INTRODUCTION

The dentition of young animals is often overlooked, as the most prevalent dental problem seen in a general practice is periodontal disease, which is rarely seen in immature animals. However, deciduous and early permanent dentitions have unique conditions, and dealing with them correctly is essential.

ERUPTION DATES

Pups and kittens are born edentulous. The deciduous teeth begin to erupt at two to four weeks of age. The canine teeth have usually erupted by four weeks, and all deciduous teeth should be in place by six weeks of age (Eisenmenger & Zetner, 1985). The deciduous dental formulae are: 2x (I^3_1, C^1_1, P^3_1, M^2_3) = 28 and 2x (I^3_3, C^1_1, P^3_1, M^2_3) = 26 for puppies and kittens respectively. Exfoliation of the deciduous teeth begins and the first permanent teeth erupt at about 14 weeks of age. By the end of the sixth month, all the permanent teeth have erupted and are in functional occlusion (Shabestari et al., 1967). The permanent dental formulae are 2x (P^3_3, C^1_1, P^3_4, M^2_3) = 42 and 2x (I^3_3, C^1_1, P^3_1, M^1_1) = 30 for adult dogs and cats respectively.

CAUSAL FACTORS

During the development of both deciduous and permanent teeth, various factors can greatly alter normal crown and root formation. Systemic and local inflammation or infection, sometimes accompanied with fever, at the time of tooth bud maturation can commonly alter the appearance and structure of the enamel and root (Eisenmenger & Zetner, 1985; Rossman et al., 1985).

Trauma, whether accidental or iatrogenic, during extraction of deciduous teeth, can also cause significant pathology (Rossman et al., 1985). The position of the permanent tooth bud lingual to most of the deciduous teeth, except the maxillary canines which are mesial, makes it extremely susceptible to stimuli from its predecessor.
FIGURE 1: This three-month-old Terrier dog is missing both upper lateral incisor teeth.

FIGURE 2: The dog in Figure 1, on radiograph, shows no evidence of permanent tooth buds for the upper lateral incisor teeth.

FIGURE 3: This four-month-old Rhodesian Ridgeback dog has fractured the deciduous canine tooth. Note the pulp exposure and vertical root fracture.

FIGURE 4: This 12-week-old German Shepherd puppy had a hard palate ulcer caused by base narrow lower canine teeth.

FIGURE 5: Malevolent interlock in a 12-week-old dog where the lower canine teeth are caught behind the upper canine teeth

FIGURE 6: This extracted pre-molar tooth shows root dysplasia, evident as the root curves or kinks excessively.
CONDITIONS AND PATHOLOGY OF DECIDUOUS TEETH

Missing Deciduous Teeth
Missing deciduous teeth in itself does not present a serious physical problem, but may be an indication of missing permanent analogs (Rossman et al., 1992) (Fig. 1). By eight to 12 weeks of age, radiographs can be taken to confirm the presence or absence of permanent tooth buds (Fig. 2). A single missing tooth typically does not indicate a major abnormality, but multiple missing teeth, especially bilaterally, increase the probability of genetic predisposition (Lobprise, 1993).

Fractured Deciduous Teeth
The deciduous teeth have very thin walls and can be fractured during play or trauma (Fig. 3). Fractured deciduous teeth should generally be extracted, as endodontic therapy is typically unwarranted, and any potential source of infection to nearby permanent tooth buds and alveolar bone should be removed (Ross & Goldstein, 1986). Infection may gain access through the open pulp canal. The root of a deciduous tooth can easily fracture on extraction, so care must be taken. If endodontic treatment is necessary in deciduous teeth, it is relatively simple, using Zinc Oxide¹ and Eugenol² as a filler (or calcium hydroxide³ if resorption has started) with an intermediate restorative access closure.

Malocclusions
Deciduous teeth may also be extracted in cases of early malocclusions. If the primary dentition shows abnormal positioning, such as base narrow mandibular canines, retention of these canine teeth may not only cause a detrimental interlock of teeth into the hard palate, resulting in ulceration (Fig. 4) and interfering with mandibular growth, but they may also influence their permanent counterparts to erupt even further lingually, except the maxillary canines which erupt mesially (Rossman et al., 1985). Since maturation of each jaw quadrant (upper and lower mandibulalae and maxillae) is relatively independent of each other, slight variations in growth may also cause a malevolent interlock of deciduous incisors and canines (Fig. 5), again potentially influencing jaw growth, in an otherwise genetically normal individual (Shipp & Fahrenkrug, 1992). In these cases, selective extraction of deciduous teeth may be attempted, realising that extractions of this kind will not be effective if malocclusion is of genetic origin (Goldstein, 1990). One simple rule is to extract the canines and incisors of the shorter jaw to prevent further interference (Shipp & Fahrenkrug, 1992). It should be remembered, however, that interlocks are occasionally advantageous, especially when the lower canines are tight against the upper lateral incisors in an animal experiencing a mandibular growth spurt.

