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Elodontoma in Two Guinea Pigs

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Summary:

Elodontoma was diagnosed in two pet guinea pigs, one involving a maxillary premolar tooth and the other affecting a mandibular incisor tooth. Diagnostic imaging, including radiographs, computed tomography, and oral endoscopy was performed in order to quantify dental disease. Diagnostic imaging was also used to guide treatment of acquired dental disease, which included intraoral restoration of normal occlusal plane and tooth extraction using an extraoral approach. These are the first histologically confirmed cases of elodontoma in guinea pigs. ***J Vet Dent 32(2); 111-119, 2015***

Introduction

Guinea pigs are *simplicidentata*, having only one pair of maxillary incisor teeth.[1-6] As in all rodent species, guinea pigs lack canine teeth and have a diastema between the incisor and premolar teeth. Premolar and molar teeth are anatomically indistinguishable, and are simply called cheek teeth.[1-6] Guinea pigs have 16 cheek teeth; 1 premolar and 3 molar teeth for each quadrant. Both incisor and cheek teeth are *hypsodont* (long crowned), and *elodont* (continuously growing and erupting). They are defined as aradicular teeth because they do not develop anatomic roots.[1-4]

Curvature in the transverse plane is an important feature of guinea pig cheek teeth. There is lateral convexity for the mandibular cheek teeth and medial convexity for the maxillary cheek teeth. This results in a 30° oblique occlusal plane sloping from dorsal to ventral, lateral to medial.[1,3,4]

With the exception of trauma, most abnormalities of incisor teeth are secondary to coronal elongation resulting in malocclusion of cheek teeth.[4,7] The clinical crowns of incisor teeth are most often affected, and not the reserve crown or apical structures. Spur formation of cheek teeth is less commonly encountered than in the rabbit. When mandibular cheek teeth elongate, orientation causes elongation in a lingual direction which can cause entrapment of the tongue.[1,7]

Clinical signs and symptoms of dental disease in guinea pigs are often non-specific, and onset is usually subtle, noted by reduced food intake or selection of food. Treatment of dental disease in this species is well described. Extraoral extraction of cheek teeth has been reported in rabbits and chinchillas,[1] but is not commonly performed in the guinea pig.

The term odontoma has been classified either as a benign tumor of odontogenic origin, or a non-neoplastic malformation (hamartoma) consisting of a mixture of dental tissues.[8] Odontomas are further classified as compound, or complex.[8] In our review of the literature, we were unable to find a report of compound odontoma in rodents, while complex odontoma has been reported in several rodent species,[9,10] but not the guinea pig. The complex odontoma is a mass lesion with fully differentiated dental components that do not form tooth-like structures. Histologically, it is characterized by the presence of well-differentiated dentinal tissue, including dentin, enamel matrix, odontogenic epithelium resembling the enamel organ, and cementum. There is no metastatic potential, but lesions are locally expansile.[8] Odontoma is reported in a number of species, including dogs and cats. The etiology is uncertain, but may include genetic factors, infection, or trauma.[11] Odontogenic dysplasia of elodont teeth is also reported in rodents and rabbits,[8] and is common in prairie dogs and other squirrels. This non-neoplastic, dysplastic malformation occurring when normal tooth eruption is impaired or arrested, has also been reported as pseudo-odontoma.[3,4,7]

Several hypotheses have been proposed for the pathophysiologic basis of complex odontomas and odontogenic dysplasia in rodents. Some are based upon rare experimentally reproduced osteopetrosis due to an autosomal recessive disease in rats and mice.[9,10] Unlike rabbits, metabolic bone disease, as an underlying cause of dental disease, has not been reported in pet rodent species.[1,8] Three guinea pigs with secondary nutritional hyperparathyroidism were affected by dental disease, but a direct relationship was not investigated.[13]

Repeated trauma, fractures, and subsequent acquired dental disease are considered the most important causes of odontogenic dysplasia in prairie dogs and other squirrels.[1,3,4,7] Apical growth continues, causing primary deformation of the apex and of the newly formed reserve crown, with secondary changes to the surrounding structures including remodeling of the incisive bone. The outcome is severe apical deformity and folds of newly formed tooth substance especially on the labial surface of the reserve crown which, in these species, acts as a space occupying mass leading to progressive obstruction of the nasal cavity.[1,3]

In order to describe odontomas in squirrels and similar species with elodont incisor teeth, while avoiding the debatable hamartomatous versus neoplastic nature of odontomas in brachyodont teeth, the new term elodontoma was proposed.[12] Clinical diagnosis of elodontoma and odontogenic dysplasia can be inferred with high quality radiographs[14] and computed tomography,[15,16] and is confirmed by histopathology. Successful treatment of elodontoma has not been reported in rodents. Treatment of odontogenic dysplasia has been described in prairie dogs and squirrels, and includes extraction of affected incisor teeth using simple extraction, intraoral trans-palatal, extraoral lateral, and extraoral via rhinotomy techniques.[1,3,8,17] Depending on the individual case, the apical mass is removed entirely or simply debulked.[3] Palliative treatment by dorsal rhinostomy and positioning of a tubular stent has also been described.[17]

Case Report #1

A 3.5-year-old, castrated/male guinea pig was presented as a second opinion for evaluation of suspected dental disease. The initial complaint included reduced food intake, dysphagia,

and weight loss. The veterinarian performed oral evaluation under general anesthesia, coronal reduction of cheek teeth, and attempted oral extraction of an apparently abnormal-appearing right maxillary premolar tooth. There was no improvement, and the guinea pig underwent computed tomography (CT) of the skull. The patient was then referred for evaluation of the CT images and continued treatment.

