Like humans, animals can have impacted or unerupted teeth.\textsuperscript{1,2} The latter can lead to oral pathology, commonly odontogenic cysts; these cysts are often diagnosed as dentigerous cysts.\textsuperscript{1,3-5} Studies have reported that unerupted mandibular canine teeth and first premolars (\textbf{FIGURE 1}) are the teeth most likely to be associated with oral pathology.\textsuperscript{4} The following case describes the presence and treatment of unerupted teeth in a young dog.

\section*{CASE REPORT: DENTISTRY}

\textbf{Multiple Unerupted Teeth in a Dog}

\textit{Brenda L. Mulherin, DVM, DAVDC}

\textit{Iowa State University College of Veterinary Medicine}

\textbf{SIGNALMENT AND HISTORY}

A 9-month-old, 3.26-kg, spayed female mixed-breed poodle presented for multiple clinically missing teeth, noted by the referring veterinarian 2 to 3 months previously. Numerous infraerupted or undererupted teeth were also noted. The growth of the jaw created a Class 3 malocclusion (increased mandible length; \textbf{TABLE 1}). There was minimal calculus and no appreciable gingivitis within the oral cavity.

\centering
\begin{tabular}{|l|p{5cm}|}
\hline
\textbf{Class} & \textbf{Description} \\
\hline
1 & 1 or 2 malaligned teeth \\
\hline
2 & Maxillary prognathism or mandibular brachygnathism \\
\hline
3 & Maxillary brachygnathism or mandibular prognathism \\
\hline
4 & Maxillary or mandibular asymmetry  \\
\hline
& \hspace{0.5cm} Side-to-side malalignment  \\
& \hspace{0.5cm} Rostrocaudal discrepancy  \\
& \hspace{0.5cm} Dorsoventral discrepancy (open bite) \\
\hline
\end{tabular}

\section*{TOOTH TROUBLES}

Surgical removal of unerupted teeth in a young poodle mix removed the possibility of associated cyst formation down the line.

\section*{CASE REPORT: DENTISTRY}

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\section*{Who Will Win the Grand Prize?}

A panel of judges selected by the NAVC, \textit{Today’s Veterinary Practice} editors, and Dechra Veterinary Products will choose 5 finalists whose case reports will be published in \textit{Today’s Veterinary Practice} during 2021. TVP’s Facebook followers will then select the grand prize winner from among the 5 finalists; the winner gets a trip to VMX 2022, including registration, hotel, and airfare.
PRESENTATION AND DIAGNOSIS
Vital parameters, including temperature, heart rate, respiratory rate, capillary refill time, hydration status, and mentation, were within normal limits. Conscious oral examination findings included severe infraeruption of the right and left maxillary canine teeth (104 and 204; **FIGURE 2**), right and left maxillary first molars (109 and 209; **FIGURE 3**), and noneruption of the left and right mandibular canine teeth (304 and 404; **FIGURE 4**) and first and second incisors (301, 302,
401, and 402; Figure 5). Unerupted left and right mandibular first molars were also noted (309 and 409; Figure 6). The patient also maintained a persistent deciduous right maxillary third incisor (503; Figure 2).

The diagnostic plan included bloodwork, a complete oral examination, computed tomography (CT), and full-mouth dental radiography. Since dental radiography only provides information in 2 dimensions, CT was recommended to evaluate the teeth impacted within maxillary and mandibular bone in 3 dimensions.

**Anesthetic Protocol**

For CT, the patient was premedicated with 2.3 mg (0.7 mg/kg) maropitant subcutaneously, and 0.01 mg (0.003 mg/kg) dexmedetomidine and 0.3 mg (0.09 mg/kg) hydromorphone were administered intramuscularly. A 22-gauge intravenous catheter was placed in the right cephalic vein for administration of lactated Ringer solution (5 mL/kg/hr). Induction was performed with intravenous propofol 3.7 mg (1.1 mg/kg).

CT revealed that the persistent deciduous right maxillary third incisor was directly adjacent to the permanent right maxillary third incisor (103). All maxillary incisors were fully erupted. Minimal eruption of the maxillary canines was noted, with the cusp of the canines just visible from the gingival margin. The apices of the right and left maxillary canine teeth extended more dorsally than expected, with the most dorsal aspect barely separated from the nasal cavity by a thin region of bone. The maxillary first molars were unerupted, with no obvious alveolar bone noted over them radiographically. The mandibular third incisors (303 and 403) were minimally erupted, and the left and right mandibular first and second incisors were unerupted. The left and right mandibular canines were

The patient was intubated with a 6.5-mm cuffed endotracheal tube and maintained on isoflurane gas (1.5% to 2.5%) and oxygen (0.75 to 1.5 L), adjusted to maintain appropriate anesthetic depth. Oxygen saturation, end-tidal carbon dioxide, heart rate, and respiratory rate were monitored and recorded every 5 minutes throughout the procedure with a Cardell monitor (Midmark, midmark.com). Temperature was recorded with a rectal thermometer.

