A thorough intraoral examination must be part of every physical examination, beginning with a puppy’s first visit. Early diagnosis of fractured deciduous teeth, deciduous malocclusions, and persistent deciduous teeth allows for immediate treatment, thus preventing pain for the patient and potential pathology of the developing permanent teeth.

This article describes the anatomy of the deciduous tooth and its relationship to the developing permanent tooth, proper technique and appropriate instrumentation for removing deciduous teeth, and tips for minimizing complications during extraction.

TOOTH DEVELOPMENT AND ERUPTION

Eruption of a permanent tooth is a continuous process that begins with formation of the tooth bud and stops only when the tooth is lost or the dog dies.1 In the developing fetus, deciduous and permanent tooth buds form at approximately the same time. The dental lamina of the permanent tooth normally splits off from the deciduous tooth lamina. If a deciduous tooth is missing because the dental lamina failed to form, then the permanent tooth will also be missing. Remember that dogs have no deciduous precursors to the first premolar or molar teeth.

Exfoliation of deciduous dentition is a complex function and is not fully understood. As the permanent tooth root begins developing, its crown contacts the deciduous root. The pressure of the crown on the deciduous root stimulates resorption of the deciduous tooth. After sufficient root support is lost, the deciduous tooth crown is exfoliated.1 If no permanent tooth is present or if the permanent tooth does not erupt in the correct location, the deciduous tooth root does not resorb and may remain in place for years.

Although eruption times vary according to the breed and size of animal, all permanent teeth are usually erupted by the time a dog is 5 to 7 months of age.2 Permanent teeth erupt on the lingual or palatal side of their deciduous precursors except for the permanent maxillary canine teeth, which erupt on the mesial side of deciduous maxillary canine teeth (FIGURE 1).

INDICATIONS FOR DECIDUOUS TOOTH REMOVAL

Fractured Deciduous Teeth

Active, chewing puppies easily fracture their long, thin, fragile deciduous canine teeth, resulting in pulp exposure (FIGURE 2). Similar to fractured permanent
teeth, pulp exposure leads to pain, bacterial infection, and pulp necrosis (FIGURE 3). Extension of the resulting infection through the apex of the deciduous tooth may damage the adjacent developing permanent tooth bud(s). Periapical inflammation from a fractured deciduous tooth may interfere with development of the permanent tooth and lead to focal enamel hypoplasia, hypomineralization, or crown malformation of the developing permanent tooth. For these reasons, a fractured deciduous tooth should be extracted as soon as possible.

Deciduous Tooth Malocclusions

For any puppy with a traumatic occlusion in which the deciduous teeth are causing trauma to the soft tissues of the mouth, the most appropriate treatment is considered to be selective extraction of the deciduous dentition. Removing the deciduous tooth or teeth provides the potential for the dog to achieve full growth via relief of any dental interlock that may prevent mandibular growth. An additional benefit of interceptive orthodontics is elimination of pain created by deciduous tooth contact with the palate. Because continued treatment is often required during eruption of permanent dentition, referring patients with

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**FIGURE 1.** (A) Intraoral radiograph of the mandibles of a puppy, showing deciduous teeth and their relationship to the permanent tooth buds. Note the long, thin deciduous mandibular left canine tooth 704 (arrow) and its close proximity to the developing permanent mandibular left canine tooth 304 (asterisk). Note 804 is missing. (B) Intraoral radiograph of the left maxilla of a puppy, showing deciduous teeth and their relationship to the permanent tooth buds. Note the long, thin deciduous maxillary left canine tooth 604 (arrow) and its close proximity to the developing permanent maxillary left canine tooth 204 (asterisk).

**FIGURE 2.** Fractured persistent 504 with pulp exposure.

**FIGURE 3.** Complicated crown fracture of 804. Note the soft tissue swelling and parulis in the gingival tissue (arrow). A parulis is a nodule that occurs at the site where a draining tract from a periapical abscess reaches the gingival surface.
deciduous malocclusions to a board-certified veterinary dentist (avdc.org/find-a-veterinary-specialist) should be considered.