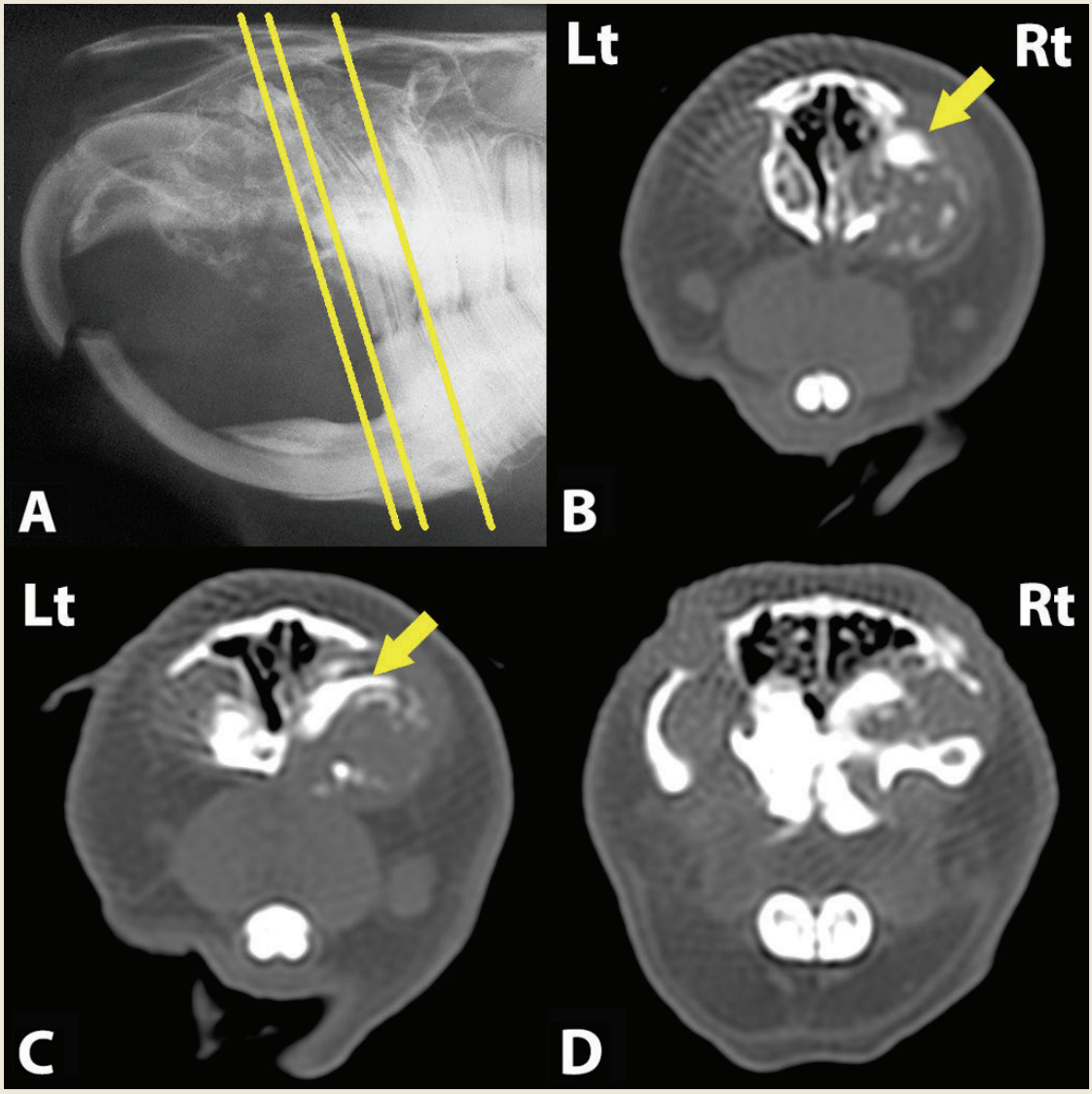
Physical examination showed the guinea pig was bright, alert, and responsive, but thin (3/5 body condition score). A hard, moderately painful swelling was present in the right zygomatic area. There was mild epiphora of the right eye. There was no evidence of upper respiratory disease, and the remainder of the physical examination was unremarkable.

Review of the CT images revealed that both the apex and reserve crown of the right maxillary premolar tooth were abnormally elongated. An adjacent irregularly calcified mass was present perforating and penetrating the lateral cortex of the right maxilla, cranial to the maxillary zygomatic process. There was also expansion and bone modelling medially with compression of the rostral portion of the right nasal cavity. The zygomatic arch and the orbital fossa were unremarkable (Fig. 1). Abnormalities were consistent with elodontoma, bony neoplasia, or periapical infection and osteomyelitis of the maxillary bone as a result of acquired dental disease of the right maxillary premolar tooth.

Continuing care for the guinea pig included support feeding, and meloxicam[a] (0.3 mg/kg) BID PO was administered. General

Figure 1

Computed tomography of the skull of a guinea pig with elodontoma (case # 1). The scout view demonstrating the scanning planes of axial views has been adapted from the radiograph of the same patient (A). The abnormal reserve crown of the affected maxillary premolar tooth (arrows) and expansile mass with loss of associated maxillary bone are visible (B-D). Courtesy of University of Zurich.



anesthesia was administered for radiography of the skull, serum chemistry and hematologic testing, and oral endoscopic evaluation. Complete blood count and biochemistry analysis were unremarkable. The anesthetic protocol consisted of premedication with butorphanol[b] (0.3 mg/kg SQ), and induction with medetomidine[c] (70.0 µg/kg) and ketamine[d] (20.0 mg/kg) IM. General anesthesia was maintained with oxygen and isoflurane[e] delivered by nasal mask. Skull radiographs revealed elongation of clinical crowns, reserve crowns, and apices of cheek teeth, especially the maxillary cheek teeth. Penetration and remodeling of the adjacent bone was present. The clinical crown of the right maxillary premolar tooth was reduced due to previous adjustment, but most of the reserve crown remained. A mixed density mass was visible rostral to the right zygomatic arch in all of the five standard projections, in particular the ventrodorsal view (Fig. 2).

Oral endoscopy using a 2.7-mm rigid endoscope demonstrated slight overgrowth of the left mandibular premolar tooth and absence of the clinical crown of right maxillary premolar tooth. No other abnormalities were noted.

