Diagnostic Imaging in Veterinary Dental Practice

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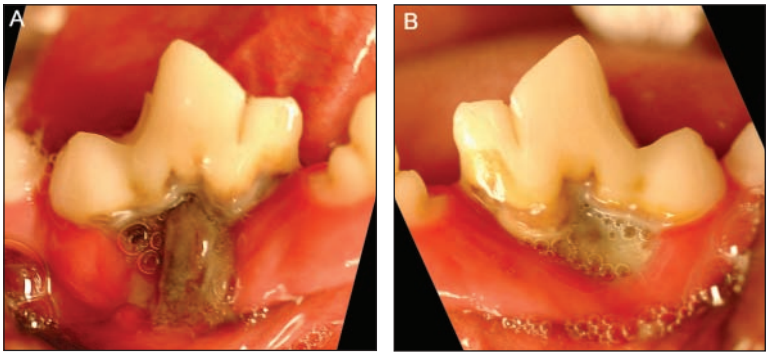

Figure 1—Gross appearance of the right (A) and left (B) mandibular first molar teeth in an 18-month-old dog examined because of chronic halitosis.

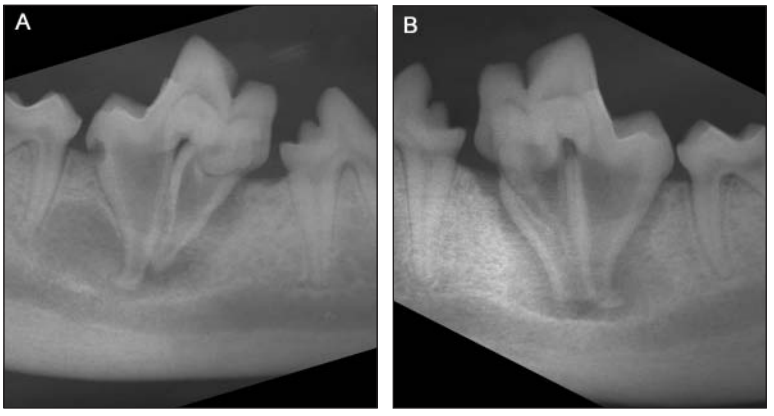

Figure 2—Intraoral radiographic views of the right (A) and left (B) mandibular first molar teeth in the dog in Figure 1.

History and Physical Examination Findings

An 18-month-old 18.3-kg (40.2-lb) neutered male mixed-breed dog was referred for evaluation and treatment of chronic halitosis. The dog was fed an over-the-counter dry adult dog food. A preliminary oral examination revealed moderate calculus and severe gingivitis with gingival recession and periodontitis localized at the left and right mandibular first molar teeth. Oral and physical examination findings were otherwise unremarkable, and results of a CBC and serum biochemical profile were within reference limits.

The patient was anesthetized to allow for a complete oral evaluation, dental radiography, and treatment of the affected teeth. The crowns of the right and left mandibular first molar teeth were malformed. The mesial and distal crowns had extra cusps along the cemento-enamel junction, especially on the mesial aspect of the crown and in the area of the furcation. Excessive mobility (1 mm of movement) of the right and left mandibular first molar teeth was noticed when digital pressure was applied. A 4-mm periodontal pocket was found on the mesiobuccal aspect of the left mandibular first molar tooth with a periodontal probe. Periodontal probing also revealed 8 and 6 mm of gingival recession at the furcations of the right and left mandibular first molar teeth, respectively. The furcation anatomy of these teeth was abnormal. Instead of a distinct separation of the mesial and distal roots, there was an extra cusp that extended apically along the roots, leaving minimal separation between the mesial and distal roots (**Figure 1**). Full-mouth dental radiography was performed. Intraoral radiographic views of the right and left mandibular first molar teeth obtained by use of the parallel technique and size 4 dental film are presented (**Figure 2**).

Determine whether additional imaging is required, or make your diagnosis, then turn the page →

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Diagnostic Imaging Findings and Interpretation

Dental radiography revealed severe endodontic and periodontal disease involving the right and left mandibular first molar teeth (**Figure 3**). All other teeth appeared radiographically normal.

Malformations of the crown and roots of the right mandibular first molar tooth are evident. The normal root conformation is not present, and the roots are convergent rather than divergent. The pulp chamber contains a structure with radiopacity similar to dentin presumably caused by invagination of enamel, dentin, and pulp into the mesial aspect of the crown of the tooth.

Figure 3—Same radiographic views as in Figure 2. In both teeth, notice the radiopaque structures at the mesial aspect of the crowns consistent with dens invaginatus (black arrows). Radiolucent areas surrounding the root apices that are associated with loss of the lamina dura and ascend coronally along the roots of the teeth, consistent with combined endodontic-periodontal lesions, are evident (white arrows). On the right side, notice the alveolar bone loss at the dorsal aspect of the mandibular canal (white arrowhead), creating a communication between the affected tooth's alveolus and the mandibular canal.