**Persistent Deciduous Tooth**

The term “persistent deciduous tooth” is used to describe a deciduous tooth that is not shed when its permanent tooth counterpart erupts. A deciduous tooth and its permanent counterpart should never be present at the same time (FIGURE 4). Persistent deciduous teeth are particularly common in toy breed dogs; the most commonly affected teeth are the incisors and canines.6

The potential consequences of a persistent deciduous tooth are increased risk for periodontal disease, malocclusion, and palatal trauma. A permanent tooth in contact with a deciduous tooth is often deprived of normal periodontal tissues.7 Plaque and calculus accumulate between the crowded teeth and predispose the permanent tooth to periodontal disease (FIGURE 5).

Orthodontically, a persistent deciduous canine tooth forces the permanent canine tooth to deviate from its normal pathway and erupt in an abnormal location. Retention of a deciduous tooth for as short a period as 2 weeks after eruption of the permanent tooth can result in occlusal defects in the permanent dentition.7

A persistent deciduous *maxillary* canine tooth results in mesial displacement of the permanent maxillary canine tooth, moving it into the interdental space that the permanent mandibular canine tooth would normally occupy. As a result, the permanent mandibular canine tooth is forced rostrally and lingually to maintain its position rostral to the maxillary canines. The displaced permanent mandibular canine tooth may contact the gingival or palatal soft tissues, the maxillary canine tooth, or maxillary incisor, resulting in abnormal tooth–tooth or tooth–soft tissue contact and discomfort for the dog.

![FIGURE 4. Persistent deciduous incisors and canine teeth in an 8-month-old Yorkshire terrier. Note the resulting displacement of permanent teeth.](image)

![FIGURE 5. Gingivitis, calculus, and plaque resulting from a persistent 604.](image)

![FIGURE 6. (A) Persistent 604 and 704 causing mesial displacement of 204 (orange asterisk) and lingual displacement of 304 (blue arrow) in a 5-month-old dog. (B) Same patient 1 month after removal of 604 and 704.](image)
A persistent deciduous mandibular canine tooth causes the permanent mandibular canine tooth to erupt in an abnormal position lingual to the deciduous tooth. Continued eruption of the permanent mandibular canine tooth in this position impinges on the hard palate, leading to pain and possible development of an oronasal fistula.

A persistent deciduous tooth should be removed as soon as the crown of the permanent tooth is visible above the gingival margin. Early removal of persistent deciduous canine teeth may allow the erupting permanent teeth to move into normal occlusion (FIGURE 6). Waiting until the puppy is older to “see if the tooth falls out” is not an appropriate treatment decision.

POTENTIAL COMPLICATIONS OF DECIDUOUS CANINE TOOTH REMOVAL

Understanding dental anatomy, knowing the location of the permanent tooth relative to the deciduous tooth, and using proper, sharp instruments in the appropriate manner and with patience will help you remove a deciduous canine tooth and minimize risk of damaging the permanent tooth or fracturing the tooth root. The best way to avoid surgical complications is through adequate preparation, evaluating the circumstances of each case, and following a mental checklist during the procedure.8

FIGURE 7. Extracted deciduous canine teeth (fractured root 604).

FIGURE 8. Enamel defect (blue arrow) and hypoplasia (orange arrows) affecting 304 resulting from removal of 704.