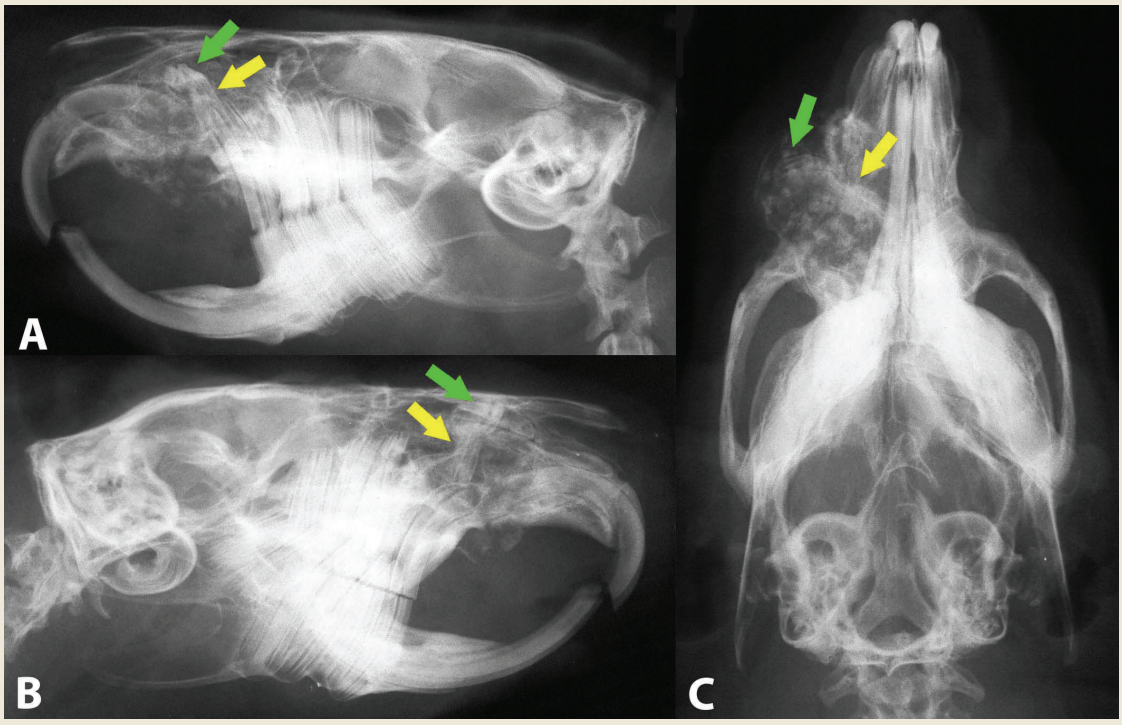
The differential diagnosis based on physical examination and diagnostic imaging findings was elodontoma or bony neoplasia as a result of acquired dental disease of the right maxillary premolar tooth in addition to periapical infection and osteomyelitis of maxillary bone. Exploration of the site and possible surgical debridement of the bone through an extraoral approach was recommended, but declined. The guinea pig was discharged on meloxicam[a] (0.3 mg/kg) and a support feeding formula[f] for herbivores. Over the next 3-weeks, the patient remained bright and alert, but continued to require assisted feeding. The facial swelling gradually increased in size. Due to progression of disease, the owner agreed to exploratory surgery.

The guinea pig was anesthetized as described previously. A 24g IV catheter was placed in the cephalic vein, and a balanced electrolyte solution delivered at 10 ml/kg/hour. Normothermia was maintained with a circulating water heating pad. The surgical field was isolated over the maxillary swelling using a transparent adhesive drape. A skin incision was performed over the swelling, and exposure to the surgical site was increased with use of an atraumatic retractor[g]. The exposed, firm mass was dissected close to its bony attachment. Scissors were used to remove the mass, that appeared to be encapsulated in firm tissue over the apex and the reserve crown of the maxillary premolar tooth. No pus was present. After thorough debridement, the maxillary premolar tooth was luxated and extracted using needles and an elevator[h] designed for rodent cheek teeth (Fig. 3). Careful probing revealed no evidence of communication between the oral and nasal cavities. The gingiva appeared to have healed normally following the extraction attempt by the referring veterinarian.

Biopsy samples of fibrous and hard tissues were submitted

Figure 2

Radiographs of the skull of a guinea pig with elodontoma (case # 1). Left-to-right lateral (A), right 15° ventral-left dorsal (B), and ventrodorsal (C) projections show elongation of clinical crowns, reserve crowns, and apices of cheek teeth with penetration and remodeling of the adjacent bone. A mixed density mass is visible rostral to the right zygomatic arch. The reserve crown (yellow arrows) and the apex (green arrows) of the right maxillary premolar tooth are present.



in 10% buffered formalin for histopathologic examination. Due to the absence of apparent infection, microbial culture was not performed. The surgical site was marsupialized with 3-0 monofilament, non-absorbable suture[i] in order to allow drainage (Fig. 3). Postoperative radiographs showed complete removal of the abnormal premolar tooth, but also revealed that the associated mass had not been completely removed (Fig. 4).

The guinea pig underwent daily flushing of the surgical site with saline, and gentle debridement. Histopathology reported neoplastic conglomerates of haphazardly arranged odontogenic hard and soft tissues. The mass was made of odontogenic epithelium closely associated with dentin and cementum-like mineralized tissue. The histological diagnosis was elodontoma (Fig. 5).

The surgical site was nearly completely healed at the 3-week postoperative examination. Skull radiographs showed enlargement of the mixed density mass at the surgical site (Fig. 4). Slight increased respiratory rate and effort were noted, and the patient's appetite had not improved. The owner declined additional diagnostic tests. The patient's overall condition had not improved at the 10-week postoperative examination. The facial mass was prominent and larger than prior to surgery. Skull radiographs showed increased radiodensity of the mass (Fig. 4). Prognosis for recovery was considered poor. The owners elected euthanasia, but declined necropsy.

