

Self-Assessment
Colour Review of

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Veterinary Dentistry

Frank J M Verstraete



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Self-Assessment Colour Review of Veterinary Dentistry

Frank J.M. Verstraete

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Preface

I hope that the contents of this book will be a true reflection of its title. This text was written to give you, the reader, whether you are a keen final-year student, a resident, a practitioner, or a board-certified specialist, an opportunity to assess your knowledge of veterinary dentistry, based on a series of well-illustrated questions. Hopefully, it will stimulate your interest and promote further study. The book should be used in combination with standard dentistry textbooks; it is not intended to substitute any of them, and by no means should this book be seen as a stand-alone volume. If, at the end of an evening, having gone through a few questions, you find your desk covered with half a dozen opened veterinary and human dental textbooks, and several article reprints scattered in between, I will have achieved my goal!

Care has been taken to ensure that the material presented is informative and factually correct. However, the format of the book does not allow in-depth discussion of the various nuances that may exist and be applicable to a clinical case. Equally, the random nature of the questions and the limited volume of this book do not allow a systematic and comprehensive review of the subject matter. Although I recognize these shortcomings, I urge the reader to see beyond the limitations of the format and use this book to explore the fascinating world of veterinary dentistry.

Frank J.M. Verstraete

February 1998

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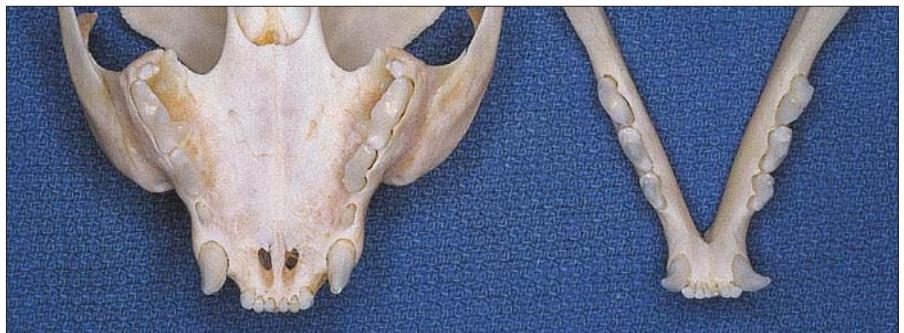
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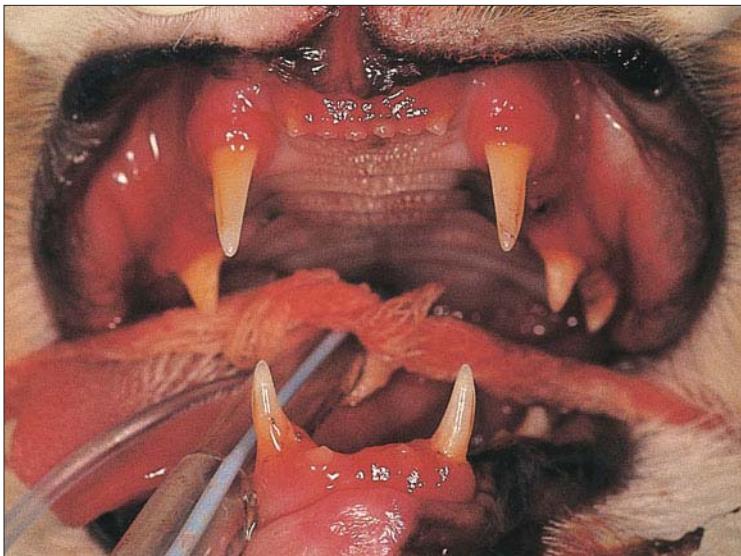
I, 2: Questions



1a

1 The dental formula of the primitive carnivore consists of 44 teeth (three incisors, one canine, four premolars, and three molars in each quadrant). The modern carnivore dentition shows several adaptations of the primitive carnivore dentition.

- i. Which teeth in the cat (1a) are reduced in number compared with the primitive carnivore dentition?
- ii. What is a carnassial tooth?
- iii. Which are the carnassial teeth in the cat?

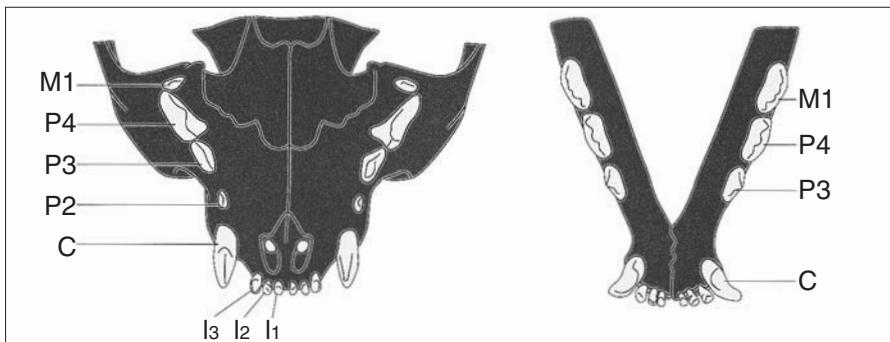


2

2 This young adult cat is healthy with the exception of the oral disease shown (2) which is painful and results in anorexia. What would you recommend for medical management of this patient's oral problem?

I, 2: Answers

1b

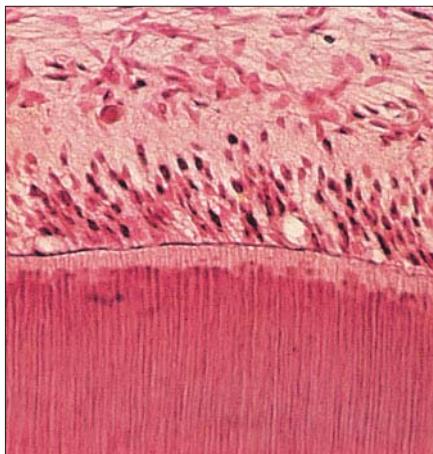


- 1 i. The premolars and molars (1b). The maxillary first premolar and mandibular first and second premolars have disappeared in the modern cat dentition. The correct anatomic designations of the first premolars actually seen in the upper and lower jaws are the maxillary second premolar and mandibular third premolar, respectively. Moreover, the cat only has one molar tooth per quadrant. This is the first molar tooth. The maxillary molar is a small, non-functional, single or double-rooted tooth and the mandibular molar has lost its grinding surface and become a carnassial tooth.
ii. A '*dens sectorius*'. The premolars and especially the carnassials are secodont, i.e. they have sharp cutting edges which function as scissors during jaw movement.
iii. The maxillary fourth premolar and the mandibular first molar.

2 This patient has severe gingivitis, stomatitis and faucitis. Initial management would include a complete evaluation of the oral cavity and teeth; a biopsy should be taken for histopathology if neoplasia or other oral problem is suspected. A complete scaling and polishing should be performed. Medical management of oral inflammatory disease is aimed at plaque control and/or suppression of the inflammatory/immune response. Long-term (e.g. 6–8 weeks) or continuous antibiotic administration may result in a decrease in oral inflammation and pain; exacerbations may occur during antibiotic administration and usually occur after antibiotics are discontinued. Methylprednisolone (15–20 mg per cat, subcutaneously) generally results in significant improvement of oral inflammation, pain, and appetite. The duration of response depends on the severity of the oral inflammation; treatments generally are required every 3–6 weeks. Oral glucocorticoids (e.g. prednisone) are usually not successful in initial management of severe inflammatory disease; they may be used for long-term management in some cats with milder inflammation. Some cats show a better response to combination therapy with antibiotics and glucocorticoids. Gold salts as a single agent or in combination with glucocorticoids have been reported to be successful in the management of some cats with oral inflammatory disease; however, treatment in immunosuppressed cats should be carefully monitored.

3–5: Questions

3



4a



3 The bulk of most mature teeth is composed of dentin (3).

- What are the main components of dentin?
- What are primary, secondary, tertiary and reparative dentin?
- How is dentin formed?

5 These dental instruments are used in what equine dental procedure (5)?

4 What technique could be used to improve the adhesion of composite resin restorative material to the tooth (4a)?



5

3–5: Answers

- 3 i. Dentin is composed of a mineralized collagenous matrix. The mineral component is principally calcium hydroxyapatite.
- ii. Primary dentin is the dentin produced before a tooth erupts and comes into function. Secondary dentin is produced once a tooth has erupted. Functional stresses on the tooth usually affect the structure and rate at which secondary dentin is produced, leading to the formation of a distinctly visible line within the dentin at the interface between primary and secondary dentin. Tertiary or reparative dentin is dentin produced as a result of pathologic influences or injury to the tooth. Reparative dentin is often produced very rapidly and may have a very irregular structure.
- iii. Dentin is formed by odontoblasts, the cells lining the pulp cavity. These cells lay down a collagenous matrix known as predentin which is then mineralized to form dentin. Throughout life the odontoblasts continue producing dentin, gradually reducing the size of the tooth's pulp cavity. The odontoblasts have long, fine cellular processes, the odontoblastic processes, which extend within the dentinal tubules. These odontoblastic processes may extend the full thickness of dentin, and occasionally slightly beyond the interface with cementum and enamel.

- 4 Adhesion of dental materials can be by mechanical interlock and by achieving micromechanical retention and sealing. Enamel and dentin are different structures and require different treatment to achieve bonding. Enamel should be etched with a phosphoric acid gel (4b). The time for etching ranges from 30–60 seconds. There is no clear-cut answer as to acid-etching dentin. Some researchers have reported that the greatest bond strength occurs in unetched dentin, while others report better success by briefly (5–10 seconds) etching. Etching is performed to remove the so-called 'smear layer' and open up the dentinal tubules, allowing improved penetration of the restorative material. Over-etching may destroy the integrity of the dentinal tubules and actually weaken the bond strength. The next step is to apply a bonding agent. The aim of modern bonding agents is to create a link between enamel and dentin (which contain water) and the dental adhesive resins which are hydrophobic. By so doing, the bonding strength between the restorative material and the tooth is increased. After application of the bonding agent, an unfilled resin is applied to the tooth. This layer is cured with a light-cure gun. The filled resin is then placed in 2–3 mm layers if necessary to build up the restoration. This filled resin bonds to the previously applied filled restorative material.



4b

- 5 These are all types of 'floats' used in removing the sharp enamel points from the buccal aspect of the maxillary cheek teeth and the lingual aspect of the mandibular cheek teeth. Floats are also used to correct abnormalities such as tall/long teeth, hooks, ramps, and breaks, and to round the mesial aspect of the second premolars.

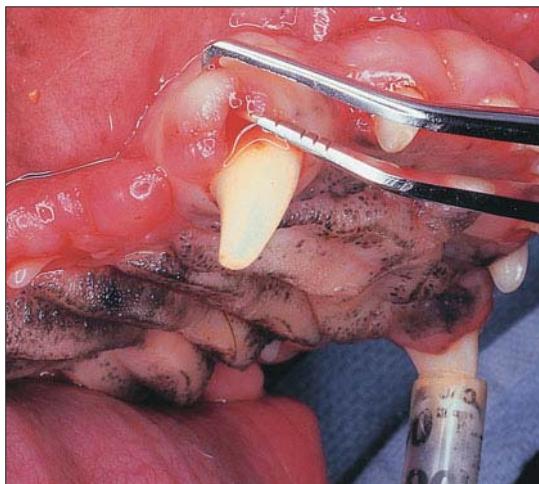
6, 7: Questions

6 Oral examination of a three-year-old male cat reveals periodontal disease and odontoclastic resorptive lesions. The remainder of the physical examination is unremarkable with the exception of a regurgitant systolic murmur, heard best over the sternum, and a gallop rhythm. The cat is strictly ‘indoors’ and is fairly inactive, and the owners have not noticed any respiratory or attitudinal changes.

- i. What is your assessment of the findings found on cardiac auscultation?
- ii. What diagnostic testing would you recommend before general anesthesia?

7 i. What procedure is being performed here (7a, b)?

ii. Discuss the principles, indications, and contraindications of this procedure.



7a



7b

6, 7: Answers

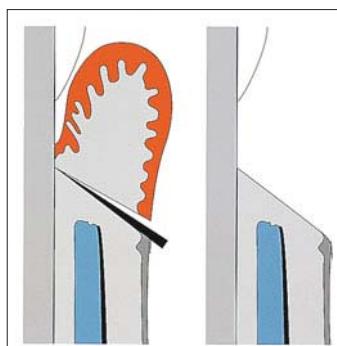
6 i. The differentials for the murmur, which is consistent with mitral valve regurgitation, include cardiomyopathy, congenital heart defect (i.e. mitral valve dysplasia) and infective endocarditis. A congenital defect should be suspected if the murmur has been present from a very early age. Infective endocarditis is uncommon in cats and would be considered if the murmur was known to be of recent onset, is associated with a fever, or if systemic signs are present. Cardiomyopathy is most likely if this is an acquired murmur. Based on the signalment, history and physical examination, hypertrophic cardiomyopathy is the most likely diagnosis. The gallop rhythm indicates ventricular diastolic dysfunction and is common in cats with cardiomyopathy.

ii. A complete blood count, biochemical profile and urinalysis are performed if systemic signs are present. Anemia and neutrophilia with a left shift are common in cats with infective endocarditis. A cardiac evaluation is required to diagnose the cardiac disorder and to determine appropriate treatment. The cardiac evaluation should include an electrocardiogram, thoracic radiographs, and an echocardiogram. An echocardiogram is required to diagnose the presence and form of cardiomyopathy. The anesthesia and dental care should be delayed until the cardiac disorder has been diagnosed and appropriately managed. The potential for complications associated with anesthesia should be evaluated and discussed with the owners. Appropriate adjustments in anesthetic protocols should be made based on the underlying cardiac disease. The clinician should be prepared to manage complications that may occur during anesthesia as well as during recovery and following anesthesia.

7 i. Gingivectomy/gingivoplasty.

ii. Gingivectomy is primarily an excisional procedure performed to remove the soft tissue wall of a periodontal pocket. It signifies complete removal whereas gingivoplasty signifies partial removal for reshaping soft tissue contour. The procedure is initiated by marking pocket depths with bleeding points on the surface of the mucosa. An incision is begun apical to the bleeding point to contour the gingiva physiologically and completely remove the pocket wall (7c). These bleeding points can be made with a probe or special transgingival marking forceps (7a). Gingivectomy may be made with gingivectomy knives (7b), cold steel blades, or electrosurgery. After excision, the roots are cleaned thoroughly. Healing occurs after epithelial migration over the wound which takes one day for each 0.5–1 mm covered. For this reason, the gingivectomy bevel is not made greater than necessary to achieve good post-healing tissue contour.

Gingivectomy is indicated for gingival hyperplasia and associated pseudopockets. It is contraindicated in infrabony defects where incomplete pocket removal and reverse architecture would result. Also, a narrow band of attached gingiva may preclude gingivectomy which might remove too much tissue. Gingivectomy is contraindicated where bone overgrowth is the problem as it is only capable of addressing soft tissue issues.



7c

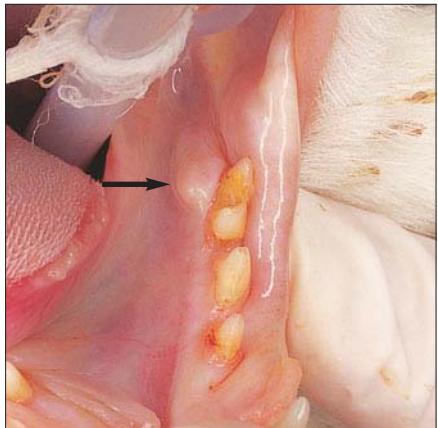
8–10: Questions

8 This cat has a membranous bulge lingual to the mandibular molar tooth (8).

i. Of what does this membranous bulge consist?

ii. Is there an equivalent structure in the dog?

iii. What consequences would you expect if this bulge was removed?

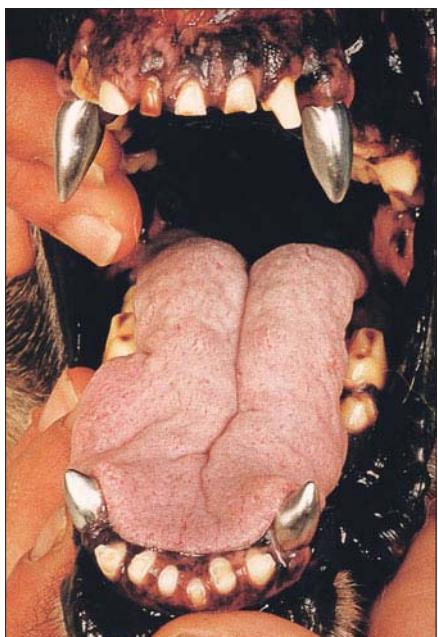


8

9 The photograph (9) shows a working dog with four abraded canine teeth covered with prosthetic crowns. These crowns have been in place for nearly four years.

i. What kind of material can be used for crown restoration in dogs?

ii. In working dogs, fragile crowns are not useful. Crown restorations must therefore be strong and adapted in form. Discuss the choice of alloy and the shape of such crowns.



9

10 Compare in table form the reproduction of detail, dimensional stability, tear strength, maximum time until pouring, and comparative cost of alginate, reversible hydrocolloid, polyether, and vinyl polysiloxane impression materials.

8–10: Answers

8 i. A small, mixed-salivary gland.

ii. No.

iii. A specific function for this gland has not been reported. Following excisional biopsy of this structure, there were no clinical changes evident in tongue function, moistness of the mouth, or calculus deposition.

9 i. A prosthetic crown is an artificial restoration which replaces a part of the natural crown of the tooth. There are various types of crowns made of various materials. A crown can consist of a cap (full coverage or full crowns) to protect the remaining crown substance, or it can be made as a combined post-crown prosthesis. A post may be used to aid retention but this weakens the root and increases the risk of subsequent root fracture. A tooth-colored crown can be made by fusing porcelain to a metal shell; however, the porcelain layer is fragile and this technique requires the removal of more dental substance.

Full-metal crowns are most commonly used and many different alloys are available. Non-precious alloys are silver-colored, inexpensive, and very hard; however, they are not cosmetic and are prone to black discoloration. Gold alloys are gold-colored, softer but esthetically more pleasing; most are too soft for use as prosthetic crowns for distal teeth and in working dogs. Gold is weaker than steel which is weaker than nickel-chrome or titanium.

ii. Alloy crowns are most commonly used in veterinary dentistry. The composition of the alloy is normally chosen in consultation with the dental laboratory preparing the crown. The choice depends on strength, cost, and corrosion resistance. An alloy of cobalt-chrome-molybdenum has been successfully used in working dogs. This alloy is very hard, corrosion-resistant, hypoallergenic, non-irritating, and inexpensive. The metal crown should be made slightly shorter and with a rounder tip than the original tooth to minimize occlusal and shearing forces.

10

	<i>Alginate</i>	<i>Hydrocolloid</i>	<i>Polyether</i>	<i>Vinyl polysiloxane</i>
Reproduction of detail	Poor	Fair	Excellent	Excellent
Dimensional stability	Poor	Fair	Very good	Excellent
Tear strength	Very low	Very low	Moderate	High
Maximum time for pouring	Immediate	7 hours kept wet	7 days kept dry	14 days
Comparative cost	Very low	Low	Very high	High to very high

(See also 150 (on the classification of impression materials).)