FIGURE 9. (A) Radiograph showing nonvital 404 (arrow), caused by an elevator impacting the developing permanent tooth during extraction of 804. (B) Extracted 404, showing the point of impact of the elevator on the buccal side of the tooth (arrow).
Root Fracture
The deciduous canine tooth is long, narrow, and thin-walled with a very long root, making it susceptible to fracture during extraction (FIGURE 7). If the root of the deciduous tooth fractures, it needs to be removed. A retained deciduous tooth root may potentially cause problems, including infection and difficulty with eruption of the permanent tooth. As with extraction of permanent teeth, if the root tip fractures, extend the buccal bone “window” to be able to visualize the root tip. Use a small elevator or root tip elevator to elevate the root tip through the window. Never dig blindly for root tips; always visualize a root tip before attempting to remove it. When elevating a deciduous tooth root tip, avoid the area of the developing tooth.

Damage to Permanent Teeth
The developing permanent canine tooth has a very thin layer of dentin, a large pulp cavity, and an open apex, which makes it susceptible to damage by improper use of the elevator or luxator during deciduous canine tooth removal. Damage to the permanent tooth may result in focal enamel hypoplasia (FIGURE 8), an endodontically diseased permanent tooth (FIGURE 9), structural defects, and/or relocation of the permanent tooth (FIGURE 10). Disturbances early in the process of tooth development will result in more extensive involvement and abnormality in the clinical appearance of the tooth than disturbance later in this process when certain aspects of the tooth will have already developed normally.

When removing deciduous teeth, client education is crucial. Clients should understand that you will do everything to minimize the potential for complications but that occasionally, removal of a deciduous canine tooth may result in damage to the developing permanent tooth.

Steps for Removing Deciduous Canine Teeth in the Dog
1. Administer a regional nerve block.9
2. Obtain a preoperative radiograph to evaluate the deciduous tooth root structure and to document the location of the developing permanent canine tooth. If the root of the deciduous tooth is being resorbed and the tooth is mobile, you can use a closed extraction technique (no flap creation and no bone removal) (FIGURE 11). If the long, thin root of the deciduous tooth is visible radiographically, it is best to use an open extraction technique (create a flap and remove buccal bone) (FIGURE 12).
3. Incise the gingival attachment around the deciduous tooth with a scalpel blade.
4. For a mobile deciduous tooth, carefully use a small
dental elevator to sever the remaining periodontal ligament fibers and remove the tooth.

5. For a deciduous tooth that is not mobile ([FIGURE 13A]), consider using an open extraction technique. The open extraction technique for removing a deciduous maxillary or mandibular canine tooth is very similar. A critical difference is the need to avoid the lingual side of the deciduous mandibular canine tooth during elevation where the permanent tooth is developing.

a. Begin by elevating a mucoperiosteal flap. Make an incision along the distal edge of the deciduous canine tooth ([FIGURE 13B]). Use a periosteal elevator to elevate the flap and expose the alveolar bone ([FIGURE 13C AND 13D]). Similar to permanent tooth extraction, elevation of a mucoperiosteal flap facilitates exposure.

b. Carefully remove the buccal bone over the root of the deciduous tooth. This is best accomplished by using a very small periosteal elevator to elevate the soft, thin layer of buccal bone ([FIGURE 14]). Remove only buccal bone over the root of the deciduous tooth; do not remove buccal bone beyond the borders of the

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**FIGURE 13.** Open extraction of deciduous maxillary canine tooth. (A) Before extraction. (B) Incision along distal edge of the tooth root. (C) Elevating mucoperiosteal flap with periosteal elevator. (D) Elevated flap.

**FIGURE 14.** Removal of buccal bone with periosteal elevator.
deciduous tooth. Using a periosteal elevator instead of a small round bur in a highspeed handpiece decreases the chance for iatrogenic trauma to the deciduous tooth root, which may lead to fracture, and decreases the chance of damaging the closely adjacent developing permanent tooth. As with permanent tooth extraction, removing the buccal bone facilitates extraction by creating a window through which to visualize the deciduous tooth and identify the periodontal ligament space (FIGURES 15 AND 16). Visualization is crucial!

c. To sever the periodontal fibers, insert an appropriately sized small dental elevator, luxator, or periotome into the periodontal ligament space along the root of the deciduous canine tooth. Keep the elevator in the

FIGURE 15. Deciduous maxillary canine tooth with buccal bone removed.