Case Report #2

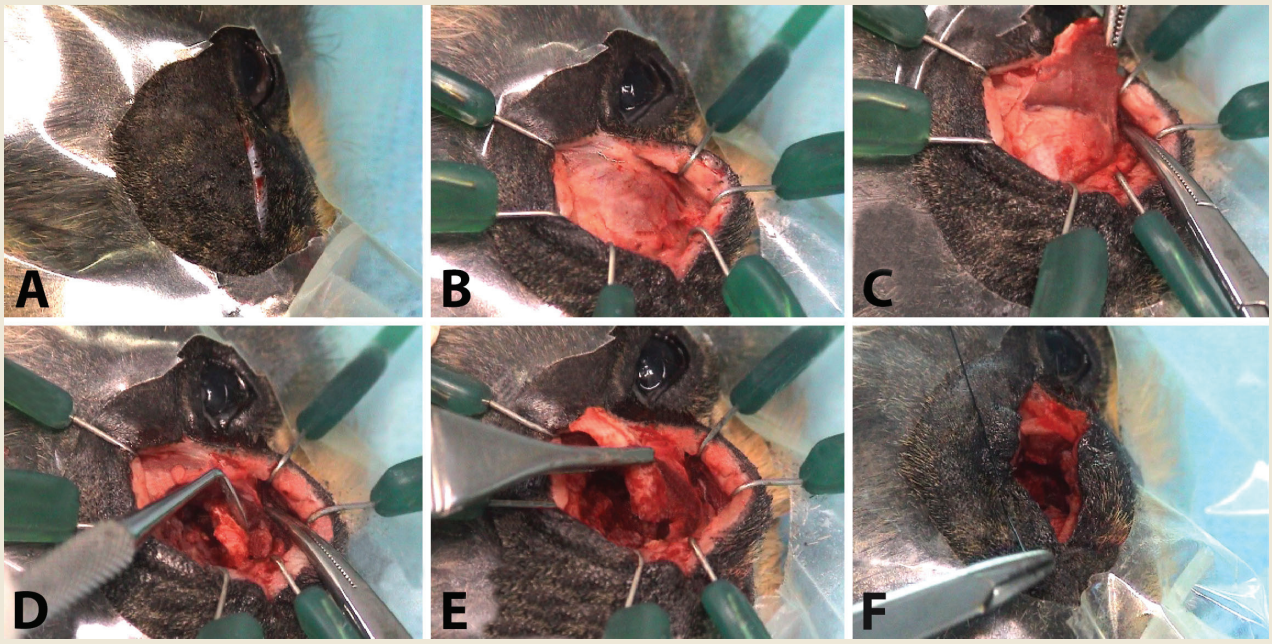
A 3-year old male guinea pig presented for progressive decreased food intake over a 2-week period. The guinea pig would approach food, but appeared to have difficulty manipulating it in the mouth. Physical examination indicated that the patient had a poor body condition score (4/5). There was a fracture of the clinical crown of the right mandibular incisor tooth, which had not been noted by the owner. Cursory oral examination with an otoscope revealed evidence of cheek tooth malocclusion. The guinea pig was scheduled for a thorough dental evaluation under general anesthesia the following week. In the interim, the guinea pig was administered meloxicam[a] (0.3 mg/kg) BID PO and feeding support with a herbivore formula.

Complete blood count and biochemistry analysis were unremarkable. The guinea pig was administered general anesthesia as described previously. Radiographs were obtained in 5 standard views. The lateral projection showed abnormalities that included an altered incisor occlusal plane and elongation of the clinical crowns of the cheek teeth and elongation of cheek tooth apices penetrating the cortices, especially the mandibular premolar tooth penetrating fully through the radiodense cortex, with subsequent deformity of the ventral profile of the mandible. The left oblique projection also emphasized the elongated apex of the right mandibular premolar tooth, and an additional radiodense deformity. A round, radiodense deformity medial to the apices of the mandibular cheek teeth was also noted in the ventrodorsal projection (Fig. 6).

Oral endoscopy showed overall elongation and malocclusion of cheek teeth clinical crowns, particularly affecting the maxillary arcades. An unusual swelling was noted between the

Figure 3

Photographs showing extraoral extraction of the right maxillary premolar tooth and surgical debridement of an elodontoma in a guinea pig (case # 1): skin incision over the mass (A); exposure of the mass and positioning of the retractor (B); further dissection of the firm mass covering the reserve crown of the affected tooth (C); luxation of the reserve crown of the affected tooth (D); extraction of the affected tooth (E); marsupialization of the surgical site (F).



right mandibular arcade and the tongue, causing significant displacement of the tongue to the left. The swelling appeared firm based on indirect palpation with forceps. There was a small round ulceration and a thin layer of white debris on the mucosa covering the swelling (Fig. 7). Coronal reduction of the cheek teeth was performed, but significant improvement of clinical symptoms was not expected due to the degree of tongue displacement. In order to obtain more information on the nature

Figure 4

Photographs showing images of the surgical site (top) and corresponding VD projection radiograph (bottom) following surgical debridement of an elodontoma in a guinea pig (case # 1). Immediate postoperatively: final appearance of the marsupialization site, and radiograph demonstrating complete removal of the maxillary premolar tooth and incomplete mass removal (A). Three-weeks postoperatively: the surgical site had almost completely healed. Skull radiographs showed regrowth of the mixed density mass (B). Ten-weeks postoperatively: the facial swelling had reoccurred and was worse than at initial presentation. The affected area had increased both in size and radiodensity (C).