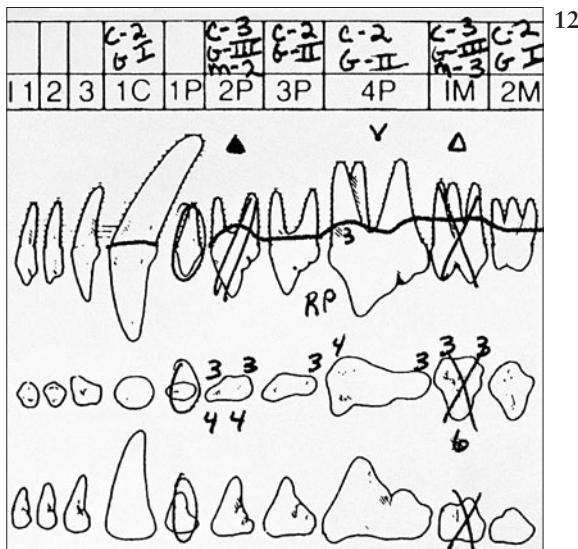
11-13: Questions

11 Knowledge of palatal development helps in understanding facial malformations.

i. What is the sequence of events in palatal development?

ii. What may interfere with normal palatal development?

12 Interpret the chart (12), and describe the periodontal status of the teeth shown.



13 Is this a young or an old horse (13)? What abnormality can be noted?



11–13: Answers

11 i. During embryogenesis, at about day 23, the paired maxillary processes, the paired mandibular processes and the median frontonasal process surround the primitive oral cavity (stomodeum). Median and lateral nasal processes originating from the frontonasal process extend on each side of olfactory placodes. In contrast to humans – where the upper lip is formed by the maxillary and nasal processes – in dogs and cats the upper lip and the primary palate are both formed by the midline fusion of the maxillary processes. At this stage of the development, the choanae open at the caudal end of the primary palate. Later, lateral palatine processes move towards the midline and fuse around day 33 with the nasal septum originating from the nasal process. This constitutes the secondary palate which will ossify (hard palate), except in the caudal part where it will form the soft palate.

ii. Numerous causes, inherited or not, may interfere with normal palatal development. Malformations are primarily due to lack of development or fusion of facial processes during embryogenesis. According to the stage of development and the severity of the cause, other physical or neurologic abnormalities may be present. In humans, more than 200 conditions have been found to be associated with cleft lip and/or palate. Teratogenic causes include metabolic disorders such as diabetes, teratogenic substances such as antimitotic drugs, corticosteroids, and vitamin A. Experimental studies have shown that the potential teratogenic effect of a substance depends on the dosage for a particular species, the duration of the effect, and the stage of development of the embryo. Hence, no specific list of substances able to induce cleft lip and/or palate has been identified in dogs and cats.

12 Interpretation of the symbols and letter codes on the chart illustrated describing the periodontal status and treatment of this left maxilla would be as follows: (1) Canine tooth: moderate calculus, mild gingivitis, normal gingival attachment. (2) First premolar: missing. (3) Second premolar: heavy calculus, severe gingivitis, moderate mobility, grade 3 furcation, and pocketing of 3 mm buccally and 4 mm palatally with gingival recession over the furcation area. An extraction is planned. (4) Third premolar: moderate calculus and moderate gingivitis, 3 mm pocketing at the distal/buccal area; otherwise normal. (5) Fourth premolar: moderate calculus and moderate gingivitis, gingival recession of 3 mm over the mesiobuccal root with 4 mm pocketing, a grade 1 furcation, and slight gingival recession over the distal root with 3 mm pocketing at the distal aspect. Treatment was closed root planing. (6) First molar: this tooth was extracted. It had severe calculus, moderate gingivitis, severe mobility with extensive gingival recession buccally exposing the furcation, pocketing of 3 mm buccally and 6 mm at the palatal root. (7) Second molar: moderate calculus, mild gingivitis, and normal attachment levels. These are only a sampling of the symbols and letter abbreviations that can be used to denote dental changes. The reader is referred to additional references for further information on charting.

13 This is an old horse with severe ‘wave mouth’. It is difficult to decide if this severe ‘wave mouth’ is due to normal or abnormal dental wear, as many old horses (more than 20 years old) wear their teeth as shown in 13. Yearly routine dental care should prevent ‘wave mouth’ formation by keeping the arcades level.

14, 15: Questions



14a

- 14 i. In the dog shown (14a), what is your diagnosis, and which dental hard tissue is disturbed?
ii. How can the different phases in the development of this dental hard tissue be distinguished and their disturbances explained?



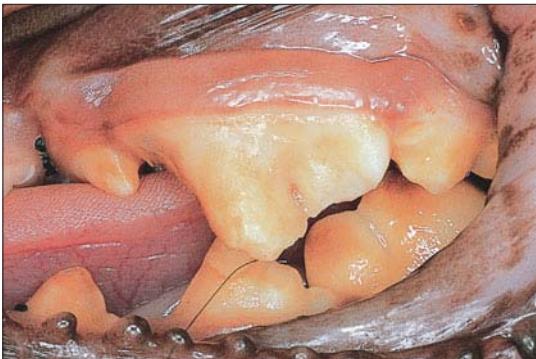
15

- 15 What radiographic abnormalities can you see in the mandible of this cat (15)?

14, 15: Answers

14 i. Enamel hypoplasia; the enamel is disturbed.

ii. The development of enamel occurs in two phases: (1) the enamel matrix formation stage; and (2) the maturation phase during which the mineralization of the enamel takes place. Disturbances during amelogenesis can cause hypoplasia, hypomineralization, or a combination of both. These conditions may be caused by systemic, local, or hereditary factors and can affect both dentitions.



14b

Enamel hypoplasia is defined as an incomplete or defective formation of the organic enamel component. In cases of enamel hypoplasia, there exists a deficiency in the thickness of the enamel: the defects in the enamel can be limited to a circumscribed area or be recognized as a single narrow zone of smooth or pitted hypoplasia.

If maturation is lacking or incomplete, enamel hypomineralization will develop (14b). The mineral content of the enamel is deficient and therefore the enamel persists as a soft enamel matrix. Shortly after eruption the hypomineralized teeth show normal shape, but the surfaces appear dull. Enamel is opaque but the soft enamel matrix will be discolored by extrinsic factors (yellow-brownish). In cases of hypomineralization, the quality of the enamel is abnormal. The lower the mineral content of the enamel, the faster will discoloration be seen and the faster the soft and brittle enamel will peel off.

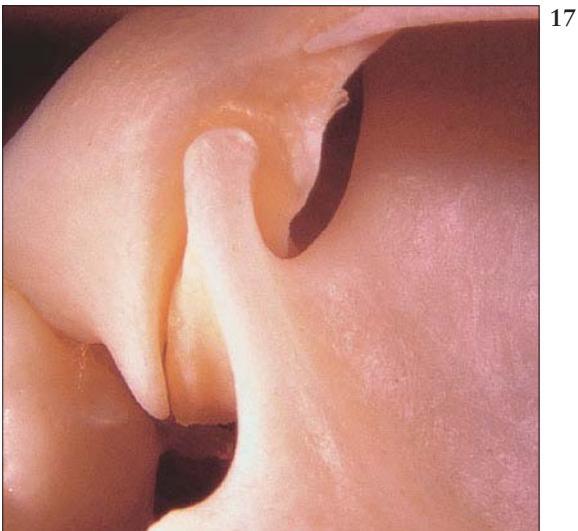
15 The third premolar tooth had a clinically evident feline odontoclastic resorptive lesion (FORL) at its buccal gingival margin. The radiograph demonstrates severe radiographic changes – there is root and crown resorption (seen as sharp-edged, but irregular areas of radiolucency) and ankylosis, affecting primarily the mesial root. Note that the adjacent tooth is entirely normal. Radiographs often delineate the extent of the resorption more accurately than clinical examination alone (often the clinical lesion is only the tip of the iceberg), and no FORL should be treated without prior radiographic examination. Teeth with resorptive lesions rarely lose their endodontic blood supply, so pulp necrosis followed by a clinically or radiographically evident periapical lesion is unusual. Lesions that are evident at the gingival margin often have some periodontal bone loss and loss of attachment, or there may be concurrent periodontal disease. This third premolar tooth is typical of the radiographic features of FORLs. As cats age, generalized osteoclastic resorption and osteoporosis are seen as areas of absent or reduced mineralization of the mandible; this change generally develops from rostral to caudal. In addition, in some cats the periapical bone may become thickened and irregular so that the roots appear more club-shaped than in younger cats.

16–18: Questions

16 What radiographic error is evident on the radiograph of 15?

17 The temporomandibular joint (TMJ) (17) functions mainly as a hinge joint in carnivores.

- i. Describe the anatomy of the TMJ.
- ii. What types of movement are possible?
- iii. What is the most common cause of TMJ pathology in the cat? Name two common conditions.
- iv. What is the most common type of TMJ luxation? Outline the management of such a case.



17

18 This dog was presented with an acute inability to close the mouth but no lateral deviation of the mandible (18).

- i. What is your tentative clinical diagnosis?
- ii. How can this diagnosis be confirmed?
- iii. Presuming that the tentative diagnosis is confirmed, what is the treatment?



18

16–18: Answers

16 The embossed dot is superimposed on the apical part of the mesial root of the third premolar. This is a common error in radiographic positioning. The dot can obliterate subtle lesions or be falsely diagnosed as a pathologic lesion. When positioning the film in the oral cavity, the dot should be located away from structures of potential interest, such as the roots, and rather be placed where there is no overlap with dental structures. This does not affect the use of the embossed dot in orienting radiographs (see 102).

17 i. The joint is comprised of the articular process of the mandible and the mandibular fossa of the temporal bone. An articular disk separates the joint into a dorsal and a ventral compartment. The disk is a flat fibrocartilaginous plate. The joint capsule is enforced by fibrous tissue which forms a strong ligament laterally. The caudoventral end of the zygomatic arch forms the retroarticular process which protects the joint and largely prevents caudal luxation.

ii. The shapes of the condyloid process of the mandible and the mandibular fossa of the temporal bone do not match exactly, which allows for some sliding movement as well as the hinge action. The sliding movements are very limited due to the precise interdigititation of teeth in the cat.

iii. TMJ pathology in the cat usually occurs as a result of trauma. Two common conditions are luxation and fracture (intra-articular or periarticular).

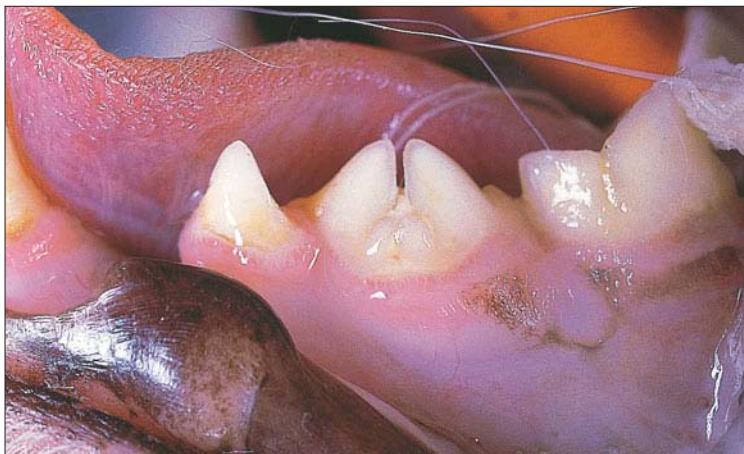
iv. Luxation is usually in a rostrodorsal direction. This causes rostromedial displacement of the mandible on the affected side and prevents closure of the mouth because of the resulting abnormal interlock of the teeth. Treatment of acute luxation consists of closing the animal's mouth with a wooden or plastic rod inserted between the upper and lower carnassials and closing the mouth, pushing the mandible backwards until the condyloid process slips back into the mandibular fossa. Chronic luxation is best treated by condylectomy. Caudal luxation is less common, and may be associated with a fracture of the retroarticular process.

18 i. Bilateral traumatic luxation of the temporomandibular joint.

ii. The diagnosis is confirmed by radiography. Two views are currently in use: the dorsoventral closed-mouth skull radiograph and the closed-mouth lateral oblique view (15–20°, nose tilted up). Unilateral or bilateral luxation is radiologically evidenced by the fact that the condyloid process is not located within the mandibular fossa. Capsular osteophyte formation is evidence of a long-standing or recurrent luxation. Usually, the condyloid process displaces rostrodorsally. If unilateral, the animal is presented with a typical lateral deviation to the side opposite the luxated joint.

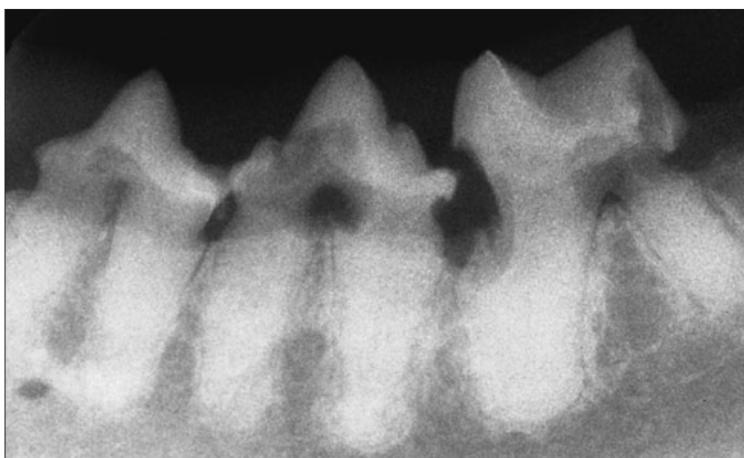
iii. Reduction is accomplished under general anesthesia by forcing the condyle ventrally. This can be done by inserting a fulcrum (e.g. pencil, syringe, dowel – depending on patient size) in between the molar teeth and gently forcing the mouth closed; this in turn levers the condyloid process in a ventrocaudal direction back into the condyloid fossa. Aftercare may include the use of a tape muzzle. Recurrent and chronic luxations can be treated by condylectomy.

19, 20: Questions



19a

- 19 i. What developmental disturbance in the shape of teeth can be shown (19a)?
ii. What other teeth in the dog and cat can be affected?
iii. What are the related conditions?



20

- 20 One of the most common indications for extraction in the cat is odontoclastic resorptive lesions (20).
i. Outline the problems associated with extraction of teeth affected by these lesions.
ii. What is the recommended extraction technique?

19, 20: Answers

19 i. This is a case of gemination of the mandibular fourth premolar in a cat. Dichotomy is a synonym mostly found in older literature. Gemination is defined as an attempt to make two teeth from a single tooth germ, resulting in partial cleavage. A geminated single-rooted tooth usually has two incompletely separated crowns and a single root canal. In this case of a premolar, three roots were present, the central one having a very wide root canal.



19b

ii. Gemination of single incisors (19b) is relatively common in the dog, while geminated canines and premolars in the dog and cat are rare. No reference to the occurrence of geminated molars could be found. Gemination can also be present in the deciduous dentition.

iii. Fusion and concrescence are related conditions. In cases of fusion, two tooth buds are united and the dentin is confluent. In cases of concrescence, the teeth are united by cementum only. If fusion occurs between two normal teeth, the total number of teeth is reduced, which is not the case in gemination. However, it may not be possible to differentiate fusion of a normal tooth and an adjacent supernumerary tooth, from a true geminated tooth. Twinning may be used to designate the presence of a normal and a supernumerary tooth of the same shape that are completely separate.

20 i. Depending on the stage of disease, different problems may occur during extraction. If a tooth is in a resorptive phase, the main problem will be its increased fragility and risk of fracture during extraction. In the reparative phase, the formation of new bone or cementum-like tissue will serve to anchor the root firmly in the alveolar bone and increase the risk of iatrogenic root fracture.

ii. Extraction of cat teeth need not be frustrating if the correct technique and suitable instrumentation are used. The first step should be to incise the soft tissue attachment using a scalpel blade or a sharp luxator into the gingival sulcus around the whole circumference of the tooth. It is useful to raise gingival flaps to improve visibility and access. Tooth sectioning of multirooted teeth and removal of buccal bone plate if required is facilitated if the flap has already been raised. Moreover, it prevents iatrogenic injury to the gingiva.

Cat teeth can be extracted using standard elevator or luxator techniques (after sectioning of multirooted teeth into single-rooted segments). Impatient or incorrect use of elevators or luxators will usually result in tooth fracture. Fractured remnants can be removed using a root tip elevator or root tip pick. Often it is necessary to bur away buccal bone to retrieve the fragments. Consequently, iatrogenic fracture is best avoided by using a gentle technique and the correct size of instruments. Preoperative radiographs are mandatory to allow accurate planning of the extraction, while postoperative radiographs will assess complete removal of the roots.

21, 22: Questions

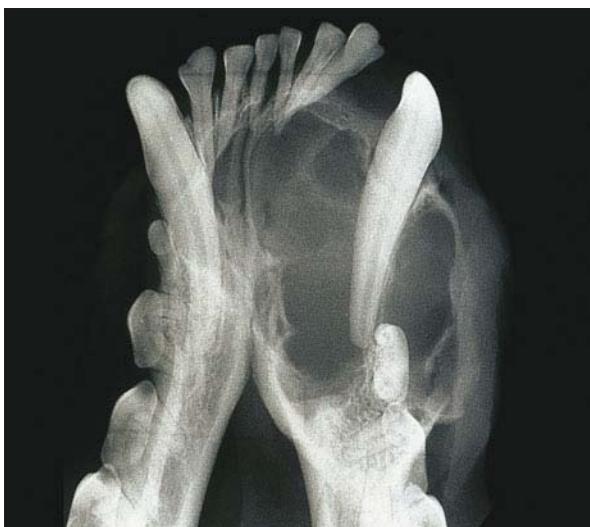
21 i. Describe three possible etiologies for this malocclusion (21a).

ii. Name the two principal means of moving teeth to correct a rostral crossbite, and briefly describe the techniques and risks.

iii. Describe the sequelae of no treatment.



21a



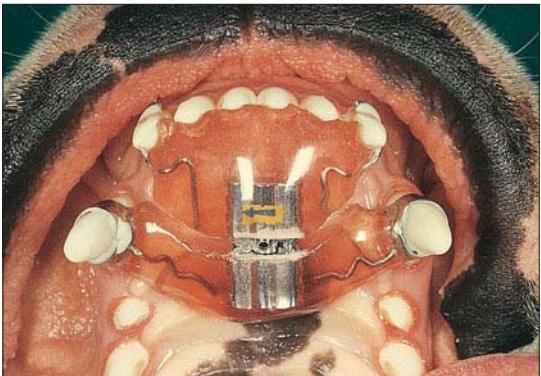
22

22 i. How would you describe the radiologic findings associated with the oral mass found in this three-year-old dog (22), and what is your tentative radiologic diagnosis?

ii. Provided the radiologic diagnosis is confirmed on biopsy, what would be the recommended treatment and prognosis?

21, 22: Answers

- 21 i. (1) Persistent deciduous incisors can result in palatal or lingual displacement of the permanent incisor(s). Persistent deciduous teeth in humans is believed to be of genetic origin in that the permanent tooth bud is displaced away from the deciduous precursor and cannot cause a resorptive action upon the deciduous root. (2) Discrepancy in jaw length (prognathism, brachygnathism, wry malocclusion) alters the normal occlusal relationship of the incisors. (3) Trauma to the premaxilla or mandible of a neonate or juvenile can result in an acquired rostral (or 'anterior') crossbite. Displacement of the permanent incisor tooth bud results in an abnormal path of eruption.
- ii. The two means of movement are mechanical or surgical. Mechanical movement requires placement of an orthodontic appliance (21b). Commonly used appliances are arch wires and various screw-type expansion devices. The risks include periodontal trauma, root resorption, failure to move, and relapse. Surgical movement involves resection of periodontal hard and soft tissues and repositioning of the tooth/teeth. Risks include perioperative extraction and postoperative endodontic complications; surgical movement therefore cannot be recommended.
- iii. Rostral crossbite rarely requires correction for the health and welfare of the patient. There is no masticatory interference or soft tissue trauma and rarely any periodontal involvement.