FIGURE 16. Open extraction of a deciduous mandibular canine tooth. Mucogingival flap created and buccal bone removed.

FIGURE 17. Sever the periodontal fibers by inserting a small dental elevator or luxator into the periodontal ligament space along the root surface of the deciduous canine tooth. (A) Small dental luxator inserted into the periodontal ligament space on the distal side of the tooth. (B) Luxator inserted on the mesial side of the tooth. (C) Mobile tooth being lifted out of the alveolus. Note: the short finger stop used during tooth extraction was removed to obtain the photographs.
periodontal space of the deciduous tooth. Do not allow the tip of the elevator or luxator to stray in the direction of the permanent tooth root, and always use a short finger stop (FIGURE 17). Remember that the permanent tooth root with its thin layer of primary dentin and very wide pulp cavity can be easily damaged by an inappropriately placed dental instrument. Do not use the permanent tooth as a fulcrum to lever against during the extraction, and do not twist the deciduous tooth with extraction forceps; doing so can lead to root fracture. Avoid the area of the developing permanent tooth, especially if the permanent tooth is not erupted.

d. After cutting and breaking down the periodontal ligament, when the tooth is very mobile, use a small elevator to gently elevate the tooth out of the alveolus (FIGURE 17C). Remember that patience and slow steady pressure are key to successful extraction of any tooth, especially deciduous teeth (FIGURE 18).

e. Take a postoperative radiograph to document removal of the entire deciduous tooth root (FIGURE 19).

f. Remove any loose bone spicules, lavage the surgical site, and close the mucoperiosteal flap with absorbable suture material (FIGURE 20).

**SUMMARY**

To prevent patient discomfort and pathology of developing permanent teeth resulting from problems with deciduous canine teeth in the dog, diagnosis and extraction of the appropriate deciduous tooth/teeth should be performed as early as possible.

Indications for extracting deciduous canine teeth are
- Fractured deciduous teeth
- Deciduous malocclusions
- Persistent deciduous teeth

Complications of deciduous canine tooth removal include fracture of the deciduous tooth root and damage to the developing permanent tooth.

To avoid fracturing the deciduous tooth root
- Use an open extraction technique if the root is visible on the intraoral radiograph.
- Carefully elevate the deciduous tooth until it is very mobile and easily removed from the alveolus with minimal effort.
- Avoid twisting the deciduous tooth with extraction forceps.

**FIGURE 18.** Empty alveolus after removal of deciduous maxillary canine tooth.

**FIGURE 19.** Postoperative radiograph documenting removal of the entire deciduous tooth root.

**FIGURE 20.** Mucoperiosteal flap closed with absorbable suture material.
To avoid damaging the developing permanent tooth

- Obtain a preoperative radiograph to identify the location of the developing permanent tooth relative to the deciduous tooth.
- Keep the small elevator or luxator in the periodontal ligament space closely adjacent to the deciduous tooth. Do not allow the elevator or luxator to stray in the direction of the developing permanent tooth. If possible, avoid elevating on the side of the developing permanent tooth.
- Avoid levering against the developing permanent tooth.

References

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Dosing Chart

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Warnings:

APOQUEL is not for use in dogs less than 12 months of age (see Animal Safety).

APOQUEL modulates the immune system. APOQUEL may increase susceptibility to infection, including dermatosis, and exacerbation of neoplastic conditions (see Precautions, Adverse Reactions, Post-Approval Experience and Animal Safety).

New neoplastic conditions (benign and malignant) were observed in dogs treated with APOQUEL during clinical studies and have been reported in the post-approval period (see New neoplastic conditions (benign and malignant) have been reported in the post-approval period).

