular lymphadenopathy. An oral examination was performed. Abnormal findings included an epithelium growth surrounding the left upper fourth premolar (tooth 208). There was no evidence of an oral mucosal defect, purulent drainage, or an abnormal odor from the oral cavity. Standing lateral, dorsoventral, and oblique radiographic views of the skull were obtained. A mass occupying the left rostral and caudal maxillary sinus was found (Figure 3). The mass consisted of multiple small, well-defined opacities consistent with tissue of dental origin. The mass was centered over tooth 208. This tooth was abnormally shaped and positioned, with an indistinct alveolus. The expansive nature of the mass
distorted the bony structures and caused nasal septum deviation towards the right. On the basis of the physical and radiographic examination findings, the differential diagnoses included a primary dental tumor such as complex or compound odontoma, ameloblastoma, an ameloblastic odontoma, or a primary bone tumor such as osteoma. Complete surgical resection was recommended to the owner. The horse was anesthetized and positioned in right lateral recumbency. A left maxillary sinusotomy was performed as described. During debulking of the mass, the oral cavity and nasal passage were entered. A combination of sharp and blunt dissection was used to remove the mass within the rostral maxillary sinus. The involvement of tooth 208 in the tumor necessitated its removal. The expansive mass obliterated the left infraorbital canal and distorted the nasal turbinates. A blood transfusion of 8 L was initiated to replace approximately 8 to 10 L of blood loss during the surgical procedure. Continued hemorrhage resulted in termination of the surgical procedure. The sinus was packed with gauze, and the oral cavity defect was packed with dental wax to minimize sinus contamination with feed material.

Histologic examination of the removed mass revealed that all elements of the tooth were present and organized as a toothlike structure or denticle, as described for horse 1. These findings were consistent with a compound odontoma. The horse recovered from general anesthesia without complications. Procaine penicillin G (22,000 U/kg, IM, q 12 h) and phenylbutazone (2.2 mg/kg, IV, q 12 h) were administered to the horse preoperatively and continued for the first 5 days after surgery. The horse was fed a complete pelleted feed during the period of hospitalization. The nasal packing was removed 2 days after surgery, and the maxillary sinus was flushed through a hole with a teat cannula once daily for 14 days. At day 5 after surgery, the horse was administered flunixin meglumine (1.1 mg/kg, IV, q 12 h) for 4 days and trimethoprim sulfamethoxazole (30 mg/kg, PO, q 12 h) for 14 days. The nasal packing was removed 2 days after the second surgery. The maxillary sinus was flushed with balanced polyionic fluid through a teat cannula every other day until discharge. The horse was discharged from the hospital 40 days after admission for the first surgery. One hundred fifty days after the first surgical procedure, skull radiographs were made. Abnormal radiographic findings included increased opacity in the left maxillary sinus and evidence of a bony response to the previous surgery. There was radiographic evidence of dental tissue consistent with persistent odontoma within the left maxillary sinus. To confirm the presence of remaining neoplastic tissue, the left maxillary sinus was trephinated via general anesthesia with the horse in right lateral recumbency. Abnormal tissue was seen through the trephination site. The abnormal tissue was removed via curettage and submitted for histopathologic examination. The sinus was lavaged with balanced polyionic fluids. The dental wax previously placed in the oral defect had fallen out, and a large defect could still be seen. A dental bridge was constructed with a combination of wire mesh covered with polymethylmethacrylate (PMMA) and 18-gauge wire to fill the remaining oral cavity defect. This dental bridge was placed during the third surgery. The wire was passed through a small hole in the maxilla made with a Steinmann pin and secured over gauze packing to hold it in place within the mouth. Polyvinyl soloxin was combined with gauze to fill the oral cavity defect and gaps around the PMMA bridge. The horse was administered potassium penicillin (22,000 U/kg, IV, q 6 h) and phenylbutazone (2.2 mg/kg, IV, q 12 h) for 10 days after surgery. The histopathologic diagnosis for the tissue removed from the sinus was compound odontoma. The horse was discharged 10 days after the third surgery. The dental bridge remained in position for 90 days after the third surgery and was gradually extruded into the oral cavity by a combination of bone response within the sinus and the development of dental alveolar granulation tissue. The dental bridge was removed by the referring veterinarian after the oral defect was completely closed.

A follow-up examination was performed 9 months after the first surgery and 4 months after the third surgery. Abnormal physical findings included facial

Figure 4—Lateral radiographic view of a portion of the head of a horse with compound odontoma. Notice that numerous denticles remain in the maxillary sinus (arrows).
distortion on the left side of the head, drainage from a fistula from the previous trephination site, and serious discharge from the left nostril. The oral defect in the left maxilla had completely healed. Skull radiographs were obtained, and there was no radiographic evidence of tumor recurrence. There was increased opacity within the left maxillary sinus consistent with osseous production and bony remodeling of the maxilla.