21b

- 22 i. This is a large, space-occupying lesion of the rostral part of the left mandible, expanding over the symphysis into the right mandible. The border of the lesion consists of thinned cortical bone, with little or no periosteal reaction. The overall radiographic density of the lesion is low and it seems to consist of one large cystic area with a few smaller ones on the periphery. The surrounding bone is expanded but the cortical bone is not disrupted. The left mandibular first premolar is absent. The left mandibular canine is marginally displaced but is no longer supported by bone. All left mandibular incisors and to a lesser extent the right first and second incisors are displaced. The tentative diagnosis is an intraosseous, benign tumor suggestive of a central (or intraosseous) ameloblastoma. This diagnosis was confirmed on biopsy.
- ii. A bilateral, partial (rostral) mandibulectomy would be indicated and would likely be curative. Adequate surgical margins would probably be mesial to the mandibular first molar on the left and mesial to the third premolar on the right. Metastasis of ameloblastoma in the dog has not been reported. A bilateral rostral mandibulectomy that far distally is likely to result in the tongue hanging out and may necessitate tying off or repositioning the openings of the mandibular and sublingual salivary ducts.

23, 24: Questions

23 This radiograph (23) shows a healing horizontal root fracture of a maxillary canine in a dog.

- i. Define crown–root fracture and root fracture.
- ii. Which type of root fracture offers the best prognosis for maintaining the tooth?
- iii. What treatment options are available for the different kinds of root fractures?



23

24 The roots of multirooted teeth are rarely parallel, often diverging to a marked degree (24). This provides the tooth with additional mechanical retention, but it complicates extraction. Extraction of single-rooted tooth segments is usually straightforward.

- i. List four items of equipment suitable for sectioning multirooted teeth.
- ii. Once a multirooted tooth has been sectioned, what additional actions may be required in order to extract the roots?
- iii. Extracting cats' teeth can be frustrating as the teeth are brittle and root fracture below the crestal bone is common when leverage is (deliberately or accidentally) applied to the crown. How may this occurrence be reduced?



24

27

23, 24: Answers

23 i. A crown–root fracture is a fracture involving enamel, dentin, and cementum. These fractures may further be classified as complicated or uncomplicated depending on whether or not the pulp is involved in the fracture line. A root fracture is a fracture involving dentin, cementum, and the pulp, and is generally complicated.

ii. The treatment and prognosis of crown and root fractures depends on: (1) the degree of displacement and mobility of the fracture segments; (2) the extent of contamination; and (3) the amount of damage to the alveolar crestal bone. Generally, horizontal root fractures involving the apical segment as well as mid-root level, respond well to treatment. Fractures of the root close to the gingival margin are unlikely to heal. If the root is to be retained, it will need endodontic therapy.

iii. Treatment options depend on the type of fracture. The fracture level determines the choice of treatment for horizontal root fractures. Many fractures involving the apical third of the root heal without treatment, largely because the fracture is stable and the blood supply is intact. The chances of successful healing decrease as the fracture line moves coronally because of the reduced stability. Mid-root fractures usually heal well if the tooth is immobilized using ligature wire and acrylic. A horizontal fracture of the coronal part of the root is unlikely to heal. The coronal segment should be extracted and the root treated endodontically if retained. Oblique root fractures are unlikely to heal because the segments separate and slide apart. The coronal segment should be removed and the apical segment either extracted or treated endodontically depending on its size.

24 i. In general, it is easiest to ensure that a tooth is sectioned in the right place by starting cutting at the furcation. Access to this area is frequently improved and the risk of soft tissue injury reduced by raising a gingival flap. Implements which may be used to section teeth include, in order of preference: (1) crosscut taper–fissure or coarse diamond taper bur in a high-speed dental handpiece; (2) a similar bur in a low-speed handpiece; (3) embryotomy wire (threaded through the furcation); (4) hacksaw blade (useful in an emergency); (5) diamond disc in a low-speed handpiece (this is a dangerous implement and is not recommended).

ii. Each segment of the tooth should be treated as a single-rooted tooth. As much as possible of the periodontal ligament is sectioned using dental luxators or elevators and if necessary, a portion of the alveolar supporting bone can be removed to reduce root retention. The rotational use of an elevator between tooth segments or on the crestal bone aids extraction.

iii. There are two simple ways of reducing the risk of accidental leverage against the crown. One involves odontoplasty, removing the bulge of dental substance above the neck of the tooth; this permits easier access to the root and periodontal ligament for luxation/elevation. A more extreme method is to totally remove the crown of the tooth. This gives even greater access and visualization of the periodontal space. This dog's maxillary fourth premolar has been sectioned to assist extraction (24). Additionally, odontoplasty has been performed on the distal aspect of the tooth to both provide access for elevation and to provide space for the distal tooth segment to be wedged and (rotationally) levered distally.

25, 26: Questions

25 A nine-month-old German Shepherd Dog sustained an acute fracture of the upper right canine. The tooth was treated with a partial coronal pulpectomy (pulpotomy) and direct pulp cap procedure within 48 hours of the injury. Shown here are the pretreatment radiograph (25a) and the nine-month follow-up radiograph (25b).

- i. What are likely causes of the radiolucency below the restoration, visible on the follow-up radiograph?
- ii. What other parameters can be evaluated on this radiograph to determine if the procedure was successful?
- iii. What are some additional complications associated with a pulpotomy procedure?



25a



25b

26 Antibiotics are often used in dentistry as most orodental diseases are of bacterial origin.

- i. Are there reasons why antibiotics should not be used systematically in orodental infections?
- ii. Antibiotic prophylaxis: what is the rationale and use?
- iii. Antibiotic therapy: what is the rationale and use?

25, 26: Answers

25 i. This post-treatment radiograph (25b) shows an adequate dentin-bridge formation with the radiolucency coronal to the dentin bridge. The likely causes are: (1) improper restorative technique leaving a gap between the composite restorative material and the base material placed over the calcium hydroxide; and (2) microleakage around the restorative secondary to improper technique or damage to the restoration. The latter is what happened in this case where the restorative had become cracked, leading to a carious lesion.

ii. You can compare the width of the root canal with the pretreatment radiographs and see the continued secondary dentin formation, as in this case, and look for periapical changes. It is beneficial to evaluate the tooth two or more times at six-month intervals to assess pulp vitality. Tooth color and transillumination of the tooth – looking for a translucent appearance – are additional ways to determine pulp vitality.

iii. There can be pulpitis associated with tooth pain and eventually leading to pulp necrosis. This may lead to periapical inflammation and eventual abscessation. Tooth discoloration can occur secondary to hemorrhage seeping into the dentinal tubules coronal to the pulp amputation or from pulpal death. Internal resorption of the dentin can also be seen (25b).

26 i. The goal of antibiotic therapy in an exogenous infection is to kill the bacteria or to stop their growth so that the defense mechanisms can eliminate all infection. Bacteria are normal inhabitants of the oral cavity and this goal cannot be achieved with an indigenous infection. Systematic use of antibiotics can lead to bacterial resistance. Antibiotics are not 100% safe; toxic or allergic reactions may develop as well as superinfection when the ‘good bacteria’ have been killed.

ii. To avoid systemic consequences of bacteremia that may occur during dental treatment. In healthy animals, bacteria in the blood stream are quickly eliminated by the reticuloendothelial defense system. Antibiotic prophylaxis should only be necessary in geriatric, immunosuppressed or debilitated animals, in patients with pre-existing heart disease, in patients where periodontal treatment is combined with elective surgery, and in cases where pulp exposure (crown amputation and pulpotomy) or extensive surgical extractions is anticipated.

The choice of antibiotic and dosage remain controversial. A good first choice for antibiotic prophylaxis is an intravenous or intramuscular injection of 25 mg/kg ampicillin or amoxicillin given one hour before the procedure followed by a second injection of 12.5 mg/kg four hours later.

iii. To deal with infections. Most orodental diseases are infectious diseases; however, antibiotics are almost never the sole treatment. The treatment of periapical lesions is endodontic treatment and the treatment of periodontitis is periodontal treatment or extraction. The choice of antibiotic is based on the current knowledge of bacteria involved in the condition, and not on culture and sensitivity tests, as few diagnostic labs are able to perform these tests properly for orodental anaerobes. Most severe orodental infections are either mixed infections or predominantly anaerobic infections. Suitable antibiotics include amoxicillin-clavulanic acid, clindamycin, doxycycline, metronidazole, spiramycin, and tinidazole.

27–29: Questions

- 27 i. What is the developmental abnormality (27) seen in this one-year-old dog?
ii. What is the clinical importance of this condition?
iii. What is the identification of this tooth using the Triadan system and the anatomic identification system?



27

- 28 Chemical antiplaque agents are a useful adjunct to mechanical plaque removal (28).

- i. List two properties of a chemical antiplaque agent which determine its expected effect in the oral cavity.
ii. Which is the most proven chemical plaque retardant to date?
iii. What formulation and what concentration are generally recommended?
iv. What is the main disadvantage of this agent?
v. List two clinical situations where chemical plaque control is indicated. Outline the rationale for this recommendation.



28

- 29 When educating clients on the importance of oral health in their pet, the potential systemic effects of untreated dental disease should be considered. What are the potential systemic consequences of untreated dental infections?

27–29: Answers

27 i. A *persistent* deciduous canine on the right maxilla. Although the term *retained* deciduous canine is more commonly used for this condition, persistent is more correct. ‘Retained’ strictly-speaking refers to failure to erupt (*retentio dentis*), while ‘persistent’ in this context means failure to exfoliate.

ii. In most cases the permanent tooth develops normally, although the time and direction of eruption are influenced by the persistent deciduous tooth. Persistent deciduous canines may cause linguoversion of the erupting mandibular canines and facial deviation of the maxillary canines (see 178). Furthermore, persistent deciduous teeth alter the gingival contour, which results in plaque and debris accumulating between the deciduous and permanent teeth.

iii. The right maxillary deciduous canine is tooth 504 in the Triadan system (see 131) and is abbreviated anatomically as c¹.

28 i. (1) Antibacterial spectrum of the active agent and (2) substantivity. (Substantivity implies that the adherence of the agent to the oral tissues should be greater or more extended than would occur following simple mechanical deposition.)

ii. Chlorhexidine.

iii. Chlorhexidine gluconate is generally preferred to chlorhexidine diacetate. A 0.12% concentration is widely used in human dentistry, although it has been shown in wound healing experiments that a 0.05% solution may be preferable because chlorhexidine is less cytotoxic at this concentration. For the same reason, alcohol-free solutions are preferred.

iv. The main disadvantage of chlorhexidine is that it may stain the teeth. Moreover, it is inactivated by the presence of organic material. For best results, chlorhexidine should be used together with tooth brushing which physically removes the plaque and reduces tooth staining.

v. Chemical plaque control is used to augment the effect of mechanical plaque removal. It can also be used on its own if mechanical plaque removal is not possible, e.g. due to postoperative pain, but where plaque control is required to allow resolution of inflammation. Two clinical situations where chemical plaque control, preferably in addition to mechanical plaque removal, is very useful are: (1) cats with chronic gingivostomatitis; and (2) following gingivectomy/gingivoplasty for hyperplastic gingivitis in dogs. Every attempt should be made to institute daily plaque removal by mechanical means as soon as the animal will allow it.

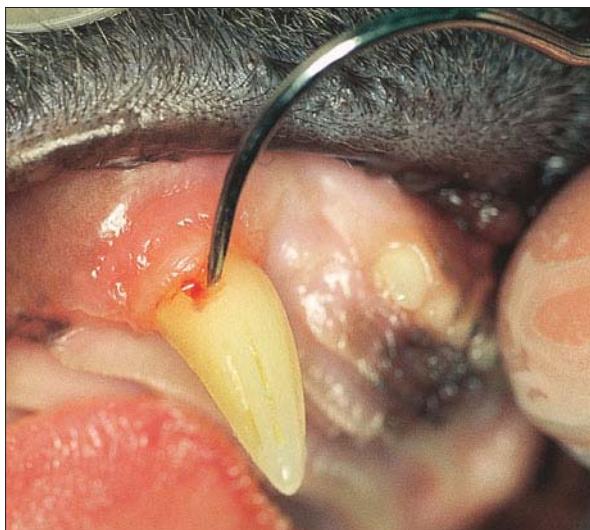
29 Oral infections such as periodontal disease, periodontal abscess, or periapical abscess are sources of bacteria that may result in a distant infection. Patients with an altered immune system are at increased risk for distant site infections. When oral disease is present, bacteremia from oral origins may occur with tooth brushing or chewing. Intermittent bacteremia of oral origins may significantly affect overall health. The kidneys, liver, and myocardium may potentially be affected secondary to chronic periodontal disease.



30

30 This is a procedural radiograph of a root canal therapy of a canine (30).

- i. Evaluate the quality of the root canal fill.
- ii. Why is a good obturation of the apical third of a root canal important?



31

31 How common are feline odontoclastic resorptive lesions (FORLs) (31) in domestic cats, and which teeth are most commonly affected?

30, 31: Answers

30 i. Although the coronal two-thirds of the canal has a dense fill, the apical third has a poorly condensed fill.

ii. A dense fill in the coronal two-thirds (along with the access restorations) would prevent contamination of the apex from materials in the oral cavity. However, even in a well-cleaned canal, apical voids may cause eventual failure. If a space exists between the root canal-obturing material and the dentin, percolation of fluids can occur. Residual bacteria, bacterial breakdown products, toxins, or organic debris in the canal can act as periapical tissue irritants. Even in a well-cleaned canal, fluid ingress from periapical tissues can stagnate in microvoids in the canal. Fluid breakdown products can then diffuse back out, acting as an irritant. A third source of potential problems is the seeding of bacteria from transient bacteremia causing reinfection of a previously non-infected canal. In veterinary dentistry, most of the teeth on which root canal therapy is performed have an apical delta rather than a large apical foramen. An apical delta consists of many small canals at the apex. In endodontic therapy, good technique achieves a three-dimensional fill to treat and obturate all the portals of exit (POE), including any lateral canals. An apical delta can be visualized as a high concentration of tiny 'lateral' canals in the apical 1–4 mm of the root. A small 'blush' of sealant from the apical POEs indicates a treated and well-filled apex.

31 The table below summarizes the results of several surveys. The prevalence increases with age, with a plateau effect as teeth are lost and thus not counted as having FORLs. Most of these surveys are based on clinical examination only, and as a result they under-report radiographically obvious mid-root lesions in canine or premolar and molar teeth (see 61). Also, the surveys generally ignore incisor teeth, which are often missing. As a general statement, it is fair to state that about 50% of domestic cats aged six years or more have one or more FORLs. Reported surveys agree that the teeth most commonly affected, based on clinical examination alone, are the mandibular third premolar and first molar teeth, and the maxillary fourth premolar teeth; the canine teeth tend to be under-reported.

Summary of prevalence of FORLs in canines, premolars and molars in domestic cats

Cats examined	Source of cats	% with FORLs	No. of FORLs/cat*	Age trend	Teeth most often affected
200	Unknown	29	2.9	↑ as age ↑	Premolars
64	Mixed ⁺	52	3.2	↑ as age ↑	Premolars
306	Dental cases	46	—	—	—
152	Dental cases	43	—	—	—
432	Dental cases	62	2.8	↑ as age ↑	Premolars
78	Dental cases	67	4.1	↑ as age ↑	Premolars
796	Mixed ⁺	26	2.3	↑ as age ↑	Premolars

*In cats that have at least one lesion.

⁺Cats presented for treatment of dental or other conditions.

32, 33: Questions

32 The apex of the tooth is the tip of the root (32a).

- i. What are the anatomic landmarks of this area in humans?
- ii. How does the apical morphology differ in dogs and cats compared with humans?
- iii. What is the clinical relevance of this morphologic feature?



32a

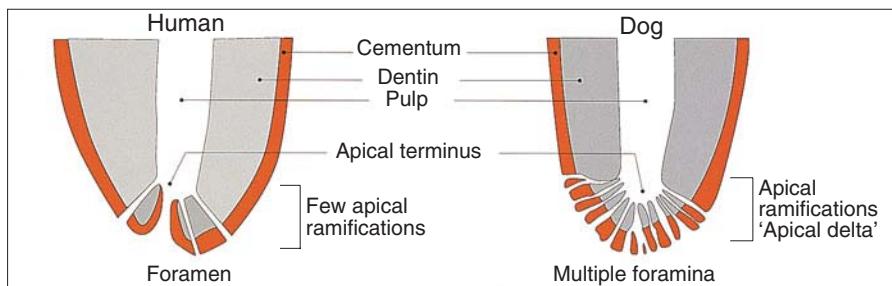
33 There is continuing confusion with regard to the origin and nomenclature of epulides in the dog (33). In broad terms, what is the current understanding and classification of these lesions, and what is their clinical significance?



33

32, 33: Answers

32b



32 i. The apical terminus of the canal is the end of the root canal which is synonymous with the apical constriction, the narrowest diameter of the canal. The foramen is the opening created by the canal ending on the external root surface. There is a funnel-shaped space between the apical constriction internal to the foramen and the foramen on the external root surface (32b). The cementum invaginates inside this cone and ends at the cementodentinal junction (CDJ) at or close to the apical constriction. The CDJ delimits where pulp becomes periapical tissue.

ii. In humans, the apical area is composed of a principal foramen with sometimes a few smaller accessory foramina. In dogs and cats, a complex apical delta is a normal feature of the apex of mature teeth. Between 10 and 20 foramina are seen in dogs' and cats' canine teeth and the apical ramifications connecting the apical terminus to the foramina are 1.75–2 mm long.

iii. The rationale of root canal therapy is to seal the root canal at the level of the CDJ in order to achieve apical healing. During root canal preparation, care must be taken not to over-instrument the canal by passing through the principal foramen. In dogs and cats with an unmodified apex, the endodontic instruments tend to stop at the end of the root canal (apical terminus) where the small ramifications of the apical delta begin. Subsequently, over-instrumentation is less likely and clinical assessment of working length is easier. Mechanical preparation of the ramifications of the apical delta is impossible and necrotic tissue may remain inside.

33 The term *epulis* refers to any tumor or tumor-like lesion on the gingiva (33). It is a clinically descriptive term with no specific histopathologic connotation. Most authors agree that epulides can be classified into four groups: (1) A group of non-neoplastic, reactive lesions occurring as a result of chronic low-grade irritation, e.g. focal fibrous gingival hyperplasia and pyogenic granuloma. (2) Benign neoplastic lesions of odontogenic origin, e.g. peripheral odontogenic fibroma. (3) An infiltrating epithelial tumor, previously known as the acanthomatous epulis and recently reclassified as peripheral or canine acanthomatous ameloblastoma. (4) Various malignant non-odontogenic tumor types, e.g. squamous cell carcinoma and fibrosarcoma.

The clinical importance of epulides can be summarized as follows: (1) An epulis must be biopsied. (2) If multiple lesions are present in an oral cavity, all must be biopsied. (3) Surgical margins for definitive excision must be determined by the biopsy result. (4) Appropriate dental treatment is indicated for reactive lesions.

34, 35: Questions



34

34 What causes feline odontoclastic resorption lesions (FORLs) such as this (34) to be so painful in some cats?



35

35 Full-mouth extraction is a last-line resort in managing patients with chronic gingivostomatitis (35).

- i. What does the procedure encompass?
- ii. Describe your immediate postoperative regimen for these patients.