Width of the pulp cavity is greater than that in adjacent teeth, consistent with cessation of secondary dentin deposition and loss of tooth vitality. There are periapical lucencies that ascend along the mesial and distal roots with loss of the lamina dura. Caudal to the distal root is a large circular radiolucency that has dense bone along its periphery, creating a distinct border. The appearance of this radiolucency is consistent with a cyst or a granuloma typically associated with chronic apical periodontitis.[1] Active bone remodeling that appears to be creating ventral deviation of the mandibular canal adjacent to the molar roots is also evident. Notice the alveolar bone loss at the dorsal aspect of the mandibular canal, which creates a communication between the diseased tooth's alveolus and the mandibular canal.

The same infolding of enamel and dentin is also present at the mesial aspect of the crown of the left mandibular molar tooth. Width of the pulp cavity is greater than that in adjacent teeth, consistent with loss of tooth vitality. Notice the periapical lucencies surrounding the converging root apices and ascending coronally along the mesial and distal roots. Ventral deviation of the mandibular canal indicative of bone remodeling can be seen. However, unlike the right side, the dorsal aspect of the left mandibular canal appears intact.

Treatment and Outcome

Radiographic findings supported a diagnosis of dens invaginatus leading to arrested maturation (pulp necrosis) of the right and left mandibular first molar teeth.[2] Treatment options that were considered consisted of extraction and root canal therapy. Given the severe developmental defects and the combination of endodontic and periodontal disease with associated bone destruction, endodontic treatment was not recommended.

Mucoperiosteal flaps were raised to allow for extraction of the right and left mandibular first molar teeth. Because of the extensive alveolar bone loss, particular care was taken during tooth extraction not to fracture the mandible. Owing to the extensive malformation of the teeth, the convergence of the tooth roots, and the concomitant periodontal disease, crown sectioning was not performed. Instead, a high-speed handpiece with a cutting bur and copious water flow was used to notch the distal cervical region of each tooth. Next, a wing-tipped elevator was inserted horizontally into the notch and used to apply an extruding force to lift the tooth intact from the alveolus. In an attempt to preserve as much of the body of the mandible as possible, the buccal alveolar bone was left intact. Synthetic absorbable monofilament suture material (5-0 poliglecaprone 25) was used to suture the repositioned flap. Postoperative dental radiography was performed to document complete removal of the affected teeth and integrity of the mandibles. The gross appearance of the extracted teeth confirmed the diagnosis of dens invaginatus (**Figure 4**).

Figure 4—Gross appearance of the right and left mandibular first molar teeth of the dog in Figure 1 following extraction.

The dog was reevaluated 2 weeks after surgery. The surgical sites had healed, and the patient had returned to normal activities with complete resolution of the halitosis.

Comments

Dens invaginatus is an anomaly that occurs during tooth development in which the enamel organ (top of the tooth bud) folds onto itself, creating a deepening or invagination of the enamel organ into the dental papilla prior to calcification of the dental tissues.[3] This can produce additional layers of enamel, cementum, dentin, or pulp tissue inside the tooth.[2] The term dens en dente (literally, tooth within a tooth) is often used interchangeably with dens invaginatus. However, dens invaginatus is the more appropriate term because it describes the actual infolding of the outer portion (enamel) of the tooth into the inner portion (dentin) with the formation of a pocket or dead space.[3] This invagination of tooth structures can result in deformities of the crown, the root, or both.[2] Dens invaginatus results in exposure of dentin or pulp and rapid devitalization of the tooth following eruption because the area of invagination is typically incompletely lined by enamel or lined by a thin layer of enamel that is of poor quality.[2,3] This creates a direct communication for bacteria to gain access into the pulp cavity, making the tooth susceptible to a variety of pathological endodontic sequelae.[4]

Dens invaginatus develops within the dentin-pulp complex and as such can result in endodontic lesions. As bacteria gain access to the nutrient-rich pulp complex by way of the invagination, the tooth loses vitality secondary to necrosis of the blood and nerve supply, and the infection manifests as a granuloma surrounding the root end (apex) of the tooth. This area of inflammation can affect the periodontal attachment and result in combined endodontic-periodontal lesions.[4] Conversely, the abnormal gingival contour at the furcation of these malformed teeth predisposes them to severe focal periodontitis, which in turn may affect pulp vitality. In this case, the endodontic and periodontal lesions may develop concurrently.

The etiology of dens invaginatus is unknown, although a genetic cause is most likely.[3] The ectomesenchymal signaling between the dental papilla and the internal enamel epithelium that occurs during tooth development affects tooth morphogenesis.[5] These signaling systems have specific roles in regulating the growth and folding of the enamel organ. The absence of certain molecules can result in defects of the developing tooth germ and thus create abnormally shaped teeth.[6,7] A symmetric pattern of dens invaginatus has been identified in human patients, similar to the case in the dog in the present report, in which the right and left mandibular first molar teeth were both affected.[8]

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