¹Zinc Oxide U.S.P., Sultan Chemists Inc
²Eugenol U.S.P., Sultan Chemists Inc
³Sealapex, Kerr

such a case, the only beneficial extractions would be of the upper central and intermediate incisors.

Interceptive Orthodontics
These practices of interceptive orthodontics should ideally be performed between six to eight weeks of age (no later than 12 weeks), after which time the permanent teeth eruptions are imminent, and often take the abnormal place of their predecessors (Lobprise, 1993). The actual process of exodontia should be carried out with extreme caution to minimise potential damage to the permanent tooth bud under the gingival surface. Infiltration of a local anaesthetic with vasoconstrictor (adrenaline 1:100,000) will help with local discomfort and decrease haemorrhage, as the forming enamel can be discoloured by the pigments in the blood. Elevation of the tooth should be done gently with gradual forces. Extreme gouging and rotation should be avoided to prevent fracture of the delicate deciduous roots (Goldstein, 1990). If the crown breaks off, attempts should be made to completely retrieve the remaining roots, but again with care. If necessary, a moderate gingival flap and alveoloplasty may be performed to expose the root tip. If infection is present, oral antibiotics should be continued post-operatively. Whenever attempting deciduous extractions, the owner should be notified that changes may occur to the permanent tooth, no matter how carefully the procedure is done. These changes may range from very mild enamel pitting, to more severe enamel and root dysplasias (Fig. 6), and even malpositioned or unerupted teeth (Goldstein, 1990).

Retained Deciduous Teeth
One area where primary exodontia is the only choice is in the case of retained deciduous teeth (Ross & Goldstein, 1986; Bojrab & Tholen, 1990; Shipp & Fahrenkrug, 1992) (Fig. 7). If the permanent counterpart has not erupted, the mouth should be radiographed, and if the permanent tooth bud is absent, the deciduous tooth should be left. Exfoliation can be influenced by many factors, such as nutrition, inflammation, trauma, endocrine disorders such as hypothyroidism and ankylosis of the tooth to alveolar bone. Once the adult tooth starts eruption, unless its way is unimpeded, it will be deflected away from its normal position, lingually for most teeth, except for the maxillary canines, which are displaced rostrally (Fig. 8). This may result in the lower canine tooth being displaced labially (Fig. 9). While the deciduous crown may be ready to exfoliate in some cases, if any root structure remains, it should be completely removed (Shipp & Fahrenkrug, 1992). Retained deciduous teeth may commonly cause malocclusion such as base narrow mandibular canines (Fig. 10), where the lower canine teeth erupt lingually to the deciduous canine teeth, or anterior cross bite (Fig. 11), where one or more of the maxillary incisors lean lingually to the mandibular incisors (lingversion). While specific dental malocclusions caused by retained deciduous teeth have not been proven to be genetic, as are jaw length discrepancies, any orthodontic adjustment should be thoroughly discussed, including breeding counselling.
FIGURE 7: This seven-month-old dog has retained deciduous canine teeth. Note the upper permanent teeth erupt rostrally to the deciduous teeth, whereas the lower canine teeth erupt lingually to the deciduous teeth.

FIGURE 8: This two-year-old dog has a rostrally displaced left upper permanent canine tooth, caused by its retained predecessor. This condition is hereditary in Shelties.

FIGURE 9: The same dog as in Figure 8. The rostrally displaced upper canine tooth causes the lower canine tooth to be displaced labially.

FIGURE 10: Retained lower canine teeth force the permanent canine teeth to erupt lingually, a condition known as base narrow canine teeth.

FIGURE 11: This dog has an anterior cross bite. Note the upper middle incisor tooth has erupted caudally to the lower incisor teeth.

Eisenmenger & Zetner, 1985 (Used with permission)

FIGURE 12: This dog has an open communication between the nasal and oral cavity, known as a cleft palate.
Development And Genetic Defects
Other developmental and genetic defects in young animals may be seen associated with the soft tissues and bony structures of the head (Harvey, 1987). Primary (cleft lip) and secondary (cleft palate) (Fig. 12) defects can lead to serious complications if not managed correctly. With so many factors regulating jaw growth and having the immature bones so sensitive to injury, a noticable discrepancy in the growth rate in one or more jaw quadrants can produce the condition known as wry mouth (Shipp & Fahrenkrug, 1992) (Fig. 13).

CONDITIONS AND PATHOLOGY OF IMMATURE PERMANENT TEETH

Missing permanent teeth
Missing permanent teeth can be a common problem in certain breeds (Elzay & Hughes, 1969; Andrews, 1972; Golden et al., 1982). The first pre-molar in German Shepherds and the second or third pre-molars in smaller breeds may be missing. In the German Shepherd dog, as well as some other large breeds, absent teeth can be a problem if the owner wishes to show and breed the animal. When a tooth is absent on examination (Fig. 14), a radiograph should be taken to confirm the presence of absence of the permanent tooth bud (Shipp & Fahrenkrug, 1992) (Fig. 15).