34, 35: Answers

34 FORLs can start anywhere on the periodontal attachment (or on the surface of the pulp tissue in the case of internal resorption). When the lesion is entirely below the epithelial attachment, it is usually asymptomatic. However, lesions that are present at the gingival margin result in bacterial contamination of the diseased area, causing acute inflammation. Occlusal pressure then results in compression of inflamed bone and tooth substance, or trapping of inflamed soft tissue against a hard surface. Another possibility is that the contamination of the lesion will result in endodontic inflammation, swelling and pain – one of the characteristics of these lesions microscopically is that they do not result in overwhelming endodontic disease that leads to pulp death; thus, the endodontic pain may continue. Antimicrobial treatment will reduce the bacterial activity and thus lessen the inflammation, and anti-inflammatory drugs will have a similar effect in reducing the pain, as will analgesic medications. However, all of these medical treatments will have only a short-term effect, and the lesion itself must be addressed to provide permanent relief from local infection and discomfort. Fortunately, most FORLs occur on the buccal surface of the tooth and are thus more readily apparent on clinical examination. Unfortunately, the inflammation associated with FORLs often is not readily distinguishable from plaque-induced periodontal disease.

35 i. Extracting all teeth, possibly with the exception of the canine and incisor teeth. It is essential that the whole tooth, i.e. crown and root(s), is completely removed. The least traumatic means of doing this is surgical extraction using a flap technique. Preoperative radiographs are always indicated. Following extraction, radiographs should be taken to ensure that there are no root remnants. Any remaining root fragments should be removed before flap closure.

Extractions should be completed one quadrant at a time. A mucogingival flap is raised to expose the furcations and buccal bone plate of the premolars and molars. Multirooted teeth are sectioned into single-rooted segments using a bur in either a high-speed or slow-speed handpiece. Buccal bone is also removed with the bur to facilitate extraction. Water cooling of the bur is mandatory. Enough bone should be removed to allow easy extraction yet trying to maintain as much as possible of the alveolar bone height. The teeth are then gently elevated or luxated out of their sockets. Following hemostasis, ensuring a clean clot in each alveolus, the mucogingival flap is closed by attaching the buccal gingiva to the palatal/lingual mucosa using fine, resorbable suture material on a swaged-on needle. The closure must be tension-free.

ii. The immediate postoperative consideration is analgesia. Cats which have had full four-quadrant extraction are usually uncomfortable. An anesthetic regimen which includes opioids and/or regional anesthetic blocks will give pain relief for a few hours after recovery. Further opioids or the use of a non-steroidal anti-inflammatory agent should then be used. Hospitalizing and feeding these cats by means of a nasogastric tube for the first few days is useful. The cat should not be discharged until it can feed itself. In some instances, it is useful to stagger the surgery, i.e. extract the maxillary and mandibular teeth on one side on the first occasion and then do the other side a few weeks later.

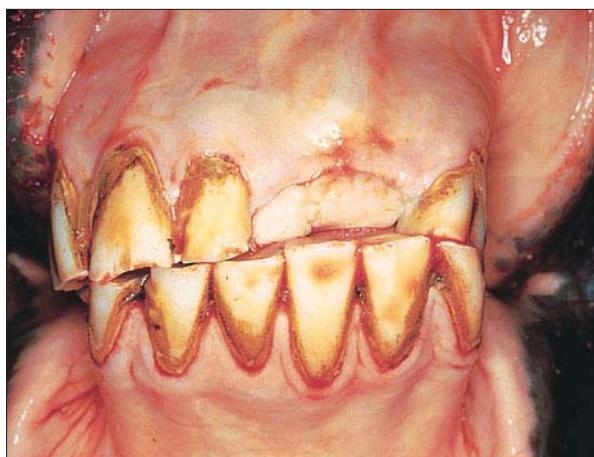
36, 37: Questions



36a

36 Discolorations of teeth can be classified as generalized, local, or pseudodiscolorations.

- Which type can be seen here (36a), and what are the possible causes?
- Is treatment necessary and, if performed, will the discoloration disappear?



37a

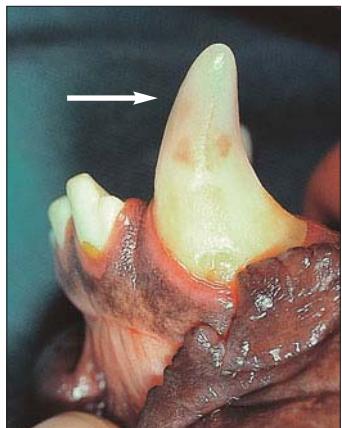
37 What should be done with this old horse's incisors (37a)?

36, 37: Answers

36 i. The list below summarizes the causes of dental discoloration. The case in question is a local discoloration, probably of endodontic-traumatic origin. Hemorrhage or necrosis of the pulp causes lysis of the erythrocytes. The hemoglobin breaks down into pigments which penetrate the dentinal tubules and are responsible for the different discolorations. The color of the crown may vary from pink-red to blue-gray or dark gray. In the case of a minor hemorrhage, the pulp may survive, blood pigments may be resorbed and the discoloration may be transient. Another possible cause of crown discoloration is acute pulpitis of hematogenous origin. A localized pink-red area on the crown may be indicative of vital pulp with internal resorption, the vascular resorbing tissue being visible through the enamel ('pink spot' – 36b, arrowed). *Generalized discolorations:* (1) Genetic: amelogenesis imperfecta; dentinogenesis imperfecta; odontodysplasia. (2) Metabolic disturbance (prolonged): enamel hypoplasia; enamel hypomineralization. (3) Ageing: enamel infarction; attrition/abrasion. (4) Iatrogenic: tetracyclines; fluorosis. *Local discolorations:* (1) Genetic: odontodysplasia. (2) Metabolic disturbance (short period): enamel hypoplasia; enamel hypomineralization. (3) Ageing: enamel infarction; attrition/abrasion. (4) Trauma/endodontic: pre-eruptive: mechanical/chemical trauma; periapical pathology deciduous tooth; post-eruptive: pulp hemorrhage; pulp necrosis; internal resorption. (5) Dental caries. (6) Iatrogenic: endodontic and restorative materials. *Pseudodiscolorations:* (1) Dental plaque and calculus. (2) Agents in food.

ii. Radiographic examination and pulp-vitality testing (if available) are indicated and endodontic treatment is most often the treatment of choice. It is important to note that discoloration may persist following endodontic treatment.

37 The tall mandibular incisors need to be shortened so the occlusal surfaces of all the mandibular incisors are level from side-to-side (37b). This is easily done with a rasp, file, or float. If a large amount of dental substance needs to be removed, a straight dental handpiece or a Dremel™-type instrument with a diamond cut-off wheel and/or bur are very helpful. If an incisor is to be cut off with cutters or nippers, it should be scored first or the incisor may fracture when cut.



36b



37b

38a



38b



38 The normal canine tooth occlusion in the dog comprises interdigitation of the mandibular canines which diverge laterally, slotting evenly into the maxillary third incisor–canine diastema without tooth-to-tooth contact. Palatal contact by malpositioned mandibular canine teeth is a commonly recognized malocclusion in domestic dogs (38a, b). Describe four different patterns of mandibular canine tooth malocclusion which commonly result in palatal trauma.

39 A wide variety of suture materials have been recommended for use in the oral cavity (39a).

- i. Chromic catgut persists in the human oral cavity for 4–7 days, which is considered to be ideal since this approximates the time limit for removal of non-absorbable suture material. Which recently introduced synthetic suture material combines a rapid and predictable absorption time with minimal inflammatory response and minimal tissue drag?
- ii. What type of needle is recommended for intraoral suturing?
- iii. Which suture material was found to be superior in a study comparing suture materials for partial maxillectomy in the dog?
- iv. In a study comparing seven different suture materials in the feline oral cavity, which of the following suture materials had the least and the greatest tissue reaction based on gross visual grading: chromic catgut, polydioxanone, polyglactin 910, polyglycolic acid, polypropylene, stainless steel, or nylon?

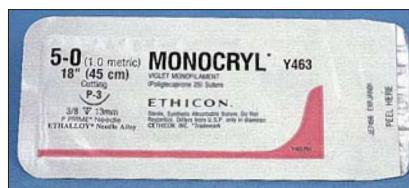


39a

38, 39: Answers

38 The four most common patterns of malocclusion resulting in palatal contact by the mandibular canine teeth are: (1) Lingual deviation of the mandibular canine teeth (upright canines) in a normal-width jaw. This condition may be unilateral or bilateral. Under normal circumstances the mandibular canine teeth initially erupt in a rostrodorsal direction, using the pathway provided by the resorbing deciduous tooth root. Once the crown appears in the mouth, the tooth then tips laterally, so avoiding palatal contact. Sometimes the adult tooth erupts at an abnormal angle, leading directly to abnormal positioning. On other occasions, for whatever reason, the deciduous tooth root may not be resorbed, so that the permanent tooth is prevented from tipping laterally as it erupts. (2) An abnormally narrow ('base-narrow') mandible can result in the mandibular canines contacting the palate even if they do diverge laterally at a normal angle. In many dogs with base-narrow mandibles the condition is masked by excessive lateral tipping of the canine teeth so that they do not cause palatal trauma. (3) Mandibular brachygnathism can lead to palatal injury by the mandibular canine teeth. In some cases the mandibular canines are positioned level with the maxillary canines which prevent the mandibular teeth tipping laterally. In more extreme cases there is a relative base-narrow effect due to the natural divergence of the maxillary dental arcades distally. This is the case with an underdeveloped mandible (mandibular micrognathia), which is a skeletal malocclusion characterized by a mandible that is too narrow and too short. (4) A fourth condition which will often result in palatal contact by one of the mandibular canine teeth is wry jaw.

39 i. Poliglecaprone 25 (Monocryl™, Ethicon, Inc., Somerville, NJ) (39b) is a synthetic, monofilament suture material which combines the rapid absorption comparable with that of catgut with the inertness, strength and smoothness previously only found in monofilament, synthetic non-absorbable suture materials such as polypropylene.



39b

ii. Although taper needles have been recommended in the past, small, swaged-on, 3/8-circle, reverse-cutting needles (e.g. FS-2 or P-3, Ethicon, Inc.) cause less tissue drag and are therefore recommended for intraoral suturing.

iii. The healing of suture lines closed with polypropylene was superior to that of those closed with polyglactin 910 (Vicryl™, Ethicon, Inc.) based on suture line bursting pressures and the degree of suppurative inflammation and tissue necrosis at the suture sites. Because of its multifilament structure and capillarity, polyglactin 910 harbors more bacteria and thus elicits more inflammation than polypropylene.

iv. Polypropylene caused a minimal reaction with <1 mm of erythema around the intra-orally placed sutures, while polyglactin 910 and polyglycolic acid caused a marked reaction with a >3 mm area of erythema with ulceration around the sutures.



40

- 40 i. What are the possible etiologies of the condition shown (40)?
ii. Is there any functional impairment associated with this malocclusion?
iii. Is any treatment indicated?

41 The eosinophilic granuloma complex in cats refers to a group of lesions affecting the skin and oral cavity (41). Oral eosinophilic granulomas also occur in dogs.

- i. Which lesions affect cats, and where are they typically located?
ii. In which breed of dog is this lesion most common, and where do they usually occur in the oral cavity?
iii. What are the recommended treatment options?



41

- 42 It is important for the veterinary dentist to use correct odontologic nomenclature. What are the correct terms to describe the dentition of the dog, horse, and rabbit?

40–42: Answers

- 40 i. A genetically narrow caudal maxilla or an abnormally wide mandible can result in a distal (or ‘posterior’) crossbite. Trauma to the maxilla of a neonate or juvenile can result in a unilateral distal crossbite.
- ii. There is generally no functional impairment resulting from distal crossbite, except for possible abnormal attrition of premolars and/or molars that are in occlusal contact.
- iii. Treatment is generally not indicated and would technically be very difficult.
- 41 i. Oral lesions in cats are usually eosinophilic ulcers or linear granulomas. Eosinophilic ulcers (e.g. indolent, rodent, and lip ulcers) are non-painful, non-pruritic lesions most commonly found on the upper lip. They are usually well-circumscribed, firm, red-brown to yellow, ulcerated lesions located on each side of the midline (41). Eosinophilic granulomas (linear granulomas) may occur as single or multiple lesions in a nodular pattern in the oral cavity. Histologic evaluation of these oral lesions is necessary for definitive diagnosis and to differentiate them from neoplasms, mycotic infections, and foreign body reactions.
- ii. An eosinophilic granuloma may occur in any breed but occurs most commonly in young Siberian Huskies. These lesions are typically identified as proliferative tissue, with or without superficial ulcerations, located primarily on the lateral and ventral surfaces of the tongue. They also occur on the soft palate.
- iii. Allergies (e.g. flea, mosquito, biting fly, food, atopy), parasites (e.g. fleas), infectious diseases (e.g. bacterial, dermatophytes, viral), and miscellaneous (genetic, immune-mediated, idiopathic) problems have been suggested as underlying causes or predisposing factors for the eosinophilic granuloma complex. When an underlying etiology is identified or suspected, treatment should be directed at eliminating or controlling it. Lesions generally respond to glucocorticoid administration. Cats are usually administered injectable methylprednisolone (2 mg/kg, minimum 20 mg) subcutaneously every two weeks for a total of 2–3 treatments. Dogs are administered prednisone orally at a dosage of 0.5–1.0 mg/kg every 12 hours for seven days then a tapering dose over the following 2–3 weeks. Progestin compounds are not recommended; they are not licensed for use in cats and may be associated with severe side-effects. Refractory eosinophilic ulcers have been successfully treated with CO₂ laser treatment in two cases. Eosinophilic granulomas may regress spontaneously.
- 42 *Dog:* a heterodont, diphyodont dentition with anelodont, brachydont teeth. Animals with heterodont dentition have teeth of mixed form and function; being diphyodont, there is a set of primary (deciduous) and secondary (permanent) teeth. Anelodont teeth have a limited period of growth as they develop anatomic roots. In a brachydont dentition the root is longer than the anatomic crown. *Horse dentition:* heterodont, diphyodont and anelodont, like in the dog. However, horses have hypsodont teeth. A hypsodont (radicular hypsodont) tooth has a long anatomic crown and a very short root when fully mature. Much of the crown is held in reserve subgingivally in the alveolar bone. The root is short in comparison with the length of the crown. *Rabbits:* heterodont, diphyodont dentition with all teeth being elodont (aradicular hypsodont): elodont teeth grow throughout life and never develop anatomic roots. Although diphyodont, the deciduous teeth are not functional and are exfoliated shortly before or after birth.

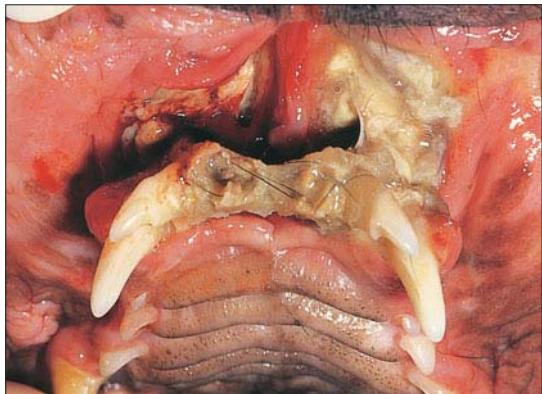


43

43 This patient (43) was presented for a fractured tooth.

- i. What are the considerations when assessing this fracture?
- ii. What type of restoration may be used?

44 This is an intraoral view of the premaxillary region of an 11-year-old, spayed, female Cocker Spaniel presented because of a six-month history of chronic, purulent nasal discharge, severe halitosis and a large, progressive, painful swelling on the dorsal nasal region (44). Six months before this presentation, the left and right maxillary first and second incisors were extracted and the remaining teeth were scaled and polished.



44

- i. What is your tentative diagnosis, and what diagnostic tests are recommended to confirm your diagnosis?
- ii. Based on the results of further diagnostic testing, what is the diagnosis and appropriate treatment in this case?

45

43, 44: Answers

43 i. This fracture extends below the gingival margin; it is therefore called a crown–root fracture. There has been some compromise of the attachment of the attached gingiva. This type of fracture can be treated; however, follow-up maintenance of oral hygiene is very important.

ii. After endodontic treatment has been performed, options for treatment include restoration of access and fracture sites or full-crown restoration. Restoration of the access and fracture sites provides primarily an economic advantage to the client. With good home care, simply closing the fracture and access sites with a light-cure composite resin may be sufficient. Periodontal surgery may be indicated to improve the gingival contour. It is much less expensive to place a composite resin restoration than it is to place a full crown. In addition, full-crown restoration requires a second anesthetic episode to place the crown. The advantage of a full-crown restoration is two-fold. First, the full crown allows greater protection for the tooth against further trauma. The tooth was weakened in the initial fracture occurrence, and may be further weakened in the therapy. The full crown will help to protect the tooth's integrity. Secondly, the full crown allows better restoration of the anatomy of the tooth. This can help to prevent further periodontal problems caused by food entrapment into a periodontal pocket that may be created by the loss of attached gingiva.

44 i. Based on the history and the appearance of the lesion, a bone sequestrum is suspected, although an underlying neoplastic process cannot be ruled out. Thoracic radiographs are necessary to reveal the presence of detectable metastatic disease. Hematologic and serum biochemical testing is recommended to rule out underlying disease; skull radiographs are recommended to further evaluate the lesion; and an incisional biopsy followed by histopathologic examination is recommended to determine the exact nature of the condition.

The results of further diagnostic testing revealed normal thoracic radiographs, and an elevated white blood cell count with a shift to the left. Skull radiographs revealed a bone sequestrum in the region of the remaining maxillary incisors and canine teeth. Histopathologic examination revealed a severe chronic inflammatory reaction.

ii. This is a case of a bone sequestrum in the premaxillary region. Appropriate treatment involves the removal of the bone sequestrum and all teeth associated with it. In this case this involved both remaining maxillary incisors and canine teeth. Following extraction of affected teeth the surrounding bone is thoroughly débrided with rongeurs and curettes until normal, healthy bleeding bone is revealed. The excised tissue is submitted for histopathologic examination to confirm the diagnosis and tissue is submitted for bacterial culture and sensitivity testing. The surgical site is liberally flushed and the gingiva is sutured. Broad-spectrum antibiotic therapy is initiated pending the results of bacterial culture and sensitivity tests. Conservative surgical treatment, such as limited curettage of obviously necrotic bone, followed by a prolonged course of antibiotics, is usually only temporarily successful. Radical resection of affected tissue back to normal bone is much more likely to cure this condition.

45, 46: Questions

45 A two-year-old dog is presented with discoloration of the left mandibular canine one year after root canal treatment of both mandibular canines (45).

- i. Describe the radiologic findings associated with the left mandibular canine.
- ii. List the possible causes for treatment failure.
- iii. What is your recommendation for salvaging this tooth?
- iv. What could have been done during the initial treatment to improve the likelihood of success?



45

46 The appropriate management of traumatic lesions of lips in dogs and cats varies depending on the clinical presentation (46).

- i. What should be included in the initial wound management of lip lacerations?
- ii. What factors influence whether or not a lip laceration should be closed primarily or closed utilizing delayed primary closure?