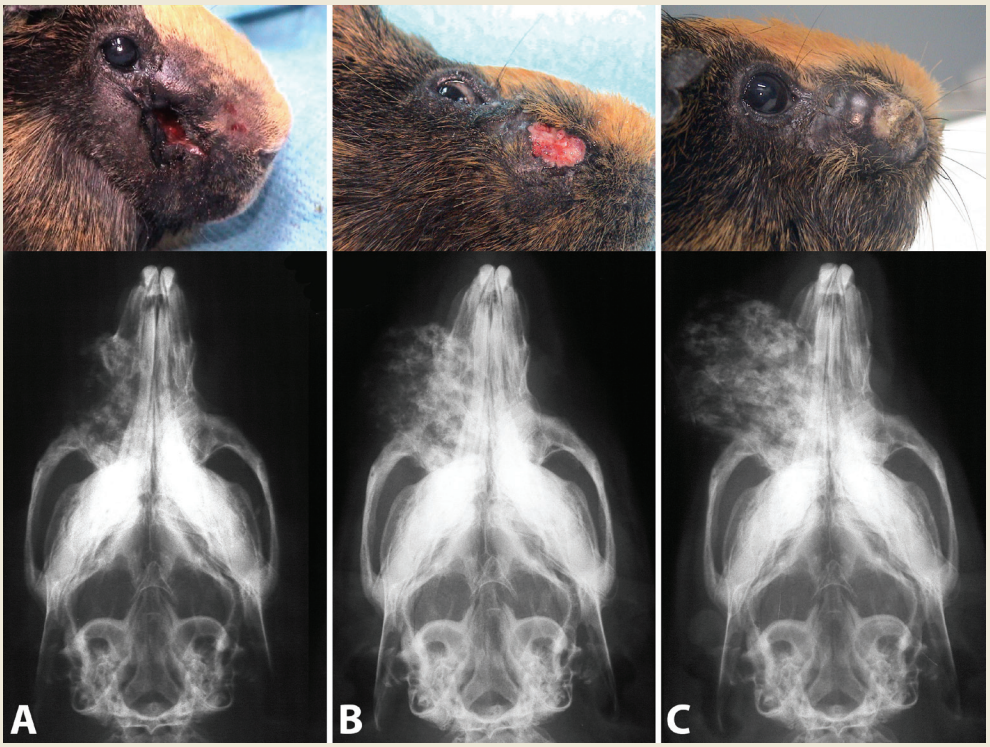


Figure 5

Histopathology of the elodontoma in the guinea pig of case #1 [H&E, original magnification = 100X (A) and 200X (B). The neoplastic mass (2 x 2.5-cm) had moderate cellularity, was non-encapsulated, infiltrative, and extended to margins, with moderate fibrous stroma. The tumor consisted of columnar odontogenic epithelium (A, 1) with prominent peripheral palisading (B, 2) and stellate reticulum-like areas (B, 3) closely linked with dentin and cementum-like mineralized tissue (A, 4). Empty spaces (A, 5) previously occupied by fully mineralized enamel are also visible after decalcification.

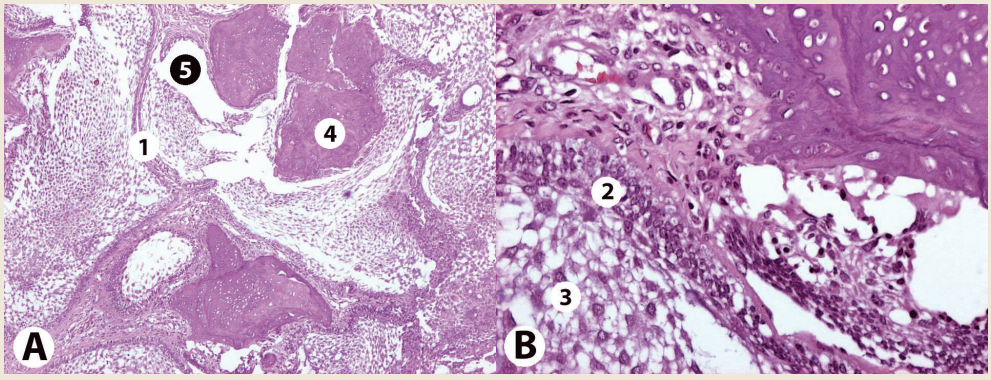


Figure 6

Radiographs of the skull of a guinea pig with elodontoma (case # 2). Left-to-right lateral projection (A): the main radiographic abnormalities are represented by altered occlusal planes of incisor teeth, and elongation of clinical crowns of cheek teeth. Overall, elongation of cheek tooth apices penetrating the cortices was present. Elongation of the apex of a mandibular premolar tooth with deformity of the ventral profile of the mandible is also visible (white arrow). Left 15° ventral-right dorsal projection (B): the oblique projection emphasizes the elongated apex of the right mandibular premolar tooth (white arrow), and the fractured reserve crown of the right mandibular incisor tooth (yellow arrow). Ventrodorsal projection (C): an additional, round radiodense deformity medial to the apices of mandibular cheek teeth is vsible (green arrow).