At 14 months after the initial surgery, a follow-up telephone conversation with the owner revealed there was no nasal discharge. The facial swelling was reduced in size, and the owner was considering starting the horse in training for western performance events. Four years after the initial surgery, there was no evidence clinically or radiographically of tumor regrowth. The horse had no problems with mastication or maintenance of body condition after the loss of 4 permanent teeth; however, regular dental care is needed every 6 months.

Odontogenic tumors in animals are rare, benign, locally expansile tumors of dental origin. Odontomas have epithelial and mesenchymal elements and induce connective tissue proliferation within the bone. The horses in this report were both young, which is a typical finding. There is no known sex predilection for the tumor. Three types of odontoma have been identified and classified according to the level of dental tissue organization: ameloblastic, complex, and compound. Ameloblastic odontomas are the most undifferentiated form of odontoma and are not commonly reported in horses. Complex odontomas are more differentiated than ameloblastic odontomas, with dental tissues arranged in a disorganized structure. Complex odontomas have been rarely reported in the horse. Compound odontomas have all the features of normal tooth formation. Well-organized toothlike structures known as denticles are often found, as was described in both horses in this report. Compound odontomas have been reported in cattle and dogs. To our knowledge, there have been no reports of compound odontomas in horses.

Both horses had firm swellings involving the maxilla or mandible. In domestic animals, the maxilla has been the most frequently described site of odontoma. Other clinical abnormalities associated with compound odontomas include lethargy, dysphagia, and perialveolar swelling.

Compound odontomas present unique surgical challenges to the veterinarian. Both horses reported here required extensive and aggressive surgical resection of the odontoma to obtain a successful outcome. Likewise, the postoperative management for each horse became intensive and time consuming. Preferably, en bloc resection of the mass should be performed once, as in horse 1. However, extensive surgical debridement in horse 1 did result in an iatrogenic mandibular fracture, which was managed successfully with an external fixator, and a large oral cavity defect, which necessitated extraordinary alimentation. Extraoral alimentation was chosen over parenteral nutrition because of the high cost of total parenteral nutrition. Extraoral alimentation was also preferred because the horse had a normally functioning gastrointestinal tract.

The midcervical esophagostomy was technically straightforward to perform, and no complications developed. The diet was well tolerated by the horse and resulted in maintenance of body condition for the 22 days the horse received the diet.

Horse 2 also presented unique surgical challenges because of the size of the odontoma and its extensive involvement of the maxillary sinus, teeth, and nasal passage. Three surgical procedures were required to ensure complete removal of all neoplastic tissue. Extensive involvement of teeth 206 to 209 required their removal. To prevent the formation of an orosinus fistula from constant contamination of the maxillary sinus with ingesta and saliva, a custom-fit dental bridge was designed. The use of this type of dental bridge has not been described, to our knowledge. Initially the defect was plugged with dental wax but was too large, and the dental wax could not be kept in situ long enough for development of granulation tissue. Alternative substances, such as PMMA, would probably also not stay in situ long enough for healing. Multiple teeth were removed, so the defect was not suitable for transposition of the levator nasolabialis muscle.

Diagnosis of compound odontomas can be confirmed with a combination of radiographic findings and histopathologic examination. Traditional surgical techniques can be used to successfully treat these tumors; however, multiple surgical procedures may be necessary and aftercare may be prolonged and complicated.

References

**Selected abstract for JAVMA readers from the American Journal of Veterinary Research**

Assessment of the efficacy of a single dose of a recombinant canarypox virus vaccine against West Nile virus in response to natural challenge with West Nile virus-infected mosquitoes in horses

Leonardo Siger et al

**Objective**—To determine the onset of immunity after IM administration of a single dose of a recombinant canarypox virus vaccine against West Nile virus (WNV) in horses in a blind challenge trial.

**Animals**—20 mixed-breed horses.

**Procedure**—Horses with no prior exposure to WNV were randomly assigned to 1 of 2 groups (10 horses/group). In 1 group, a recombinant canarypox virus vaccine against WNV was administered to each horse once (day 0). The other 10 control horses were untreated. On day 26, 9 treated and 10 control horses were challenged via the bites of mosquitoes (*Aedes albopictus*) infected with WNV. Clinical responses and WNV isolation were monitored for 14 days after challenge exposure; antibody responses against WNV after administration of the vaccine and challenge were also assessed in both groups.

**Results**—Following challenge via WNV-infected mosquitoes, 1 of 9 treated horses developed viremia. In contrast, 8 of 10 control horses developed viremia after challenge exposure to WNV-infected mosquitoes. All horses seroconverted after WNV challenge; compared with control horses, antibody responses in the horses that received the vaccine were detected earlier.

**Conclusions and Clinical Relevance**—In horses, a single dose of the recombinant canarypox virus-WNV vaccine appears to provide early protection against development of viremia after challenge with WNV-infected mosquitoes, even in the absence of measurable antibody titers in some horses. This vaccine may provide veterinarians with an important tool in controlling WNV infection during a natural outbreak or under conditions in which a rapid onset of protection is required. (*Am J Vet Res* 2004;65:1459–1462)