46

47

45, 46: Answers

45 i. Immature tooth with a root canal filling; overfilling with root canal cement and extrusion into the periapical tissues; periapical rarefying osteitis.

ii. Incomplete obturation at the apex allowing percolation of fluids; incomplete canal cleaning leaving debris in the canal; overfill of material acting as tissue irritant; leakage of the coronal restoration allowing bacteria and fluids eventually to reach the periapical tissues. The fact that this tooth was still immature, with an incompletely formed apex at the time of root canal therapy, largely contributed to the occurrence of this complication.

iii. Surgical approach for root tip amputation (apicoectomy) and retrograde filling (surgical endodontics) to remove the overfilled material, débride the periapical lesion, and obturate the apex. The large periapical radiolucency indicates that the cortical bone plate is involved. With the extent of the periapical lesion which is now evident, the prognosis for this tooth is guarded to poor.

iv. Apexification. An immature permanent tooth with an incompletely formed apex has weak walls and no apical stop or seat against which to compress a filling material. The open foramen has thin and fragile dentinal walls which would complicate an apicoectomy and make it difficult to obtain a seal. Apexification allows the apex to mature and close. To perform this, the canal is emptied, cleaned and dried similar to routine endodontic treatment. Then the canal is filled with a temporary material (usually $\text{Ca}(\text{OH})_2$) until radiographic evidence of apical closure is demonstrated. Mixing a small amount of barium sulfate with the $\text{Ca}(\text{OH})_2$ allows radiographic monitoring. If the material is resorbed before apical closure, the remaining material may need to be removed and the canal refilled with fresh $\text{Ca}(\text{OH})_2$. Once the apex has closed, routine root canal filling may be performed. Other materials, such as tricalcium phosphate and collagen–calcium phosphate, have also been shown to promote apexification. The important point is cleaning the necrotic material from the canal and preventing ingress of bacteria to allow bone growth in the periapical region.

46 i. Initial wound management should include débridement of devitalized tissue and copious lavage. The condition of the wound following débridement will influence the decision on timing and method of wound closure.

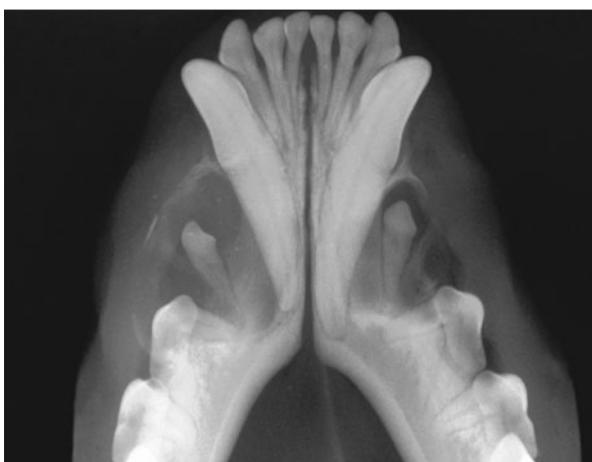
ii. Several factors influencing primary wound closure include: degree of contamination, time interval since injury, presence of devitalized and damaged tissue, adequacy of blood supply, availability of tension-free closure, overall status of the patient, and client compliance with wound management. Acute wounds can usually be débrided and closed primarily. A full-thickness lip laceration should be closed in two layers. The mucosa is apposed with simple-interrupted absorbable sutures with the knots located within the oral cavity, while the skin is apposed with simple-interrupted non-absorbable sutures. In general, the number of sutures should be kept to a minimum. The suture size should be as small as possible; usually 5-0 suture material is adequate and the sutures should be carefully placed, taking care not to devitalize tissues. Delayed primary closure is indicated when the wound is grossly contaminated, purulent, extensively devitalized, edematous, or inflamed. Delayed primary closure is performed 3–5 days after injury. The advantage of delayed primary closure is that it permits evaluation of the progression of wound healing and serial débridement of devitalized tissue.



47

47 The oral cavity is lined by a continuous mucous membrane (47).

- i. What is the difference between free and attached gingiva?
- ii. What are the structural differences between attached gingiva, alveolar mucosa, and palatal mucosa?



48

48 The intraoral examination of an 18-month-old Shih Tzu revealed two 15 mm, smooth, soft, non-painful, fluctuating swellings in the edentulous areas distal to the mandibular canine teeth and mesial to the mandibular second premolars. Aspiration of the swelling produced a serous, slightly blood-tinged fluid. Intraoral radiographs were taken of the rostral mandible (48).

- i. What is your tentative diagnosis?
- ii. What is the appropriate treatment for this condition?
- iii. What complications may be encountered in the management of this patient?

47, 48: Answers

- 47 i.** Gingiva covers the alveolar processes of the maxilla and mandible and surrounds the teeth. The gingival mucosa comprises the oral gingival epithelium, sulcular epithelium, and junctional epithelium with the underlying connective tissue (lamina propria) contributing to the attachment apparatus of the tooth (see 65 and 206). The gingiva coronal to the cementoenamel junction is called the marginal or free gingiva.
- ii.** The attached gingiva is demarcated from the alveolar mucosa by the mucogingival junction and is tightly bound to the underlying periosteum of the alveolar bone. The oral gingival epithelium has a keratinized surface layer. Parakeratinization, characterized by the presence of pyknotic nuclei in the flat, horny scales, is common. The basal cells continuously produce new epithelial cells. The oral gingival epithelium and the lamina propria are dove-tailed with one another through pegs and ridges. The network of collagen fibers in the sub-epithelial connective tissue, which form bundles, extends into cementum, periosteum, and the surface of the outer cortical plate of the alveolar process.

The alveolar mucosa is a loose, movable, highly vascularized, non-keratinized epithelium. Compared with the oral gingiva, the connective tissue consists of a submucosa located below the lamina propria. Collagen and elastic fibers are present and the latter give the oral mucosa its mobility. The mucosa of the lips and cheeks and the mucosa of the floor of the mouth is similar in structure to that of the oral mucosa. The epithelium of the mucosa of the floor of the mouth is very thin.

The mucosa of the hard palate consists of keratinized, stratified, squamous epithelium. It is developed in several transverse curved ridges (palatine rugae). It has a thick, tough, connective tissue support, the mucoperiosteum, which is continuous with the periodontal ligaments of the maxillary teeth.

- 48 i.** A bilateral dentigerous cyst, containing an unerupted mandibular first premolar. Although dentigerous cysts occur infrequently in dogs, it should be a primary consideration in young dogs presenting with oral swellings in an edentulous area.
- ii.** Treatment involves making an incision over the cyst, burring away any buccal cortical bone overlying the cyst, drainage of fluid, and extraction of the unerupted tooth following minimal elevation. The cyst wall is thoroughly curetted to ensure complete removal. The entire cyst lining should be submitted for histopathologic examination. The use of a cancellous bone graft is recommended. The oral mucosa is closed with multiple, simple-interrupted sutures.
- iii.** Incomplete removal of the cystic epithelium may result in recurrence of the dentigerous cyst. Malignant transformation of the epithelial lining cells of the dentigerous cyst to primary osseous carcinoma, adenomatoid odontogenic tumor, and ameloblastoma has been reported in humans; this potential, although rare, exists in dogs, making thorough histopathologic examination and careful postoperative evaluation of the surgical site mandatory. The structure of the mandible will be considerably weakened as a result of the cysts and surgery, and care should be taken to avoid fracture of the mandible.

49, 50: Questions

49 This radiograph (49) shows a potential complication of an endodontic procedure.

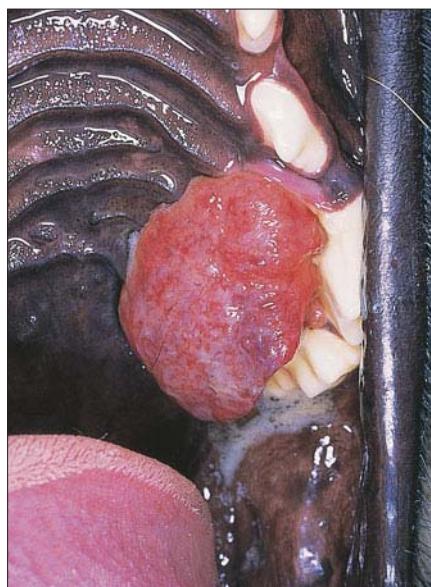
- i. What is the complication evident on this radiograph, and why can this be a problem?
- ii. What can be done to help prevent this or similar instrument complications?
- iii. When this complication occurs, what steps can be taken to correct it?



49

50 This tumor on the caudal palate in a seven-year-old dog was diagnosed as a fibrosarcoma (50).

- i. What are important factors in the therapeutic decision-making process?
- ii. Of what possible specific complications should the client be informed if a maxillectomy is considered?



50

51

49, 50: Answers

- 49 i.** The radiograph shows a separated Lentulo® paste filler tip in the root canal. This can be a problem if the presence of the tip prevents adequate obturation of the canal or becomes forced through the apex during obturation. This canal has been previously cleaned since this complication occurred during placement of the root canal cement. If an endodontic file tip becomes separated during the filing stage of the root canal, it may make it impossible to completely clean and shape the canal.
- ii.** Measures to prevent separation of instrument tips during a root canal procedure include: (1) Having a straight-line access to minimize bending of the instrument. (2) Starting with the smallest file that will go to the apical limit of the canal and increasing in size. (3) Using a lubricating agent and lavage during filing. (4) Checking files and spiral filling instruments for signs of weakening (unraveling of the twists or cracks). (5) Keeping a steady hand so the instrument is moved straight in and out of the canal. (6) Using the instrument appropriately (e.g. do not twist Hedström files, use a reduction contra-angle with spiral fillers).
- iii.** If a separated instrument tip does occur, the procedure may still be able to be salvaged. An attempt can be made to remove the instrument tip by using a magnetized file, ultrasonic endodontic files to loosen and flush the tip out, or try to snag the instrument with another file if in a larger canal. If the tip becomes wedged, it can be impossible to remove it. If the canal is clean and the mishap occurred later in the procedure, it may be possible to fill the canal with a heated gutta-percha technique and follow it along radiographically. If there is failure of the procedure or the separated instrument tip prevents satisfactory completion of the root canal procedure, an apicoectomy can be performed to ensure a clean and filled apical portion of the canal.
- 50 i.** In addition to the general considerations of overall health, life expectancy, and wishes of the client, an accurate assessment of the extent of the tumor is extremely important. An oral fibrosarcoma infrequently has regional lymph node involvement but distant metastasis is occasionally present. Of particular importance in this case is to determine the extent of the primary tumor. Good-quality oral and nasal radiographs are essential to establish whether the tumor has invaded the nasal cavity. More advanced diagnostic modalities (e.g. CT, MRI) may be very useful. If modalities other than surgery are contemplated, it is important to know that the response of oral fibrosarcoma to radiation therapy is only fair to poor.
- ii.** The main intraoperative complication is hemorrhage, which can be life-threatening with inadequate anesthetic support and suboptimal surgical skill. Wide surgical margins are indicated as a fibrosarcoma is known to infiltrate deeply. Given the fact that this is a large tumor, tumor-free margins and tension-free closure may be difficult to achieve. The client should be informed that local recurrence is a distinct possibility. Partial dehiscence of the buccal flap used for closure of the maxillectomy site is generally due to closure under tension. The cheek on the operated side may be visibly pulled inwards. The mandibular teeth, the first molar in particular, may occlude with and traumatize the flap covering the maxillectomy site.

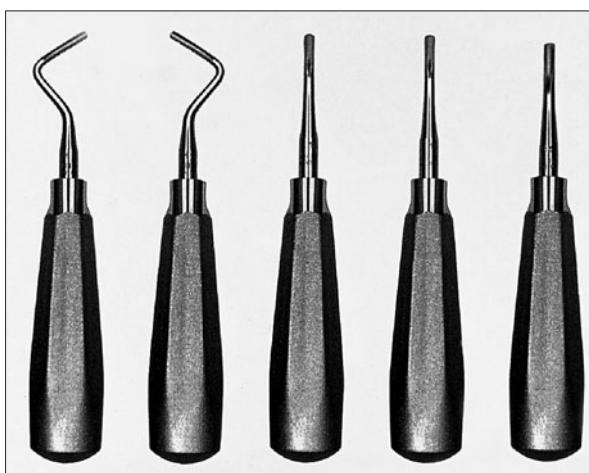
51, 52: Questions



51

51 The use of pins in this case has contributed to the failure of this restoration (51).

- Explain why this has occurred.
- What precautions can be taken to avoid complications when using this technique?
- What would have been a better alternative for restoration of this tooth?



52a

52 i. Which dental instruments are suitable for use as levers (52a), and what precautions should be applied to their use in this manner?

- What is differential rotational leverage, and why is it better than simple leverage for tooth extraction?

51, 52: Answers

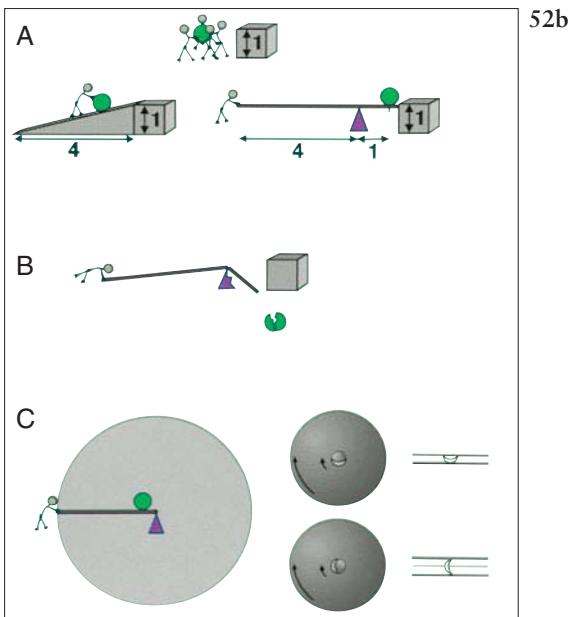
- 51 i. Pins do not add strength to the restoration; however, they do increase the retention of dental materials. In this case, the pins have actually made the restorative material more subject to fracture due to shear. While the pins may have increased the retention of the material, they have made the material subject to fracture.
- ii. Pin holes must be carefully planned. They must be placed no closer than 1 mm from the restorative edge and dentinoenamel junction to avoid crazing of enamel. Caution must be used in vital teeth to avoid pulp exposure. In all teeth, pinholes should be positioned to avoid perforations into the periodontal ligament. The process of drilling into the tooth removes tooth structure and weakens the tooth.
- iii. While the placement of pins may be an advantageous economic alternative, a better dental alternative in this case would have been a full prosthetic crown.

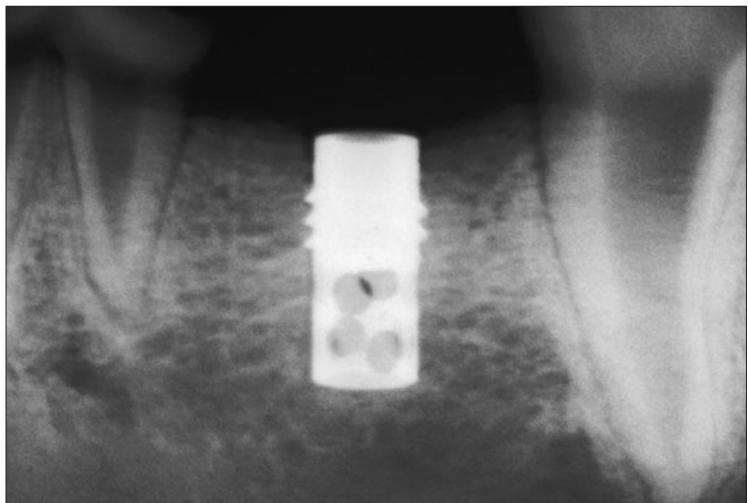
52 i. Dental elevators may be used as levers. The tips of luxators are made from softer metal and are less robust, making them unsuitable as levers. Dental luxators are efficient wedges, using the mechanics of a slope.

Carefully applied, the mechanical advantage produced by leverage can assist with extraction of teeth. Levers apply forces in two directions, one way at the working end and in the opposite direction at the pivot (52b (A)). To minimize the risk of damage (52b (B)), when it is necessary to apply simple leverage, an area of hard tissue should be used as a fulcrum rather than a point contact. Teeth which are to remain in the mouth should never be used as a fulcrum. Leverage against the crown of a tooth

(accidental or deliberate) is liable to cause root fracture below the level of the alveolar bone. In order to minimize this risk, odontoplasty or full-crown amputation can be performed on the tooth to be extracted before extraction of the tooth's root(s).

ii. Differential rotational leverage (52b (C)) applies a powerful force over a very short distance, thus reducing the risk of causing unnecessary damage. Elevators and luxators are designed with large-diameter handles; gentle rotation of the handle rotates the semicircular working end, thus applying a considerable force over a very short distance. The fulcrum used during rotational leverage can have a large surface area, usually of crestal bone or another portion of a tooth which is to be extracted, thus minimizing the risk of unnecessary damage to remaining tissues.





53

- i. What is the device shown on the radiograph (53)?
- ii. What are the indications for its use?
- iii. What are the contraindications for its use?
- iv. What are the complications in the installation of this device?
- v. What are the complications after placement?

54 This is an intraoral view of the premaxillary area of a seven-month-old intact female Labrador Retriever, which was kicked in the mouth by a horse (54). Palpation and intraoperative radiographic evaluation revealed a segmental fracture of the premaxilla involving an interdental bone fracture between the left maxillary second and third incisors and the right maxillary second and third incisors. The fracture segment contained the left and right maxillary first and second incisors.



54

- i. What is your diagnosis and treatment of the soft tissue injury?
- ii. What non-invasive, inexpensive technique could be utilized to stabilize the segmental fracture of the premaxillary region?
- iii. What postoperative dental complications may be associated with this type of injury?

55

53, 54 Answers

- 53 i.** A titanium implant. It has been coated with hydroxyapatite to promote osteointegration.
- ii.** The indications for this device are to replace lost teeth in working dogs.
- iii.** The contraindications are uncontrolled periodontal disease, inability of the client or the patient to accept home care, and patients that will be used for show purposes. If the tooth has been lost due to periodontal disease, there is very little likelihood of improvement in overall oral hygiene. This will lead to infection and loss of the implant.
- iv.** A few of the possible complications in the placement of implants include overheating of bone, improper alignment, perforation into the nasal cavity, and damage to adjacent teeth. Overheating of bone can be prevented by using ultra-slow speed (300–500 r.p.m.) handpieces with sterile saline irrigation through the handpiece. Failure to take this precaution may cause fibrous scar tissue to form rather than bone. This will not be as strong as bone and may result in implant failure. Improper alignment, perforation into the nasal cavity, and damaging adjacent teeth may be prevented by careful measurement and the use of a pilot hole.
- v.** Complications immediately after placement include failure of osteointegration and infection. In the long term, hygiene at home is critically important for the success of the procedure. Without good home care, bacterial invasion will occur into the adjacent tissue. Bone will be lost and osteomyelitis may result. Eventually the implant may be rejected or implant removal may become necessary.

- 54 i.** This is a midline avulsion of the gingiva from the maxilla. Initial therapy in these cases should include thorough débridement and flushing of the wound. Following thorough débridement, the avulsed gingiva is sutured to the palatal mucosa with fine, monofilament, absorbable suture material. Sutures may be placed around adjacent teeth to improve the retention of sutures.
- ii.** The premaxillary fracture segment contains the right and left maxillary first and second incisors. The maxillary second and third incisors are interdentally wired to each other on the left and right to provide initial reduction of the fracture site. Once the fracture segment is reduced, an acrylic splint is applied to the facial aspect and the inter-dental spaces of the six maxillary incisors to provide rigid stabilization until fracture healing occurs.
- iii.** The trauma sustained to the premaxilla may result in postoperative endodontic disease of the maxillary incisors. Although the incisor teeth were not fractured in this case, periodontal trauma (concussion, subluxation) can displace the root apex and compromise the blood supply to the pulp. Pulp that is impaired or devoid of a blood supply may become colonized by bacteria via hematogenous spread through the apical foramen, resulting in pulpitis or pulp necrosis. Periodic reevaluation of the premaxillary region will determine the need for subsequent endodontic therapy in this case.