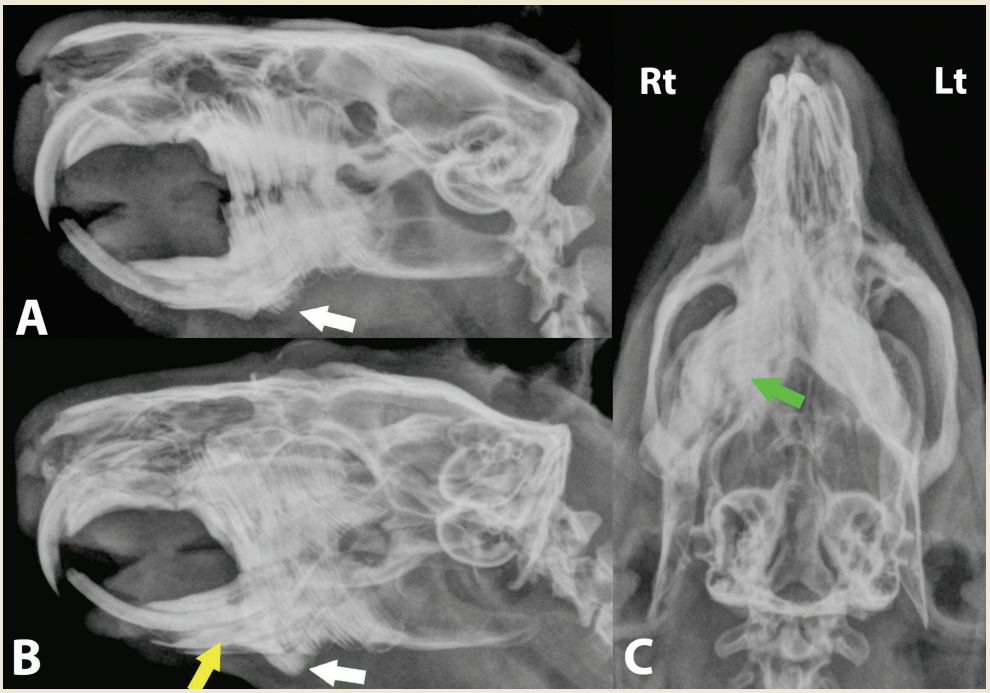


Figure 7

Oral endoscopic views before (A) and after (B) surgical removal of the diseased apex of the right mandibular incisor tooth in case # 2. Note the swelling between the right mandibular arcade and the tongue, causing significant displacement of the tongue to the left (A). The mucosal surface was covered by a film of whitish debris, and ulceration was present (arrow). Overall elongation and malocclusion of clinical crowns of cheek teeth were also visible. Note that after the procedure, the bony deformity was significantly reduced, with return of the tongue to a normal position (B).

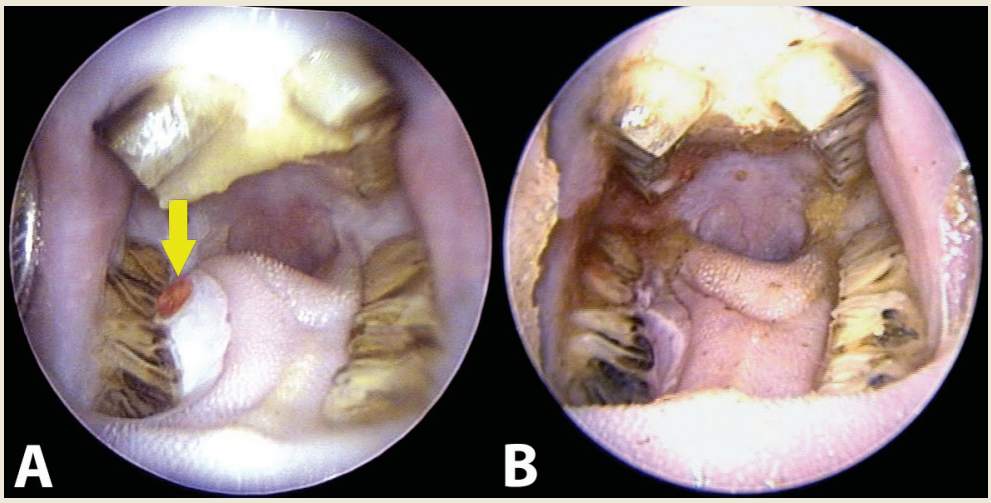
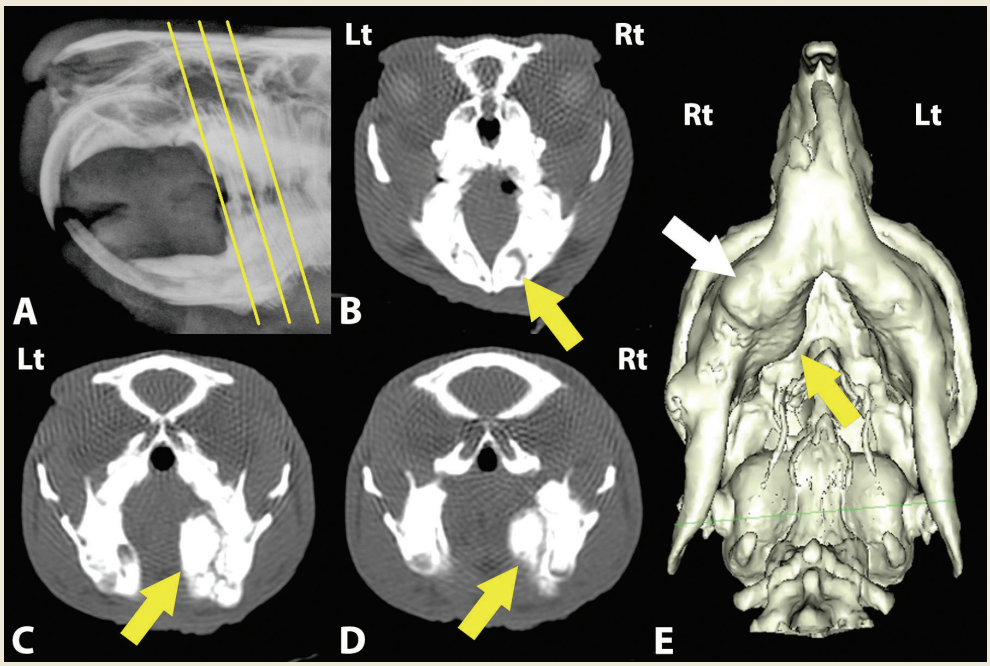


Figure 8

Computed tomography of the skull of a guinea pig with elodontoma (case # 2). The scout view demonstrates the scanning planes of axial views. The axial views emphasize the diseased reserve crown of the right mandibular incisor tooth (B, arrow), and the presence of abnormal radiodense material ventromedial to the right mandible, compatible with overgrowth of new bone or dental material (C, D, arrows). In the 3-D surface rendering of the skull (E), this ventrodorsal reconstruction clearly demonstrates the deformity of the medial side of the mandible (yellow arrow) as well as abnormal elongation of the apex of the right mandibular premolar tooth (white arrow). Other apices penetrating the cortical bone are also visible.



of the swelling, computed tomography (CT) was performed immediately after coronal reduction.