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Human Warnings:

This product is not for human use. Keep this and all drugs out of reach of children. For use in dogs only. Wash hands immediately after handling the tablets. In case of accidental eye contact, flush immediately with water or saline for at least 15 minutes and then seek medical attention. In case of accidental ingestion, seek medical attention immediately.

Precautions:

Dogs receiving APOQUEL should be monitored for the development of infections, including dermatosis, and neoplasia.

The use of APOQUEL has not been evaluated in combination with glucocorticoids, cyclosporine, or other systemic immunosuppressive agents.

APOQUEL is not for use in breeding dogs, or pregnant or lactating bitches.

Adverse Reactions:

Control of Atopic Dermatitis

In a masked field study to assess the effectiveness and safety of oclacitinib for the control of atopic dermatitis in dogs, 152 dogs treated with APOQUEL and 147 dogs treated with placebo (vehicle control) were evaluated for safety. The majority of dogs in the placebo group withdrew from the 112-day study by Day 16. Adverse reactions reported (and percent of dogs affected) during Days 0-16 included diarrhea (4.6% APOQUEL, 3.4% placebo), vomiting (3.9% APOQUEL, 4.1% placebo), anorexia (2.6% APOQUEL, 0% placebo), new cutaneous or subcutaneous lump (2.6% APOQUEL, 2.7% placebo), and lethargy (0.0% APOQUEL, 1.4% placebo). In most cases, diarrhea, vomiting, anorexia, and lethargy spontaneously resolved with continued dosing. Dogs on APOQUEL had decreased leukocytes (neutrophil, eosinophil, and monocyte counts) and serum globulin, and increased cholesterol and lipase compared to the placebo group but group means remained within the normal range. Mean lymphocyte counts were transiently increased at Day 14 in the APOQUEL group.

Dog that withdrew from the masked field study could enter an unmasked study where all dogs received APOQUEL. Between the masked and unmasked study, 283 dogs received at least one dose of APOQUEL. Of these 283 dogs, two dogs were withdrawn from study due to suspected treatment-related adverse reactions: one dog that had an intense flare-up of dermatitis and severe secondary pyodermia after 19 days of APOQUEL administration, and one dog that developed generalized demodicosis after 28 days of APOQUEL administration. Two other dogs on APOQUEL were withdrawn from study due to suspected or confirmed malignant neoplasia and subsequently euthanized, including one dog that developed signs associated with a heart base mass noted on echocardiography after 21 days of APOQUEL administration, and one dog that developed a Grade III mast cell tumor after 40 days of APOQUEL administration.

One of the 147 dogs in the placebo group developed a Grade I mast cell tumor and was withdrawn from the masked study. Additional dogs receiving APOQUEL were hospitalized for diagnosis and treatment of pneumonia (one dog), transient bloody vomiting and stool (one dog), and cystitis with urinalysis abnormalities (two dogs).

In the 283 dogs that received APOQUEL, the following additional clinical signs were reported after beginning APOQUEL (percentage of dogs with at least one report of the clinical sign as a non-pre-existing finding): pyodermia (12.0%), non-specified dermal lumps (12.0%), otitis (9.9%), vomiting (8.2%), diarrhea (6.0%), histiocytoma (3.9%), cystitis (3.5%), anorexia (3.2%), lethargy (2.8%), yeast skin infections (2.5%), pododermatitis (2.5%), lipoma (2.1%), polydipsia (1.4%), lymphosarcoma (1%), nausea (1.1%), increased appetite (1.1%), aggression (1.1%), and weight loss (0.7%)