55, 56: Questions

55 i. What are the important considerations regarding time and pouring for alginate and vinyl polysiloxane impressions (55)?

ii. How can air bubbles be avoided when pouring a stone model?



55



56

56 This is a four-month follow-up radiograph of a mandibular fracture stabilized with an external fixateur. It indicates that a non-union is present, even though the repair is still very stable (56).

- i. What is/are the likely cause(s) of this complication?
- ii. What are the recommended guidelines for preventing this problem?
- iii. What would the therapeutic approach be at this stage?

57

55, 56: Answers

55 i. *Alginate impressions:* the stone models should be poured within 30 minutes. Excess water should be removed from alginate impressions. If the stone model is not poured immediately, the impression should be wrapped in a dampened paper towel and kept in the refrigerator. After 24 hours, discard the impression.

Vinyl polysiloxane impressions: delay the stone model pouring for one hour in order to obtain the best surface on the model (small gas bubbles may come to the surface during the first hour). Pouring may be delayed up to 14 days without loss of accuracy.

ii. Wet the stone in the center of the mixing bowl by stirring with a spatula. Once the stone is wet, begin spatulating it on the side of the mixing bowl. Spatulate in one direction to minimize air bubbles. The bowl can be placed on the vibrator to remove any air bubbles. The mixing time should be less than two minutes. One end of the impression is placed on the vibrator and small amounts of dental stone are placed at the opposite end of the impression. The vibration will cause the stone to flow into the impression. The flow should be controlled to avoid air being trapped in the deep recesses of the impressions. Once the teeth and floor of the impression have been carefully filled with stone, the vibrator is turned off and small brass pins (Pindex®, Coltène/Whaledent Inc., Mahwah, NJ) are gently inserted into the canine teeth so that only the tips of the pins appear from the stone. The remainder of the stone is thickened and added to the top of the model. It is important to build up the model to strengthen it. The model is then placed on a level surface to allow the initial set to occur which takes approximately 10–15 minutes. The mixing and pouring of the dental stone should be done in less than five minutes. After 45–60 minutes the impression can be separated from the stone model.

56 i. The distal root of the mandibular fourth premolar and the mesial root of the first molar are involved in the fracture line. These roots are poorly supported by bone, and a severe periodontal–endodontic lesion is present at the distal root of the mandibular fourth premolar. A large bone defect is present, which has also contributed to this non-viable, non-union.

ii. It is common for an alveolus to be involved in the fracture line. If the tooth involved is luxated, it should be removed. If there is still enough healthy periodontal attachment, evidenced by the fact that the tooth is non-mobile, retention of the tooth is usually indicated as it will contribute to the stability of the fracture fixation. The presence of a tooth in the fracture line increases the incidence of infectious complications; however, the immediate removal of the tooth cannot reverse these effects. If a tooth involved in the fracture line is retained, it should be carefully monitored subsequently for any evidence of periodontal or endodontal pathology; appropriate treatment should be instituted as soon as either is recognized.

iii. The two affected teeth should be extracted, the area débrided, and a cancellous bone graft applied. Antibiotic therapy based on bacteriologic examination of a sample taken intraoperatively is indicated. The external fixateur may be left in place if it is still stable. Progress should be monitored radiographically and the bone graft may have to be repeated.

57, 58: Questions

57 Define scaling, root planing, and gingival curettage, and explain how these three procedures may form part of routine periodontal treatment (57a).



57a

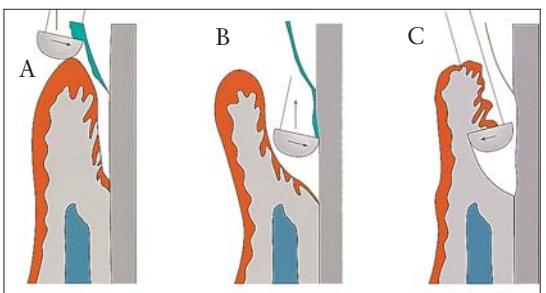


58a

58 Obtaining a good radiographic picture of the maxillary premolars and molar in the cat may be difficult. This radiograph (58a) was taken using an extraoral technique. Briefly explain this technique.

57, 58: Answers

57 Scaling (57b (A)) is the removal of accretions (plaque and calculus) from the teeth. Scaling implies a procedure to clean the accessible part of the tooth, in order to remove acquired material which is likely to promote the development of disease. It does not signify preparation of the surface involved. When there is severe gingival inflammation, 'gross' scaling is performed to remove the majority of local irritants, with the intent to proceed to more thorough and exacting techniques.



57b

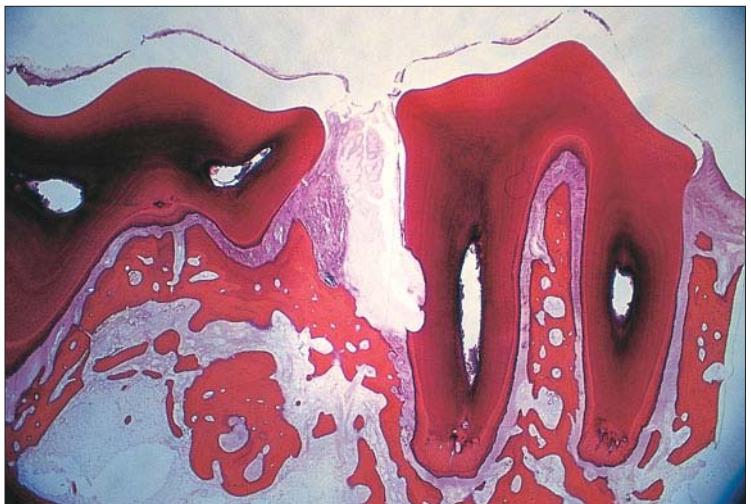
The rationale for staging treatment in this manner is that some tissue healing can occur before other more delicate procedures are instituted – usually at least a few days later. The end point in scaling is visual cleanliness. **Root planing (57b (B))** is removal of accretions and smoothing the root surface. Root planing may be directed at cementum irregularities or notches left in the tooth surface by previous therapeutic procedures. The end point of root planing is tactile smoothness of the root. An instrument, such as an explorer, is used to feel the root surface which, when properly smoothed, should feel 'smooth as glass'. Overlapping short smooth strokes with a sharp periodontal curette are used to create this surface. **Gingival curettage (57b (C))** indicates removal of granulation tissue and diseased epithelium from the sulcus or pocket lining by scraping the soft tissue with a curette. A universal curette held in the reverse position from that used for normal scaling can be used for this procedure; a finger held against the gingiva can stabilize the gingiva during the curettage. The operator must exercise discretion in how much pressure to apply in scraping the soft tissue: enough to remove the friable diseased tissue but not so much that the gingiva is badly torn. Gingival curettage is generally performed in a closed fashion, i.e. without creating a gingival flap. The rationale behind this procedure is that the defect created is expected to heal by epithelial regeneration, resulting in long but healthier junctional epithelium and some connective tissue reattachment.

58 Image overlap of the zygomatic arch and opposite maxillary premolars commonly occurs in the cat. In order to avoid this problem, the extraoral, near-parallel technique is recommended (58b). With the animal in lateral recumbency, the dental film is placed under the head (under the side which you wish to radiograph) with the mouth propped open. Visualize the central X-ray beam to be perpendicular to the maxillary root axes. Any films used extraorally must be marked to separate them from intraorally exposed film to ensure proper orientation.



58b

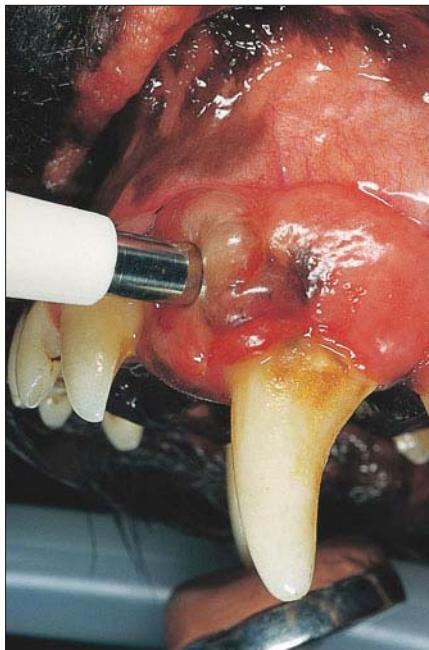
59, 60: Questions



59

59 What causes feline odontoclastic resorption lesions (FORLs) (59)?

60 What are important considerations and guidelines when taking a biopsy of a suspected oral tumor (60)?



60

61

59, 60: Answers

59 The cause of FORLs remains a mystery. However, the tooth substance is destroyed once the process has started. Many years ago, these lesions were called ‘feline caries’; however, they are not the result of enamel demineralization caused by acids produced by bacteria, so ‘caries’ is an incorrect term. Circulating stem cells are attracted to the cementum and differentiate into odontoclastic and osteoclastic cells. In most other species, it is the alveolar bone that is attacked by these cells, whereas for FORL it is the cementum and then the dentin that is attacked (59). The odontoclastic cells clamp on to the cemental surface and secrete acid to leach out the mineralized tissue to create a defect. They continue to bore into the tooth, reaching in all directions – the crown may be externally intact but riddled underneath, and in other cases the lesions extend into the pulp tissue. As the cavity advances, vascular tissue follows, and eventually a reparative tissue known as ‘bone-cementum tissue’ is laid down. The pulp maintains its viability. However, the reparative tissue causes ankylosis between alveolar bone and the tooth substance, and thus the shock-absorbing effect of the normal periodontal ligament is lost, and the tooth often fractures. We do not know what attracts the stem cells to the area that will become affected. Since there is very often severe gingivitis associated with clinically-evident FORLs, one suggestion was that gingivitis resulting from plaque and calculus accumulation causes release of the inflammatory mediators that have been identified in the area of early lesions (prostaglandins, osteopontin); there is now gathering evidence that this is not the case. Other specific factors that have been investigated, such as nutritional deficiencies or alterations to the surface of cat food, have failed to identify a cause. Since we do not know the cause, we cannot do much about prevention.

60 An incisional biopsy is preferred if: (1) One is uncertain whether the lesion is neoplastic. (2) The result of the biopsy might influence the therapeutic plan. (3) The planned therapy is potentially associated with considerable disfigurement and morbidity. (4) The client desires an accurate prognosis.

All of these considerations were valid in the case illustrated (60), which turned out to be a poorly differentiated sarcoma. This case also illustrates the wide variety of histopathologic entities which may clinically present as an *epulis* (see 33). In selected cases of very small tumors on the gingival margin, an excisional biopsy by means of gingivectomy may be indicated where the tumor can easily be excised *in toto*.

In taking a biopsy, the following important technical details should be borne in mind: (1) Taking a biopsy must be done as atraumatically as possible, to prevent exfoliation and seeding of neoplastic cells. (2) The site of the biopsy must fall within the boundaries of the tissue to be excised. (3) A representative tissue sample should be obtained and normal tissue should not be included in order to avoid opening previously unopened tissue planes.

The biopsy should be adequately fixed and submitted to a pathologist with experience in oral pathology. The result of the histopathologic examination should be compatible with the clinical findings; if not, the matter should be discussed with the pathologist. If any doubt remains, an additional biopsy may be indicated.

61, 62: Questions



61a

61 Are these cat's mandibular canine teeth normal (61a)?

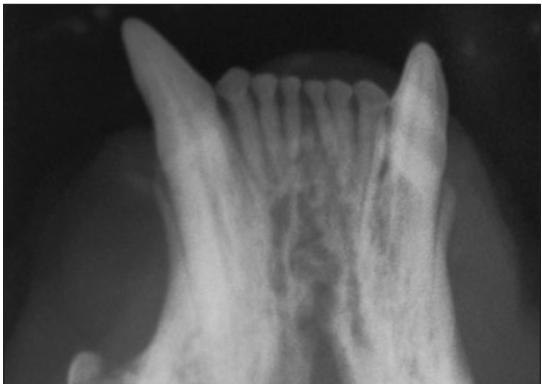


62

62 This radiograph of a dog with periodontitis illustrates the radiographic findings typical of this disease process (62). Describe the radiographic features of periodontitis.

61, 62: Answers

61 Absence of gingival inflammation, normal sulcus depths, and normal appearance of the crowns leads to a clinical diagnosis of ‘normal tooth’. However, the teeth may be very abnormal in their root structure. In the radiograph (**61b**), one canine tooth has a normal crown, but has extensive root resorption. Root ankylosis is so severe that the cemental margin of much of the root cannot be followed. There are less severe FORL changes on the mesial surface of the mid root of the other canine tooth. The third premolar tooth is missing on the right side, and the left third premolar has a severe FORL. FORLs have often been referred to as ‘neck lesions’ or ‘cervical line lesions’, because they were originally recognized as clinical lesions occurring at the gingival margin. The change to the term ‘feline odontoclastic resorptive lesions’ is a result of recognition that these lesions can occur anywhere on the cementum. Radiographs are mandatory before considering restoration of even a ‘minor’ FORL lesion. Once we know that the tooth is abnormal, we then have to decide what to do about it (see 15, 20, 35 and 175).



61b

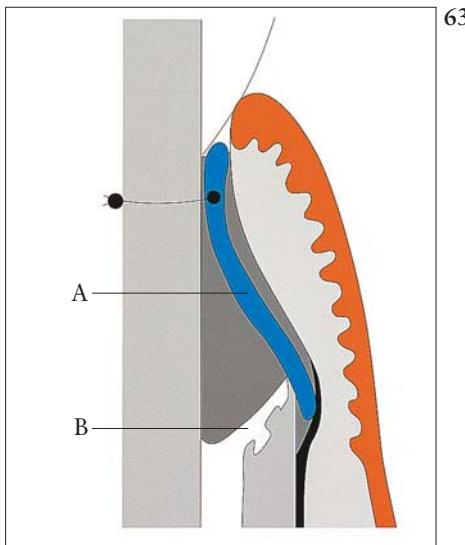
62 In advanced cases of periodontal disease, the supporting bone peripheral to the lamina dura can appear either as more dense (sclerotic) or less dense (osteolysis) than healthy bone. The alveolar crest will often be lowered apically because of bony resorption. With horizontal bone loss the alveolar crest recedes parallel to the line connecting the cementoenamel junction and this can be seen affecting two or more adjacent teeth (**62**). Vertical bone loss (infrabony pockets) is seen involving single teeth or a single root of a tooth, and radiographically is either visualized as a wide periodontal space or as a ‘crater’ appearance of bone loss. Loss of bone attachment, advanced tooth mobility, gingival recession, and pocket depth confirm periodontitis.

Radiographic assessment also reveals evidence of furcation involvement. When the crestal bone in the furcation area is lost this is called furcation involvement. This can be incomplete (a probe can enter the furcation but not pass through) or complete. Periapical loss of bone is also evident leading to loss of attachment and tooth mobility. Reports state that 30–60% of the bone must be demineralized before it can be detected radiographically.

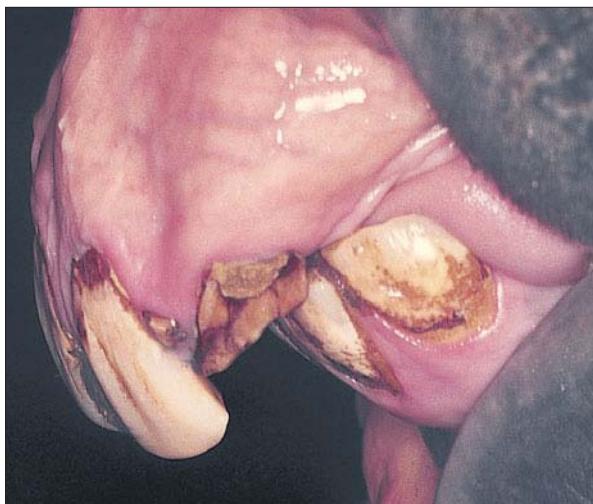
Because of the unique patterns of periodontal bone loss associated with certain forms of periodontal disease, radiographs can provide useful diagnostic information. The main information provided by traditional radiography is an estimate of alveolar bone loss at the time of the radiographic survey. By comparing radiographs at different times, it is possible to estimate the loss or gain of bone at selected locations in the dentition.

63, 64: Questions

63 What is this technique called (63), and what are the major principles involved?



63



64a

64 What is the significance of maxillary prognathism/mandibular brachygnathism ('parrot mouth' conformation) (64a) to the oral health of a horse?

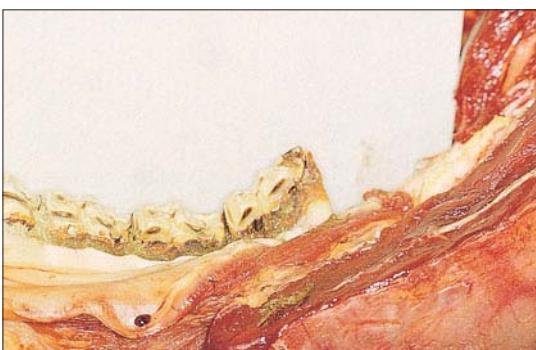
65

63, 64: Answers

63 The barrier (A) over the infrabony defect (B) signifies guided tissue regeneration surgery. The defect must regenerate from cell populations with bone and periodontal ligament characteristics. The barrier excludes gingival connective tissue and oral epithelium which proliferate more rapidly and would otherwise fill a significant portion of the defect. Thus, guided tissue regeneration often allows regrowth of bone and periodontal ligament where it had formerly been lost due to periodontitis. Successfully treated teeth have stronger support and may have improved long-term survival rates because deep active infrabony pockets are not as likely to recur.

A variety of modifications have been proposed for guided tissue regeneration. The barrier is common to all but the character of the barrier is quite variable. Non-resorbable barriers which must be removed in a second surgery, resorbable barriers which are bioabsorbable, reinforced barriers which prevent collapse and thus preserve space for tissue growth under the membrane, and extraskeletal barriers which allow guided bone regeneration to the periosteal surface of the maxilla and mandible are all commercially available. A wide variety of implant materials are available to act as stimulants or scaffolding to bone growth below membranes. Hydroxyapatite, demineralized bone matrix, glass, calcium sulfate and others are commercially available. Growth factors have been added to implants experimentally in order to test their effect on the principles of bone regeneration, and the results have been encouraging.

64 Horses with ‘parrot mouth’ usually show little difficulty in the prehension of herbage, and even those severely afflicted rarely lose bodily condition through an inability to take in ingesta. The most important aspect of this disparity in the relative lengths of the mandible and maxilla is that abnormal attritional wear takes place with a tendency for hooks to form on the maxillary second premolar and mandibular third molar. Sharp points on the latter tooth can impinge on the soft tissues of the opposite jaw to cause extreme discomfort and marked dysphagia. They are best resected using purpose-made instruments to guillotine the dental overgrowths without fracture of the remainder of the tooth or damage to neighboring crowns. The incidence of periapical abscessation of this tooth has increased markedly with the advent of unqualified equine dental technicians and through inept attempts to remove hooks using chisels (64b).



64b

In general terms, careful assessment of oral conformation is an important part of the prepurchase examination, because faults are likely to lead to poor occlusion, dysphagia and limit the long-term usefulness of the horse. Horses with ‘parrot mouth’ should not be used for breeding as this defect is genetically transmitted.

65, 66: Questions

65 The gingival sulcus is a very important area (65a).

- i. What is the gingival sulcus, junctional epithelium, and sulcular epithelium?
- ii. How does the gingival sulcus differ from a periodontal pocket?