CT findings confirmed the presence of the fractured reserve crown of the mandibular incisor tooth and an abnormal radiodensity ventromedial to the right mandible. The density was thought to be compatible with overgrowth of new bone or dental material, which displaced the tongue (Fig. 8). Three-dimensional reconstruction surface rendering of the skull clearly demonstrated the deformity of the medial aspect of the mandible as well as the swelling associated with bone remodeling over the elongated apex of the right mandibular premolar tooth. There was also evidence of other apices penetrating cortical bone (Fig. 8).

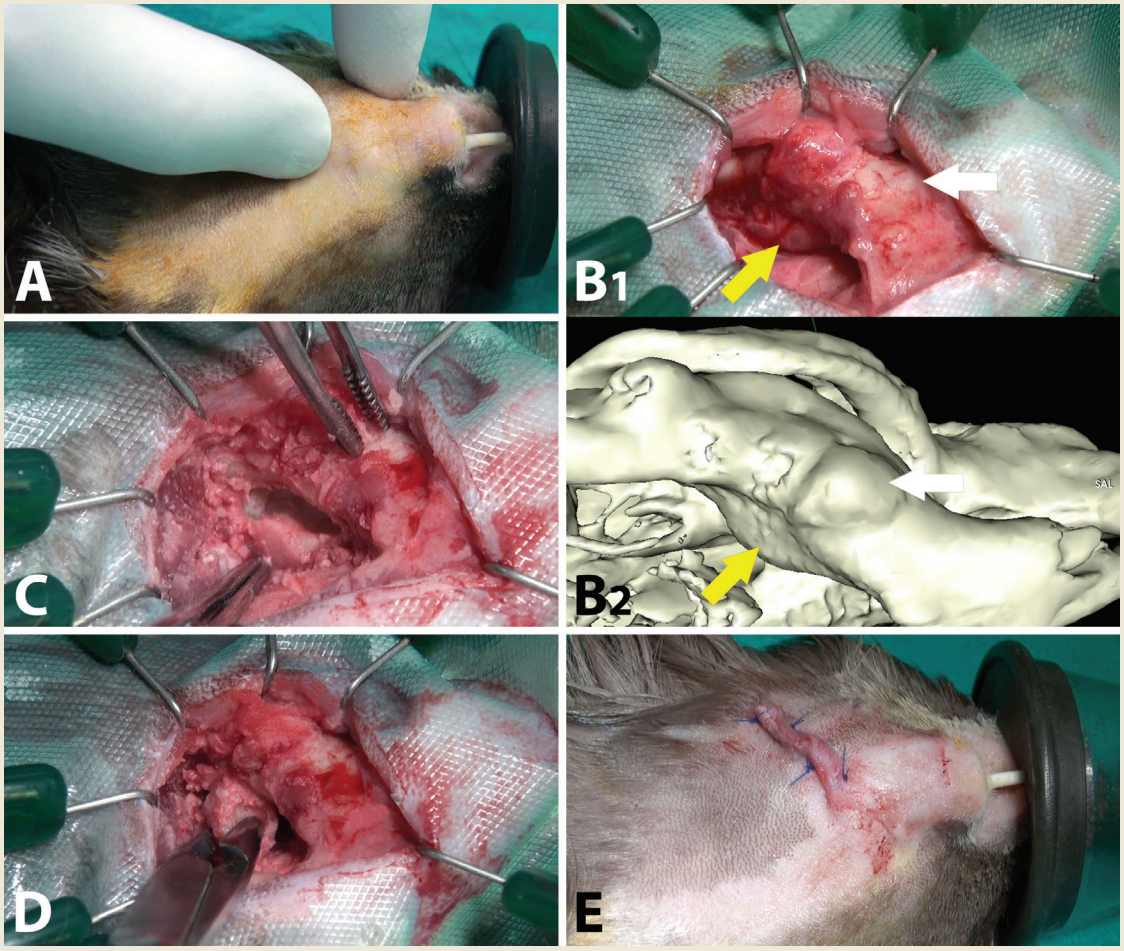
The guinea pig recovered uneventfully from anesthesia. A recommendation was made for exploratory surgery in order to reduce the size of the mandibular density and obtain a biopsy specimen. In the interim, meloxicam and assisted feeding were continued. The differential diagnosis included elodontoma, neoplasia, and osteomyelitis.

The guinea pig was administered general anesthesia, and maintained and monitored as described previously. The patient was placed in dorsal recumbency and the surgical site prepared routinely. A curvilinear skin incision was made following the natural contour of the ventral mandible. Blunt subcutaneous dissection exposed the mandible, and the masseter muscle on the ventromedial aspect was elevated and atraumatic retraction[g] applied. The elongated aspect of the first mandibular premolar tooth was visible after the ventral and medial portions of the mandible were exposed. The bony deformity was identified and was firmly attached to the medial wall of the mandible, and contiguous with the reserve crown of the right mandibular incisor tooth. The oral submucosa was protected by retracting it medially and the mass was aseptically removed by burring it away from the mandible using a fine 1-mm, #2 metal bur (Fig. 9). Due to elapsed surgical time and concern for the condition of the patient, an attempt to remove the remaining reserve crown of the incisor tooth was not attempted. Bleeding was minimal and controlled with cotton-tipped applicators. The skin wound defect was apposed with 3-0 monofilament non-absorbable suture[i] in a simple interrupted pattern. Oral endoscopy performed after resection showed normal positioning of the tongue (Fig. 7). The excised mass was submitted in 10% buffered formalin for histopathologic examination.