**Diagnostic Imaging**

CT was performed with the patient in sternal recumbency. The patient was scanned from the tip of the nose through the mid-cervical vertebra in the transverse plane using both bone and soft tissue algorithms. Images were reconstructed in dorsal and sagittal planes for analysis. No contrast was administered. Full-mouth dental radiographs were subsequently taken.

CT revealed that the persistent deciduous right maxillary third incisor was directly adjacent to the permanent right maxillary third incisor (103). All maxillary incisors were fully erupted. Minimal eruption of the maxillary canines was noted, with the cusp of the canines just visible from the gingival margin. The apices of the right and left maxillary canine teeth extended more dorsally than expected, with the most dorsal aspect barely separated from the nasal cavity by a thin region of bone. The maxillary first molars were unerupted, with no obvious alveolar bone noted over them radiographically. The mandibular third incisors (303 and 403) were minimally erupted, and the left and right mandibular first and second incisors were unerupted. The left and right mandibular canines were unerupted.

**Figure 4**. (A) Unerupted left mandibular canine (304). (B) Unerupted right mandibular canine (404).

**Figure 5**. Infraerupted right and left mandibular third incisors (403 and 303) and unerupted right and left mandibular first and second incisors (401, 402, 301, 302).
unerupted and covered with gingiva bilaterally, but no alveolar bone covered the most coronal aspect of these teeth. The roots of the mandibular canine teeth extended distally and lingually to terminate distal to the roots of the mandibular second premolars (306 and 406). A small margin of alveolar bone was noted lingual to the apex of each root. A nearly complete circumferential rim of bone was noted coronal to the left and right mandibular first molars. The radiographic findings were consistent with the CT results.

Based on the findings, the owner was given the options of orthodontic extrusion, operculectomy, or surgical extraction for teeth impacted within alveolar bone. After discussion, the owner elected surgical extraction of all maxillary and mandibular canine teeth and operculectomy of all maxillary and mandibular first molar teeth and unerupted left and right first and second mandibular incisors.

**TREATMENT**

**Extraction**
Regional anesthesia was achieved with 3 mg (0.4 mL) 0.75% bupivacaine divided into bilateral caudal maxillary nerve blocks and bilateral intraoral mandibular nerve blocks; 0.75 mg (0.1 mL) was used per site. A #15 scalpel blade was used to make a sulcular incision around the persistent deciduous right maxillary third incisor, which was elevated with a 2-mm winged elevator. The tooth was grasped as apically as possible with extraction forceps and removed.

**FIGURE 7.** (A) Pre-extraction radiograph of right maxillary canine (104) and persistent deciduous right maxillary third incisor (503). (B) Postextraction radiograph of right maxillary canine (104) and persistent deciduous right maxillary third incisor (503). (C) Postextraction clinical image.
from the socket. The incision was closed with 4-0 Monocryl sutures (Ethicon, ethicon.com) in a simple interrupted pattern.

For the right (FIGURE 7) and left maxillary canine teeth, divergent mesial and distal releasing incisions were created, extending from the free gingival margin to a few millimeters apically beyond the mucogingival line. An EX-9 periosteal elevator (Cislak, cislak.com) was used to reflect the gingiva and mucosa from the underlying bone. A high-speed handpiece with a #330 bur was used to remove one-half to two-thirds of the buccal alveolar bone over the unerupted teeth, and 2- to 4-mm winged elevators were used to elevate the teeth from their sockets, with care taken to not pressure the palatal aspect of the tooth and push the apex of the tooth into the nasal cavity. Once the teeth were sufficiently mobile, they were grasped as apically as possible and extirpated from the oral cavity. A small pear diamond bur was used to smooth the buccal alveolar bone. Mucoperiosteal releasing incisions were made on the periosteal side of the flap. Tension-free closure was achieved over the extraction sites, which were closed using 4-0 Monocryl sutures in a simple interrupted pattern, tacking the mesial and distal aspects of the sulcular incision first then filling in the remaining incisions with sutures spaced every 2 to 3 mm.

The right (FIGURE 8) and left mandibular canine teeth were extracted using a divergent mesial releasing incision made with a #15 blade, sparing the gingiva around the mandibular third incisors. An interdental releasing incision was made extending distally and directed apically, distal to the labial frenulum, sparing the gingiva at the mesial aspect of the mandibular first premolar teeth. The flap was reflected with an EX-9 periosteal elevator, with care taken to spare the middle mental artery and nerve exiting the middle mental foramen. A high-speed handpiece was used with a #330 bur to remove the buccal alveolar bone. Winged 2- to 4-mm elevators were used to elevate the canine teeth from the sockets. Extraction sites were closed as described for the maxillary canine teeth.