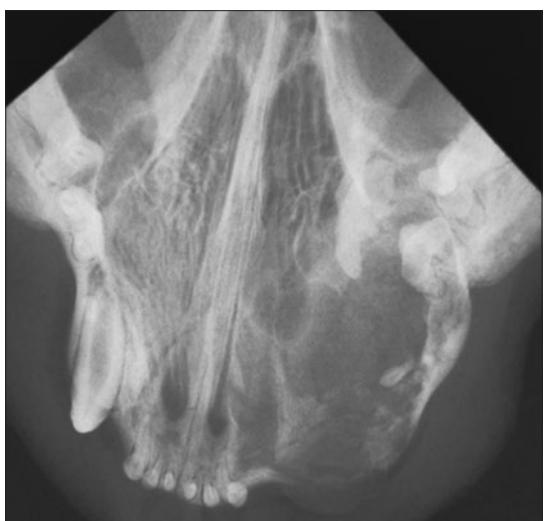
65a

66 This is an oral tumor found in an 18-month-old cat (66a, b).

- i. What is your tentative radiologic diagnosis?
- ii. What is known about this tumor type?



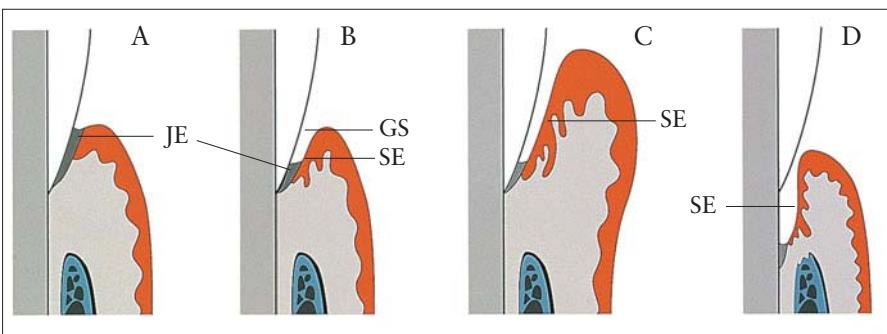
66a



66b

65, 66: Answers

65b



65 i. In dogs not exposed to dental plaque (germ-free dogs or dogs subjected to thorough dental home care since tooth eruption) there is no gingival sulcus (65b (A)). The gingival margin ends on the tooth surface in a thin, narrow-angled margin with the junctional epithelium (JE) extending directly to the level of the gingival margin. This characterizes a histologically normal gingiva (no inflammation).

With plaque accumulation after tooth eruption, a sulcus forms (65b (B)). This is the normal feature in what is called clinically healthy gingiva (not histologically healthy as a subclinical inflammation already exists). The gingival sulcus (GS) is defined as a narrow groove between the gingival margin and the tooth surface. Its depth is usually 1–3 mm in the dog and around 1 mm in the cat. The sulcular epithelium (SE) forms the lateral wall; its interior wall is formed by enamel or, with ageing, by root cementum, and the bottom of the sulcus is formed by JE. The JE is located at the level of the cementoenamel junction in young dogs, whereas it is apical to it in old dogs. The interface between JE and subepithelial connective tissue follows a fairly smooth line with usually no rete pegs, contrary to the epithelial-connective tissue interface of the oral gingival epithelium. Both JE and SE are non-keratinized, although some para-keratinization is occasionally observed in SE.

ii. A pseudopocket forms with gingival hyperplasia (65b (C)). This should be differentiated from a true periodontal pocket (65b (D)), which is a space around a tooth as a result of the tissue destruction which occurs with periodontitis. Both can be measured clinically by inserting a probe into the space and measuring the distance from the base of the pocket to the free gingival margin (probing depth). A more accurate measure of attachment loss is to measure the distance from the base of the pocket to the cementoenamel junction.

66 i. This is a typical example of a feline inductive odontogenic tumor.

ii. The feline inductive odontogenic tumor, originally described as inductive fibroameloblastoma, is an uncommon tumor-type occurring mainly in young cats. It is characterized by ameloblastic epithelial cells arranged around dental pulp-like stroma. The rostral maxilla is the most common site of occurrence. The tumor may be locally invasive, but metastasis has not been recorded.

67–69: Questions

67 These are examples of medicated endodontic sealers and pastes (67), rarely used in the USA but still popular in some parts of Europe.

- What do these products generally contain?
- How are or were these products used?
- Why is the use of these products strongly discouraged?



67

68a



68b



- 68 i. What endocrinopathy should be considered in a cat with insulin-resistant diabetes mellitus, hepatomegaly, and a large head with a protruding mandible (68a, b)?
- ii. What would be the most likely cause, and how would the diagnosis be confirmed?

69 This structure (which has been bisected) (69) caused a palpable swelling over the maxilla of a horse and was subsequently surgically removed from the parotid salivary duct.

- What is it?
- What is the pathogenesis of this condition?



69

69

67–69: Answers

67 i. A strong antiseptic (formaldehyde, iodoform), heavy-metal compounds (mercury, lead), and corticosteroids. For example, N-2 Medical™ (right) contains paraformaldehyde, phenyl mercuric borate, lead oxide, and corticosteroids in a zinc oxide and eugenol basis. The purpose of the paraformaldehyde is to sterilize the root canal system. The heavy-metal compounds increase the radiopacity and the hardness of the material once set. The corticosteroids are there to suppress the inflammatory reaction associated with the leakage of the irritating compounds through the apex.

ii. Most of these products are used as pastes for root canal obturation without a solid core. Some, such as N-2 Medical™, can also be used as root canal sealer cement in combination with gutta-percha. Others, such as Kri™-paste (left), are used more with the mummification technique, whereby a small amount of paste is placed on the vital or non-vital pulp, in order to achieve sterilization and fixation of the root canal contents.

iii. Numerous studies have shown that a considerable periapical inflammatory tissue response occurs in reaction to the irritating compounds. In addition, the dissemination of heavy-metal ions raises systemic health concerns. All US dental schools, and various regulatory and professional organizations (e.g. Food and Drug Administration, American Dental Association), strongly discourage the use of these products.

68 i. Chronic hypersecretion of growth hormone (GH) results in acromegaly. Growth hormone excesses induce peripheral insulin resistance. Other clinical features that may be present include cardiomegaly, congestive heart failure, nephromegaly, nephropathy (proteinuria, azotemia), renal failure, weight gain/loss, body enlargement, arthropathy, large tongue, and central nervous system signs.

ii. A GH-secreting tumor of the pituitary gland is the most common cause of acromegaly in cats. Hyperadrenocorticism and hyperthyroidism are other endocrinopathies that may be associated with insulin-resistant diabetes and they should be excluded in the diagnostic evaluation of an insulin-resistant diabetic cat. Demonstrating significantly elevated circulating GH concentrations is diagnostic for acromegaly; however, there is limited availability of veterinary laboratories performing feline GH assays. Indirect evaluation of growth hormone concentration by measuring somatomedin C (insulin-like growth factor-1) may be beneficial. A presumptive diagnosis of acromegaly is made when the thyroid and adrenal glands are normal and the cat has characteristic clinical signs and laboratory data, and a pituitary mass is identified. Computed tomography (CT) or magnetic resonance imaging (MRI) may be used to demonstrate a pituitary mass.

69 i. A sialolith.

ii. An ascending foreign body, in this case a grass awn, is usually the cause of a single sialolith within a salivary duct. The sialolith consists of concentric layers of mostly calcium phosphate crystals around the organic nucleus. They are usually elongated in shape. In the dog and cat, dystrophic calcification of inspissated saliva in salivary mucocles may also result in sialolith formation; in these cases, multiple small sialoliths may be present. A single, large sialolith located in a salivary duct may give rise to some retention of saliva but is generally believed not to cause a salivary mucocoele.

70, 71: Questions

70 Ageing and pathologic effects, such as attrition, abrasion, erosion, uncomplicated fractures, and caries, elicit a reaction of the dentin–pulp complex.

i. Define the terms abrasion and attrition.

ii. Describe the defense mechanism of the dentin to wear of dental hard tissue.

iii. In cases of attrition or abrasion, the central area of the incisal or occlusal surface of the tooth may have a dark color, as seen in this example of abrasion caused by chewing tennis balls (70a). How can this be differentiated from caries or the exposed pulp of a complicated crown fracture?



70a

71 This dog was hit by a car and developed a progressive inability to open its mouth (71).

i. What is your diagnosis?

ii. What is the treatment, aftercare, and prognosis?



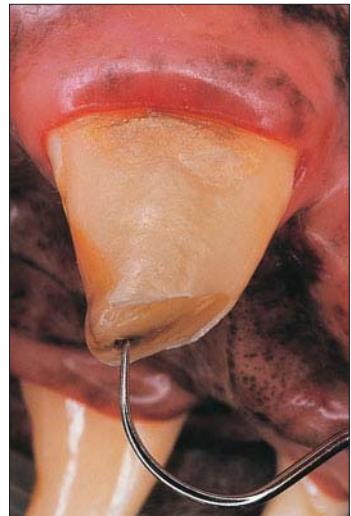
71

70, 71: Answers

70 i. Attrition and abrasion are terms that are often confused. Attrition is a physiologic process that can be defined as a gradual and regular loss of tooth substance (wear) as result of natural mastication. If attrition is caused by abnormal function or malocclusion, the excessive wear caused by tooth-to-tooth contact is called pathologic attrition. Abrasion refers to mechanical wear other than by normal mastication or tooth-to-tooth contact, e.g. wear caused by chewing rocks, bars, or wire.

ii. The primary dentin are the first layers of dentin formed during odontogenesis. Under normal conditions, formation of dentin continues throughout life and so-called secondary dentin is deposited on the entire pulpal surface of the primary dentin. Extensive wear exposes the odontoblastic processes of the odontoblasts and these cells may degenerate as a result of this wear. However, it is more common for these cells to survive the traumatic insult and to be stimulated to form the so-called reparative or tertiary dentin. Tertiary dentin has a less-organized structure than primary and secondary dentin and stains easily. This is evidenced as a brown area in the middle of the incisal or occlusal surface. At times, the teeth may be worn to the gingival margin without exposure of the dental pulp. This is possible because the pulp responds with a progressive formation of tertiary dentin.

iii. A fresh exposure of vital pulp will bleed and cause acute pain when probed with a dental explorer. If left untreated, the opening in the pulp chamber with the exposed pulp stays open and becomes brown or black in appearance and occluded with necrotic material. However, it always remains possible to introduce a dental explorer into the pulp chamber, as seen in this photograph (70b). In case of attrition or abrasion the colored central area is hard with no pulp exposure. An early carious lesion usually appears brown or black and will feel slightly soft or 'sticky' when probed with a fine dental explorer. A carious cavity involving the dentin is filled with disintegrated dental substance and debris. The walls of the cavity are lined with contaminated decalcified dentin, in contrast to resorption defects, which are lined by healthy, hard dental substance.



70b

71 i. This is a case of temporomandibular joint ankylosis, likely due to osteophyte formation as a post-traumatic complication, usually after a fracture involving the condyloid process. Another, less common cause of this condition is a bony bridge between the distal aspect of the mandible and maxilla following a mandibular fracture.

ii. Treatment consists of a condylectomy and excision of all osteophytes. Aftercare should ensure plenty of chewing activity, by feeding large-size kibble and providing chew-toys to prevent reankylosis. The prognosis is guarded to poor, as the cut bony surfaces are inclined to reanklylose.

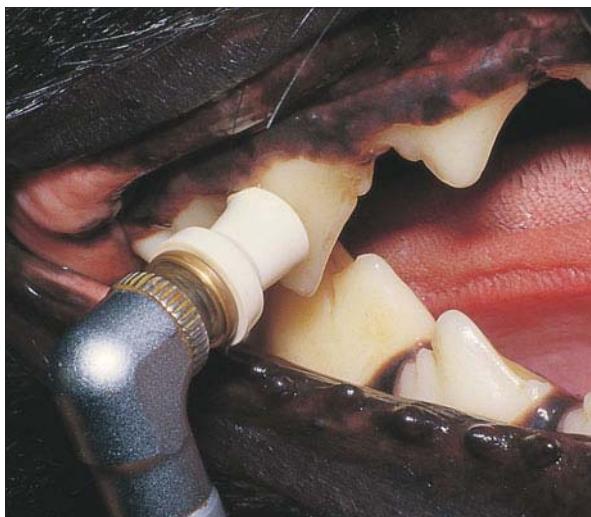
72, 73: Questions



72

72 Developmental abnormalities are commonly seen in puppies.

- i. Describe the abnormality shown in the photograph (72).
- ii. What is the most common cause of this type of abnormality?
- iii. Why is immediate treatment required, and what are the aims of treatment in a puppy?
- iv. What is the most practical treatment in this puppy?



73

73 What is being done to this tooth, and why is this important (73)?

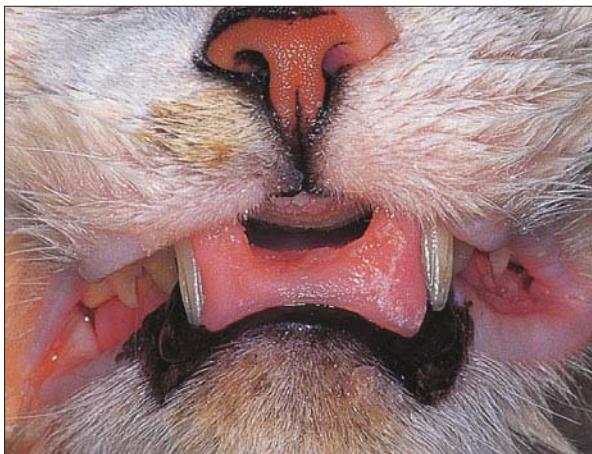
73

72, 73: Answers

- 72 i. The puppy has a pronounced mandibular brachygnathism resulting in malocclusion of the deciduous dentition. The mandibular incisor teeth occlude against the incisive papilla and the mandibular canines are damaging the palate on the mesiopalatal aspect of the maxillary canines.
- ii. Jaw length is determined primarily by heredity. The actual length attained by the jaw is also influenced by factors such as diet, metabolic disease, traumatic injury, infection, and both natural and artificial orthodontic forces. These factors rarely cause dramatic, symmetric changes in the mandible alone.
- iii. Palatal and incisive papilla contact by the mandibular canines and incisors leads to discomfort, ulceration, and pain. The abnormal dental interlock with the tips of the lower canine teeth embedded in the palate will also interfere with further growth of the mandible. The maxilla and mandible grow at different rates and may have growth spurts at differing times. Development of an abnormal dental interlock, whether simply due to eruption of teeth during a growth spurt or due to a jaw deformity, results in abnormal forces affecting the upper and lower jaws, restricting or enhancing growth depending on the direction of the forces. Early relief of an abnormal dental interlock may permit the jaws to grow to their full genetic potential. It must be remembered that the genetic potential may be for further deterioration of, rather than an improvement in, the situation.
- iv. Interceptive orthodontic extraction is the most practical treatment. It gives rapid relief from palatal trauma and removes the abnormal dental interlock. All the teeth which have an abnormal interlock or are causing palatal injury/irritation should be extracted, preferably by 12 weeks of age. Great care is required during extraction in order to minimize the risk of damaging the developing permanent tooth buds. A surgical approach is often preferable to closed extraction. It is generally recommended that extractions are performed in a bilaterally symmetric pattern so that both sides of the jaw are equally influenced by the resultant changes in functional forces.

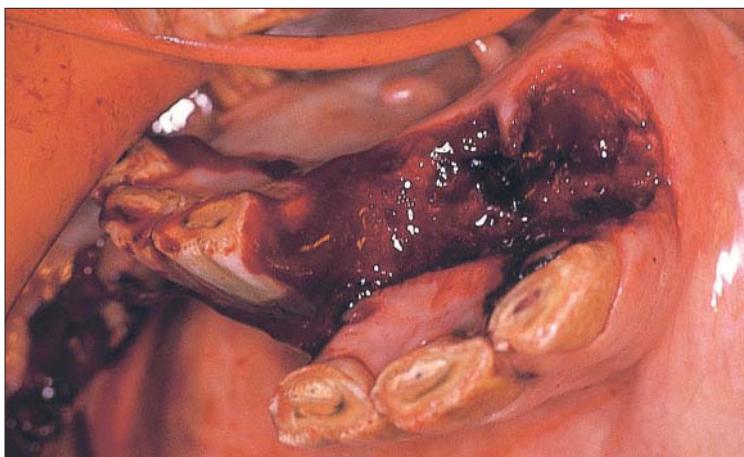
73 The tooth is being polished using the standard cup-and-pumice technique. When teeth are scaled for calculus removal during a dental cleaning, regardless of the method used, microetching of the enamel occurs. These surface irregularities appear as deep grooves under high magnification. This effect occurs even when the teeth are hand-scaled, and some power-scaling equipment can cause marked damage. These grooves act as plaque-retentive sites. Polishing the teeth using a low-speed handpiece, a rubber prophylaxis cup, and pumice removes these surface irregularities. The rubber cup is filled with a slurry of a mildly abrasive prophylaxis paste or pumice polish. The slow-speed unit may be powered by compressed air or an electric motor. It should be rotated at less than 3,000 r.p.m., using only enough pressure to slightly flare the edge of the cup. Using too fast a rotation speed, too little paste, or polishing for too long a time on one tooth can all generate heat which can injure the pulp.

Some dental hygienists prefer not to polish teeth due to concerns about iatrogenic loss of enamel. However, the amount of enamel lost over the lifetime of a dog or cat is negligible and this does not outweigh the beneficial effects of careful polishing after any type of tooth scaling.



74

74 What are the indications, advantages, disadvantages, and principles of application of intraoral acrylic splint fixation of mandibular fractures?



75a

75 A six-year-old gelding has been kicked when at pasture with other horses. It has sustained a fracture of the incisor quadrant of the left mandible (75a). Can you suggest a simple method to restore normal occlusal alignment and to provide stability of the fracture during healing?

74, 75: Answers

74 Indications for intraoral acrylic splint fixation of mandibular fractures include unilateral, relatively stable fractures of the rostral part of the mandible, e.g. a fracture between the canine and first premolar. There must be at least two teeth on each side of the fracture which are stable and large enough to provide adequate support (74). One advantage is firm fixation on the tension surface of the fractured bone. Also, the procedure is less invasive than most other options. Other methods require driving pins or wires into the mandible on each side of the fracture line. This introduces the danger of perforating or damaging tooth roots or periodontal ligaments. Roots which have been damaged in this way require either extraction, root canal treatment, or periodontal therapy as complications develop.

The biggest disadvantage of acrylic splint fixation is the gingivostomatitis which inevitably accompanies the areas covered by the splint. Food, debris, and bacteria accumulate and irritate the tissues. Flushing helps and the gingivitis generally resolves quickly following splint removal. Also, the setting reaction of acrylic produces heat (exothermic reaction), but incremental additions of acrylic minimizes this.

To apply a mandibular acrylic splint, the mouth is flushed with a 0.05–0.12% chlorhexidine solution, and the teeth are thoroughly cleaned and polished with pumice polish. They are then acid-etched, rinsed well, and dried. There are two methods of building the splint. In the first method, the powder is poured on the area and drops of the liquid are applied. Then more powder is added and the sequence is repeated until the splint acquires the desired shape. In the second method, the powder and liquid are mixed in a paper cup until it thickens. The prepared teeth are painted with some of the liquid, and the premixed acrylic is pushed onto the teeth and shaped. With both methods, the fracture must be held in reduction and with proper alignment to provide normal occlusion until the acrylic has hardened. Then it should be checked for any sharp edges which could irritate the tongue or gingiva. The splint can be built up slightly on the buccal aspect as far back as the fourth premolar. On the molars, any build-up must be on the lingual aspect to avoid occlusal interference.