The guinea pig recovered uneventfully from anesthesia, and was hand fed a finely ground support feeding formula for herbivores[j] which was accepted well the day of surgery. The guinea pig was very depressed and would no longer swallow hand fed food by 24-hours postoperatively. Additional diagnostic testing and supportive care were offered but declined by the owner, who elected euthanasia. The owner did not allow necropsy. Histopathology revealed elodontoma of the apical portion of the incisor tooth. This elodontoma was composed of ameloblastic epithelium, empty spaces previously occupied by

Figure 9

Surgical exploration of the elodontoma in the guinea pig of case # 2. The patient was placed in dorsal recumbency and surgically prepared. The surgeon's fingers are shown palpating the mandibular deformity (A). Exposure of the mid-ventral portion of the right mandible and the medial deformity of the mandible (yellow arrow) was possible with gentle retraction (B1). Note the elongation of the apex of the right mandibular premolar tooth with deformity of the ventral profile of the mandible (white arrow). The CT surface reconstruction accurately reflects the gross lesion (B2). A bur was used to separate the mass from the medial aspect of the right mandible (C), followed by mass removal (D), and wound closure (E).



fully mineralized enamel, stellate reticulum-like areas, and dentin (Fig. 10).

Discussion

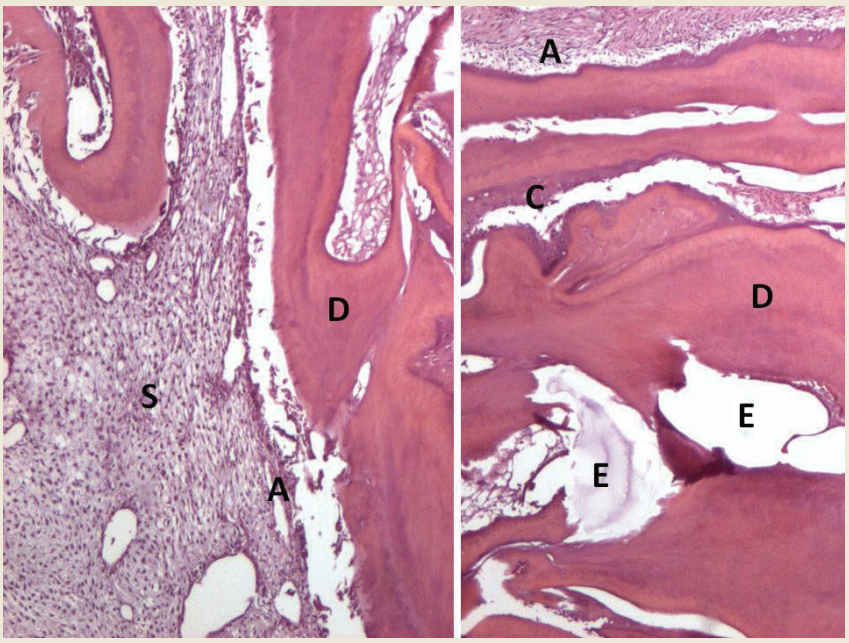
These cases describe the first reported cases of elodontoma in guinea pigs. The term elodontoma is appropriate for these cases since the lesions were continuous with the apices of elodont (open rooted, continuously growing) incisor and cheek teeth.

Diagnostic imaging was an important part of the work-up in both cases. Standard radiography provided useful information, but CT was critical in both cases, especially in case #2. In case #1, radiographs were complementary to CT for detecting the specific dental abnormality. To the authors' knowledge, complete extraction of cheek teeth via the oral approach has not been documented in guinea pigs, and is considered to be challenging due to the unique anatomy of cheek teeth. This intrinsic difficulty, exacerbated by the elongated and deformed reserve crown, resulted in failure of the first dental extraction procedure in case #1, where only the clinical crown of the premolar was removed, but the reserve crown remained *in situ*. At referral, extraoral extraction was actually relatively straightforward and effective as the apex and the reserve crown of the affected tooth were within the core of the zygomatic mass. Continued development of the elodontoma postoperatively was clearly demonstrated on subsequent radiographs. The guinea pig was euthanized due to ongoing debilitation, including increased respiratory symptoms likely due to progressive disease and encroachment of the nasal cavity by the elodontoma.

Cause of elodontoma in this guinea pig was uncertain, but may have been related to trauma, as has been noted in other species.[11] Trauma related to incomplete extraction of the right maxillary premolar may have led to development of elodontoma, or conversely if elodontoma was already present, it may have resulted in malocclusion of that tooth. The latter is

Figure 10

Histopathology of the elodontoma in the guinea pig of case #2 illustrating the disorganized but sequential differentiation of ameloblastic epithelium (A), enamel spaces (E), stellate reticulum-like areas (S), dentin (D), and cementum (C) [H&E, original magnification = 40X].



most likely, since computed tomography performed shortly after the extraction attempt identified a mass lesion.

In case #2, CT was critical for aiding the diagnosis and surgical treatment plan. Standard projection radiographs underestimated the extent of the lesion, and could not differentiate between primary dental and bony lesions. In this case, the elodontoma caused significant lesions including deviation of the tongue. While removal of the entire incisor reserve crown in case # 2 would have been ideal, the primary goal of surgery was to restore normal tongue position, relieve dysphagia, and to obtain a diagnostic biopsy. A second attempt for extraction of the retained reserve crown could have been considered, had the patient survived. The outcome in case # 2 may have been related to the anesthetic or surgical procedure. Necropsy would have been useful to help determine the reason for the guinea pig's poor response following surgery. Elodontoma is an unusual diagnosis in the guinea pig, but should be considered in cases of a mass lesion affecting the tooth apex.

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[a] Metacam, Boheringer, Ingelheim, Germany.

[b] Dolorex, Intervet, Boxmeer, The Netherlands.

[c] Domitor, Pfizer, New York, US.

[d] Ketavet, Intervet, Boxmeer, The Netherlands.

[e] Isoba, MSD Animal Health, Walton Manor, Walton, Milton Keynes, UK.

[f] Oxbow Critical Care, Oxbow Animal Health, Murdoch, NE.

[g] Lone Star retractor; Lone Star Medical Products, Inc. Stafford, TX, USA.

[h] Crossley's elevator, Veterinary Instrumentations, Sheffield, UK.

[i] Ethilon, Ethicon, Johnson & Johnson Medical, Langhorne, PA, USA.

[j] Critical Care Fine Grind, Oxbow Animal Health, Murdock, NE.

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