Retained deciduous and absent permanent teeth
Sometimes, a deciduous tooth may be retained with no evidence of a permanent tooth erupting (Eisenmenger & Zetner, 1985). Before extraction of the deciduous tooth, a radiograph must be taken to confirm the presence or absence of a permanent tooth bud (Fig. 16).

Orthodontics
Many stimuli can have some influence on the eventual placement of the permanent dentition (Bojrab & Tholen, 1990). If the teeth are in abnormal positions, orthodontic evaluation is usually initiated when the animal is still very young. The timing of orthodontic therapy is very important (Grove, 1986; West & McNeil, 1986). Specifics of orthodontics will not be discussed here, but some general guidelines are important to follow when dealing with immature dentitions. Unless severe trauma is present, orthodontic movement generally should not be attempted until the patient is at least nine months of age (sometimes later), due to the underdevelopment of the root and the apex, as well as incomplete coronal height. Any forces applied should be relatively light to avoid excess trauma (Proffit, 1986).

Abnormalities in the shape of teeth
Developmental abnormalities in the shape of the tooth are rare and usually of little clinical importance. Dens in dente is a rare condition (Fig. 17) when, during tooth development, the enamel organ enters the dental papilla, resulting in an area of enamel within the dentin. This exposes the pulp to bacterial infection (Rossman et al., 1985), which may result in periapical abscession or suborbital swelling (Harvey et al., 1983) (Fig. 18).

Fractures
 Canal exposure in immature permanent teeth can respond to treatment, if handled correctly. Due to the large canal size and excellent blood supply, vital pulpotomy procedures (apexogenesis) can be attempted as late as two weeks post-exposure (Peter Emily, pers. comm.). If there is any chance to preserve pulp vitality to encourage continued maturation of the open apex and thin dentinal walls, it should be tried (Camp, 1984; Webber, 1984; Torneck, 1986). If the pulp is completely non-vital, however, apexification with canal debridement and calcium hydroxide placement may help stimulate a hard tissue closure of the apex (Camp, 1984; Webber, 1984; Torneck, 1986; Walton & Torabinejad, 1989).

Enamel defects
As the permanent teeth erupt, certain enamel changes may become evident. A chalky white appearance to the enamel may indicate mild hypocalcification (Fig. 19), while others may exhibit enamel dysplasia, a severe generalised enamel defect (Fig 20). In general, any febrile or systemetically debilitating disease during the development stages may cause lack of proper mineralisation (hypocalcification) of the enamel (Williams, 1986). Distemper teeth are commonly mislabelled as enamel hypoplasia, but this is wrong, as they should be termed enamel hypoplastic. Hypoplasia means thin enamel but normal mineralisation, whereas hypocalcification means poorly calcified enamel that may discolour, decay, be soft and have rapid attrition. It should be noted that some cases of enamel dysplasia may be accompanied by some degree of root dysplasia, possibly even total absence, so radiographs should always be taken. Gently scrubbing to remove the diseased enamel, accompanied by smoothing of the surfaces, polishing and fluoride treatment can help the overall appearance to a degree. Full restorations (crowns) are occasionally attempted in individual teeth, but are less practical in generalised situations. The owners should be encouraged to maintain good dental hygiene, including weekly stannous fluoride applications, or brushing with an animal toothpaste4, but they should also be informed that the remaining enamel may eventually experience some changes as well.

CONCLUSION
Paediatric dentistry deals with the diagnosis and treatment of developmental, genetic and iatrogenic factors that may lead to missing teeth, tooth fractures, root or enamel dysplasia and dental malocclusions. While in some individuals, teeth may experience unusual juvenile syndromes, periodontal disease is typically not a problem in young animals. When the young animal has emphasis placed on accurate diagnosis and treatment of early dental

4CET/CHK products, Cenvet
FIGURE 13: This seven-month-old Cavalier King Charles Spaniel dog has a wry mouth. This occurs when there is a discrepancy in jaw lengths, causing the maxilla or mandible to bow or twist to one side.

FIGURE 14: This eight-month-old German Shepherd dog was missing its left lower first pre-molar tooth.

FIGURE 15: The dog from Figure 14, on radiograph, shows the missing left lower first pre-molar tooth, but has the right lower first pre-molar tooth present.

FIGURE 16: This 17-month-old cat still had its deciduous canine teeth, with no evidence of any permanent canine teeth. A radiograph did not show any sign of permanent tooth buds.

FIGURE 17: This dog had a condition known as dens in dente. The enamel has formed within the dentin in this upper first molar tooth.

FIGURE 18: The dog in Figure 17. A common clinical sign of pulpal infection is suborbital swellings.
pathology, current dental conditions and any future problems can be avoided throughout the pet’s life.

REFERENCES


FIGURE 19: This nine-month-old dog has enamel defects, seen as roughened enamel on the labial surface of the upper canine tooth. Note it also has a retained canine tooth.

FIGURE 20: This eight-year-old Golden Retriever dog has severe enamel dysplasia, seen as shelves and rings of enamel formation.

Experience is what alerts you to a mistake when it is about to happen for the second time.