Opectuclectomy
Operculectomies were performed using a #15 scalpel blade, making wide elliptical incisions over the suspected crowns of the infraerupted right and left (FIGURE 9) maxillary first molars and unerupted left and right (FIGURE 10) mandibular first molars. A periosteal elevator was used to remove the incised pieces of tissue. Envelope flaps were made on the buccal and lingual aspects. Bone overlying unerupted teeth was removed to the level of the alveolar crest of
the adjacent fully erupted teeth, using a small pear diamond bur, Molt elevator, and small bone rongeurs. Care was taken to preserve the crowns of the maturing adult teeth. Alveolar bone was contoured around the exposed teeth, and the gingiva was sutured loosely with sling sutures of 4-0 Monocryl to maintain an appropriate gingival margin but not inhibit necessary eruption. Pre- and post-extraction and operculectomy radiographs were obtained.

RECOVERY AND DISCHARGE

The patient recovered uneventfully from anesthesia and was discharged later that day with instructions for soft or canned food; no tugs, toys, or chews for 14 days; and reevaluation at 14 days and 3 to 4 months.
In dogs, the deciduous dentition erupts between 3 and 12 weeks (Table 2), beginning with the incisors and moving distally to the canines and premolars. There are no molars in the deciduous dentition. Around 12 weeks of age (depending on the breed), the permanent dentition begins to erupt. By this time, the deciduous teeth should have already exfoliated. By 7 months of age, all teeth should be erupted or show evidence of eruption within the oral cavity. Knowledge of the deciduous and permanent dental formulas is imperative (Table 3). If the permanent teeth do not show evidence of eruption by 7 months of age, they are considered impacted.

It is imperative that the oral cavity be evaluated, including both the deciduous and adult dentition, throughout maturation. According to the 2019 American Animal Hospital Association Dental Care Guidelines for Dogs and Cats, the deciduous and adult dentition should be assessed for any missing, unerupted, or slow-to-erupt teeth and treated as deemed appropriate. The occlusion of the juvenile patient should be evaluated and intervention completed to help the permanent dentition erupt appropriately. Once the permanent dentition begins to erupt, extraction of any persistent deciduous teeth should be performed urgently to help prevent a malocclusion.

Dental radiography, CT, or cone-beam imaging is needed to verify whether unerupted teeth are present in areas of visibly missing dentition. If teeth are found to be impacted, extraction, operculectomy, or orthodontic extrusion is warranted to help prevent oral pathology.

**CONCLUSION**

Dentigerous cysts are commonly associated with unerupted teeth. Their etiology is unknown, but they are thought to form from the remnant epithelial tissue from the enamel organ or the reduced enamel epithelium. Removal of the unerupted tooth with capsule enucleation of the cystic lining, if present, is usually curative for patients. For the patient in this case, no radiographic evidence of cystic formation was observed on any of the unerupted teeth. Surgical removal of the unerupted teeth and the remnant enamel organ was curative in this patient.

**References**


**TABLE 2 Tooth Eruption Times in Dogs**

<table>
<thead>
<tr>
<th>Tooth Type</th>
<th>DECIDUOUS</th>
<th>PERMANENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisors</td>
<td>3-4 weeks</td>
<td>3-5 months</td>
</tr>
<tr>
<td>Canines</td>
<td>3 weeks</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Premolars</td>
<td>2-12 weeks</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Molars</td>
<td>None</td>
<td>5-7 months</td>
</tr>
</tbody>
</table>

**TABLE 3 Canine Dental Formulas**

<table>
<thead>
<tr>
<th>Tooth Type</th>
<th>DECIDUOUS DENTITION (IN EACH ARCADE)</th>
<th>PERMANENT DENTITION (IN EACH ARCADE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisors</td>
<td>3 maxillary</td>
<td>3 maxillary</td>
</tr>
<tr>
<td></td>
<td>3 mandibular</td>
<td>3 mandibular</td>
</tr>
<tr>
<td>Canines</td>
<td>1 maxillary</td>
<td>1 maxillary</td>
</tr>
<tr>
<td></td>
<td>1 mandibular</td>
<td>1 mandibular</td>
</tr>
<tr>
<td>Premolars</td>
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<td>4 maxillary</td>
</tr>
<tr>
<td></td>
<td>3 mandibular</td>
<td>4 maxibular</td>
</tr>
<tr>
<td>Molars</td>
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<td>2 maxillary</td>
</tr>
<tr>
<td></td>
<td>0 mandibular</td>
<td>3 maxillary</td>
</tr>
</tbody>
</table>

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Dr. Mulherin is a clinical professor at Iowa State University College of Veterinary Medicine. She began a dual appointment with Iowa State and the University of Wisconsin-Madison School of Veterinary Medicine in a dentistry and oral surgery residency, which she finished with the University of Wisconsin-Madison in 2014. She became a Diplomate of the American Veterinary Dental College in 2015. She is charged with dental education of veterinary students at Iowa State University.