Control of Pruritus Associated with Allergic Dermatitis

In a masked field study to assess the effectiveness and safety of oclacitinib for the control of pruritus associated with allergic dermatitis in dogs, 216 dogs treated with APOQUEL and 226 dogs treated with placebo (vehicle control) were evaluated for safety. During the 30-day study, there were no fatalities and no adverse reactions requiring hospital care. Adverse reactions reported (and percent of dogs affected) during Days 0-7 included diarrhea (2.3% APOQUEL, 0.9% placebo), vomiting (2.3% APOQUEL, 1.8% placebo), lethargy (1.8% APOQUEL, 1.4% placebo), anorexia (1.4% APOQUEL, 0% placebo), and polydipsia (1.4% APOQUEL, 0% placebo). In most of these cases, signs spontaneously resolved with continued dosing. Five APOQUEL group dogs were withdrawn from study because of: darkening of areas of skin and fur (1 dog); diarrhea (1 dog); fever, lethargy and cystitis (1 dog); an inflated footpad and vomiting (1 dog); and diarrhea, vomiting, and lethargy (1 dog). Dogs in the APOQUEL group had a slight decrease in mean white blood cell counts (neutrophil, eosinophil, and monocyte counts) that remained within the normal reference range. Mean lymphocyte count for dogs in the APOQUEL group increased at Day 7, but returned to pretreatment levels by study end without a break in APOQUEL administration. Serum cholesterol increased in 25% of APOQUEL group dogs, but mean cholesterol remained within the reference range.

Control Field Study

After completing APOQUEL field studies, 239 dogs enrolled in an unmasked (no placebo control), continuation therapy study receiving APOQUEL for an unrestricted period of time. Mean time on this study was 372 days (range 1 to 610 days). Of these 239 dogs, one dog developed demodicosis following 273 days of APOQUEL administration. One dog developed dermal pigmented viral plaques following 266 days of APOQUEL administration. One dog developed a moderately severe bronchopneumonia after 272 days of APOQUEL administration; this infection resolved with antimicrobial treatment and temporary discontinuation of APOQUEL. One dog was euthanized after developing abdominal ascites and pleural effusion of unknown etiology after 450 days of APOQUEL administration. Six dogs were euthanized because of suspected malignant neoplasms: including thoracic metastatic, abdominal metastatic, splenic, frontal sinus, and intrarenal neoplasms, and transitional cell carcinoma after 17, 120, 175, 49, 141, and 286 days of APOQUEL administration, respectively. Two dogs each developed a Grade II mast cell tumor after 52 and 91 days of APOQUEL administration, respectively. One dog developed low grade cell lymphoma after 390 days of APOQUEL administration. Two dogs each developed an apocrine gland adenocarcinoma (one doral, one anal sac) after approximately 210 and 320 days of APOQUEL administration, respectively. One dog developed a low grade oral spindle cell sarcoma after 320 days of APOQUEL administration.

Post-Approval Experience (2020):

The following adverse events are based on post-approval adverse drug experience reporting for APOQUEL. Not all adverse events are reported to FDA/CVM. It is not always possible to reliably establish an adverse event frequency or establish a causal relationship to product exposure using these data.

The following adverse events reported in dogs are listed in decreasing order of reporting frequency:

Vomiting, lethargy, anorexia, diarrhea, elevated liver enzymes, dermatitis (i.e. crusts, pododermatitis, pyoderma), seizures, polydipsia, and demodicosis.

Benign, malignant, and unclassified neoplasms, dermal masses (including papillomas and histiocytomas), lymphoma and other cancers have been reported.

Death (including euthanasia) has been reported.

Contact Information:

To report suspected adverse events, for technical assistance or to obtain a copy of the Safety Data Sheet, contact Zoetis Inc. at 1-888-963-8471 or online at www.zoetis.com. For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or online at www.fda.gov/reportanimalae.

Storage Conditions:

APOQUEL should be stored at controlled room temperature between 20° to 25°C (68° to 77°F) with excursions between 15° to 40°C (59° to 104°F).

How Supplied:

APOQUEL tablets contain 3.6 mg, 5.4 mg, or 16 mg of oclacitinib as oclacitinib maleate per tablet. Each strength tablets are packaged in 100 and 250 count bottles. Each tablet is scored and marked with AQ and either an S, M, or L that correspond to the different tablet strengths on both sides.

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