75 Simple in-and-out wire fixation with monofilament steel is very effective for the fixation of incisor quadrant fractures of the mandible or maxilla (75b). The canine teeth provide stabilizing points but when these are not present in mares, geldings, or young horses, a lag screw inserted at the buccal aspect at an equivalent level can be used. Normal occlusion is checked after removal of the endotracheal tube. Absorbable sutures are used to close the mucosal wounds. Care should be taken to protect the soft tissues from laceration by the sharp ends of the fixation wire. This can be achieved either by tucking the ends between teeth or by covering them with bone cement or dental wax.



75b

76, 77: Questions



76

- 76 This soft, fluid-filled, fluctuating swelling (76) is fairly typical for a condition commonly seen in the cat, but also in the dog.
- Name and define this condition, and explain its pathogenesis.
 - What are the treatment options?



77a

- 77 This is an oral view of a 15-year-old Miniature Poodle, immediately following the extraction of the right maxillary canine tooth (77a). Following extraction of the tooth, a small amount of blood was evident at the right nostril.
- What is your diagnosis, what is the most common cause of this condition, and where does it usually begin?
 - What general principles should be followed during the repair of this condition to ensure successful flap surgery? What are the indications for utilization of a single versus a double-layer flap repair?

77

76, 77: Answers

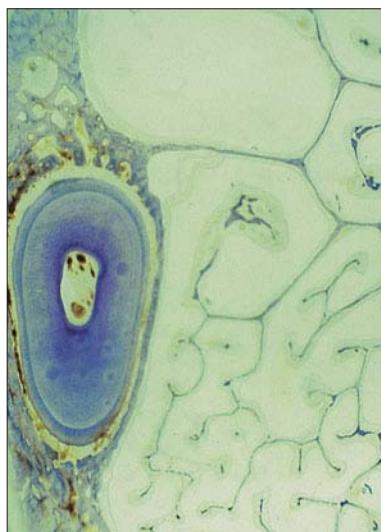
76 i. A *ranula* is a clinically descriptive term for a salivary mucocele that occurs specifically in the floor of the mouth and sublingually. Salivary mucoceles in the dog and cat are generally considered to be caused by extravasation of saliva, largely of unknown origin. Usually there is no history of trauma. Obstruction, simple transection of the duct, or trauma to glandular tissue does not cause a mucocele. Ligation of the duct causes atrophy of the gland involved. It is generally accepted that there is a lesion of the sublingual or mandibular salivary duct, or in one of the small ducts of the polystomastic sublingual salivary gland. Saliva leaks out and is not absorbed. This is irritating and causes the formation of a pseudocyst, lined by granulation tissue and macrophages. This pseudocyst is sometimes multilocular.

ii. A ranula may be treated by intraoral marsupialization. An elliptical part of the ranula wall is excised. The edges are oversewn with a simple continuous suture, using thin synthetic absorbable suture material, to prevent premature closure.

Alternatively, or if the above procedure is unsuccessful, surgical resection of the mono-stomastic sublingual and mandibular salivary glands on the affected side is performed. Alternatively – or in addition – the polystomastic sublingual salivary gland can be resected, which is very difficult but fortunately only rarely necessary.

77 i. This is an acquired oronasal fistula which is most commonly caused by periodontal disease. Periodontal disease that results in the development of an oronasal fistula most frequently begins on the palatal aspect of the maxillary canine tooth, when periodontal disease causes the destruction of the thin alveolar bone between the alveolus and the nasal cavity (77b). Other teeth that can potentially be involved in oronasal fistula formation are the maxillary incisors, the maxillary first and second premolars, and the mesial root of the third premolar. Fistula formation between the oral cavity and the maxillary recess may be associated with advanced periodontal disease of the distal root of the third premolar, fourth premolar, and first molar.

ii. General principles that should be followed to ensure successful flap surgery include the following: (1) Flaps should be larger than the defects to be covered. (2) Flaps should be apposed without tension by releasing the periosteal layer and removing prominent buccal alveolar bone. (3) Tissues should be sutured to appose edges that do not have an intact epithelial surface. (4) Tissues should be gently handled. (5) Relatively large bites of tissue should be taken. (6) A single-layer flap is recommended for the repair of most fresh oronasal fistulas. Recurrent or large fistulas may require the use of a double-layer flap.



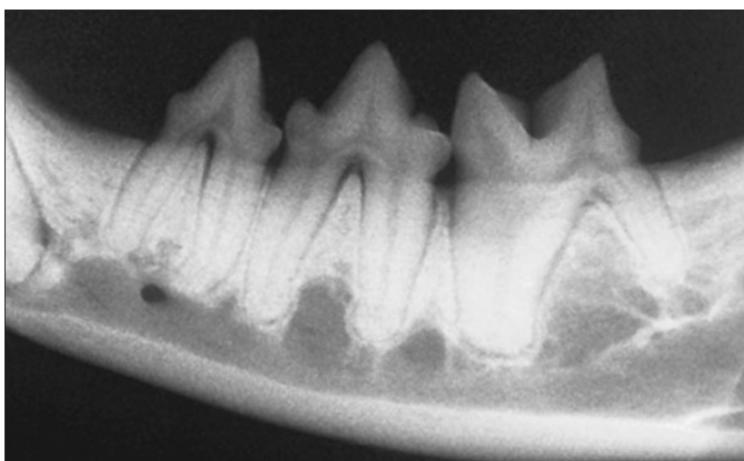
77b



78

78 The file is in the access site for performing standard root canal therapy on this ten-year-old Golden Retriever (78).

- i. Is the access site in the correct place?
- ii. What is the purpose of the red material pierced by the file?
- iii. Should the pulp chamber coronal to the access site shown be prepared and obturated in a non-fractured crown?



79a

79 i. What is the round radiolucency located ventrally to the mandibular third premolar in this cat (79a)?

- ii. Where can similar radiolucencies be found in the dog and cat?
- iii. Which nerves and blood vessels are associated with these structures?

79

78, 79: Answers

78 i. Yes, although the access ideally would be made more mesially, the clinician should take into account that the third incisor might interfere with the head of the handpiece, obstructing clear and easy penetration of the pulp chamber. In the dog, the canines are curved, so straight-line access to the apex is best made at the buccomesial aspect of the tooth, about 1–2 mm coronal to the gingival margin. The third incisor will interfere with the access if the entrance is made too far mesially. If the entrance site is too coronal, one may place excessive stress on the endodontic file, subjecting it to unnecessary fatigue. Also there will be a tendency to over-prepare (strip) the distal aspect of the canal or gouge and perforate the mesial aspect of the canal.

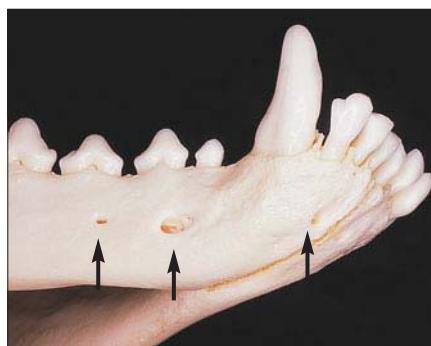
ii. An endodontic stop. This rubber-like material is perforated by the endodontic file before being inserted into the access hole. It is used first as a measuring device in determining the working length of the file during standard root canal preparation, and subsequently serves to assure that over-instrumentation does not occur with successive, sequentially larger files.

iii. It is controversial whether the pulp chamber coronal to the main access site should be instrumented. Human endodontic texts recommend removal of all pulp chamber contents. It is generally accepted that percolation of fluids can occur from the pulp chamber. Residual bacteria, bacterial breakdown products, toxins or organic debris in the pulp chamber can therefore act as periapical tissue irritants. Many veterinary dentists believe that infection within the pulp chamber will be contained and prevented from further periapical contamination by the combined installation of root canal sealer, gutta-percha, and the intermediate restorative. If the canine tooth is not fractured, additional access to treat the pulp chamber can be made at the buccomesial line-angle at the level of the pulp chamber's roof. The site for access should be determined radiographically.

79 i. A mental foramen.

ii. There are usually three mental foramina, both in the dog (79b) and the cat. The middle mental foramen is the main one and is located ventrally to the mesial root of the second premolar in the dog. In the cat, the middle mental foramen is usually located distal to the apex of the canine tooth. A smaller mental foramen is found further distally, opposite the third premolar. A third mental foramen is situated near the mandibular symphysis, at the level of the apices of the first and second incisor, but this foramen can usually not be seen radiologically.

iii. The mental nerves are branches of the inferior alveolar nerve which branches from the mandibular nerve. The mental nerves are sensory to the lower lip and the skin of the rostral intermandibular region. The caudal mental artery, middle mental artery, and rostral mental artery and associated veins accompany the mental nerves. The middle mental artery is the largest of the three.

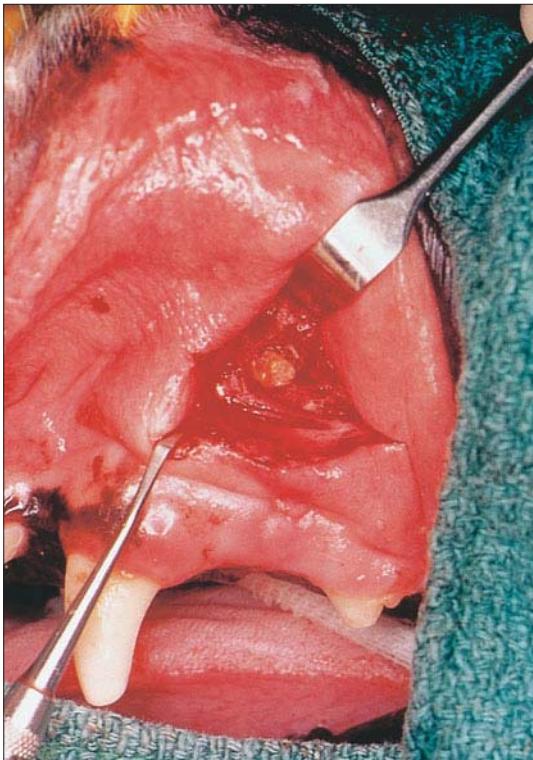


80, 81: Questions

80 i. What endodontic procedure is shown in this illustration (80)?

ii. What are the indications for this procedure?

iii. What are three types of filling materials that can be used in this procedure?



80

81 The use of dental radiographic film is recommended in veterinary dentistry (81). These films are flexible and are available in various types and sizes.

i. Discuss the dental radiographic film commonly used in veterinary dentistry.

ii. Which sizes of dental film are recommended for veterinary dentistry?



81

80, 81: Answers

- 80 i. A completed apicoectomy with a retrograde filling (surgical root canal).
- ii. A surgical endodontic procedure is indicated if there is failure of conventional root canal therapy associated with underfill or overfill of the root canal. Often, retreatment with improved obturation will be sufficient to correct the problem and may be tried first. If there is evidence of persistent or increasing periapical changes radiographically after conventional root canal therapy with adequate obturation, an apicoectomy can be performed to remove the diseased root end and granulation tissue harboring persistent infection. Surgical endodontic therapy is often indicated if there are mishaps during conventional treatment, such as a broken instrument that precludes further treatment or a root end perforation that leads to failure. Additional indications for an apicoectomy would be if coronal access is impossible due to a stricture or calcified pulp chamber or if there is a horizontal fracture of the root tip.
- iii. After the apex has been removed, a cavity preparation is made in the canal for the retrograde filling material. The three materials that are generally recommended for this are a zinc oxide–eugenol intermediate restorative material (IRM™, Caulk), a zinc-free amalgam, or a zinc oxide–cement with alumina (Super EBA™, Bosworth). Zinc-free amalgam is preferred when an amalgam is used as it is less sensitive to the moisture that might be present in this procedure. The cavity preparation for all three should be undercut since all of these materials are kept in place by mechanical retention.

81 i. Both D- and E-speed films are routinely used in veterinary dentistry. D-speed film (Kodak Ultra-speed™) is a high-contrast, fine-detail film. The E-speed film (Kodak Ektaspeed Plus™) is a film that allows a 50% decrease in radiation to the patient without an appreciable reduction in contrast. Ektaspeed film is twice as fast as Ultra-speed film with the same processing characteristics. It is a little lower in contrast. Exposure times can be reduced by one-half of that used with Ultra-speed film, allowing a 50% reduction in patient radiation. Some films are available in waterproof plastic packets (Super Poly-Soft, Kodak), which are easy to wipe clean before processing. Additional infection control can be achieved using barrier envelopes (Clinasept, Kodak). Double-film packets are also available, which allow one automatically to produce a duplicate record of the radiographic examination.

ii. Five sizes are available but three sizes are most commonly used in veterinary dental practice. Sizes # 0 and 2 are known as periapical films, and size #4 as occlusal film.

Size	Kodak Ultra-speed	Kodak Ektaspeed Plus	Dimensions (mm)	Possible use
#0	DF-54	EP-01P	22 × 35	Mandibular P3-M1 in cats and very small dogs
#2	DF-58	EP-21P	31 × 41	Standard size
#4	DF-50	EO-41P	57 × 76	Occlusal views, large dogs

82, 83: Questions



82a

82 i. A post-and-core build-up was used in this case (82a).

- What does this technique involve, and what is it used for?
- Describe the procedure used.
- What are the potential complications?



83

83 This four-year-old cat was still not eating well ten days after an apparently well-performed repair of a mandibular symphysis separation (83).

- What is your diagnosis?
- How common is this type of injury?
- What are the treatment options?

82, 83: Answers

82 i. There are two types of post-and-core build-ups. The first type is the use of a post in the pulp chamber/root canal and build-up of a restorative material around the post before a crown preparation, as in 82b. The second type is the shaping of the pulp chamber and subsequent creation by a dental laboratory of a custom post-and-core with a crown to fit over the post-and-core. A post-and-core technique is used to lengthen the crown height when the remaining natural tooth does not have enough height for the placement of a prosthetic crown.



82b

ii. First, endodontic therapy is performed. In the first type, an endodontic post or dowel is selected that is slightly less than one-third the width of the tooth. A Peeso-reamer of corresponding size or, in some cases, a bur is used to open the canal and remove the gutta-percha down to the desired depth. It is important to make as clean a cut into the tooth as possible. Wobble of the reamer may cause a non-circular canal and prevent a tight fit of the post. A trial fit of the dowel is made. The dowel is cemented in place with a glass-ionomer or resin cement. A small pin may be placed parallel to the post to increase stability. A composite resin is placed over the post to build up the crown. A routine crown preparation is performed. In the custom post-and-core technique, the pulp chamber is prepared with a 5–10° wall preparation. A routine crown preparation is performed. Impression material is first inserted into the pulp chamber and then around the remaining crown and adjacent gingiva. To strengthen the post impression, a needle, toothpick, small wire, or other object may be inserted into the pulp chamber before inserting the impression material; or, these stiffeners may be inserted just after inserting the impression material but before coating the crown with the impression material.

iii. The greatest complication of this type of treatment is subsequent fracture of the tooth due to the external stresses that may cause fracture of the supporting walls of tooth. To overcome this, the ratio of the exposed length should be at least one length of exposed post to one to two lengths of post depth. For example, if the desired height of post build-up is 1 cm, the post depth should be 1–2 cm. This added length of the post helps to distribute the forces down the root.

83 i. There is an intra-articular fracture of the condyloid process of the mandible.

ii. It has been found that this type of injury is relatively common, as mandibular fractures in the cat mainly involve the rostral and the caudal part, contrary to the dog where the body of the mandible is most commonly affected. However, these lesions can easily be overlooked as excellent radiographic technique is required to diagnose them.

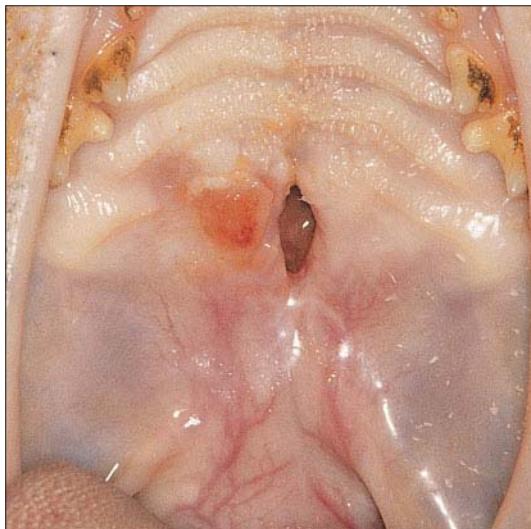
iii. Because of the limited size of the fracture fragments, internal fixation would prove very difficult, if not impossible. These fractures may heal as a pain-free and functional non-union. Intra-articular or comminuted fractures, however, are likely to result in temporomandibular joint ankylosis; this complication is characterized by a progressive inability to open the mouth (see 71). Alternatively, a condylectomy, i.e. the surgical removal of the condyloid process, can be performed.

- 84 i. What factors should be taken into consideration when deciding on the type of impression material to be used (84)?
ii. Which impression material would be ideal for crown and bridge restorations, and why?
iii. Which impression material is generally recommended for orthodontic evaluation, orthodontic appliances, as a record of treatment progress, and to aid in treatment planning?



- 85 i. Name the common types of interdental wiring.
ii. When is interdental wiring indicated?

86 Numerous attempts to close this mid-palatal defect (86) have been unsuccessful. Poor surgical technique (closure under tension, poor flap design, etc.) is the most important cause of failure in palate surgery. Repeated surgery decreases the chances of success, even with the proven procedures (e.g. double-flap closure), because the adjacent tissue is of poor quality as a result of the first failed closure. What salvage procedure may be indicated in these cases?



84–86: Answers

84 i. Important factors include: accuracy (surface reproduction, dimensional stability), rheologic properties (viscosity), elasticity (tear strength, resistance to deformation), setting time, shelf life, and cost.

ii. Vinyl polysiloxane (also called addition polymerizing silicone). It is very accurate, has a medium-to-long working time, high tear strength, excellent reproduction of detail, very high resistance to deformation, excellent dimensional accuracy, and pouring the impression may be delayed up to 14 days without loss of accuracy. The putty form can be used to fabricate a custom tray. The medium and light-body types come in easy to use automixer dispensers. Vinyl polysiloxanes are relatively expensive impression materials.

iii. Alginate is also known as an irreversible hydrocolloid. Alginate is inexpensive, easy to remove, and acceptable for less accurate stone models. Alginate is hydrophilic and is affected by the presence of blood and tissue fluid.

85 i. Ivy, Stout, Essig, and Risdon wiring. Ivy loop and Stout multiple-loop techniques are the most commonly used. Both involve a straight run of 22- to 26-gauge wire on the buccal aspect of the teeth, with the other arm of the wire running on the lingual aspect of the teeth. The lingual arm has loops of wire extending buccally between the teeth: a pretwisted loop into which the buccal wire is threaded in the Ivy loop and a single loop placed around the buccal wire in the Stout multiple loop.

ii. Although interdental wiring has frequently been used in human oral surgery, it is less commonly used in veterinary dentistry due to the anatomy of canine and feline teeth. The large interdental spaces, coronally tapering crowns, and lack of a cervical 'waist' make wiring difficult. Wires placed subgingivally will predispose to periodontal disease. Some form of fixation, other than merely twisting them tightly to the teeth, can be added to prevent the wires from slipping off, which happened in this case (85). This can be accomplished by making a small notch in the enamel of the teeth (not recommended) or by cementing the wire to etched enamel with acrylic or composite. Rarely is interdental wiring sufficient as the only stabilization for fracture repair. It is much more common now to use an intraoral acrylic splint, with the interdental wiring used merely as an adjunct to help reinforcing the splint. Wiring the teeth together helps maintain occlusion in highly comminuted fractures. It can also help to stabilize the fracture fragments during the building of acrylic splints.

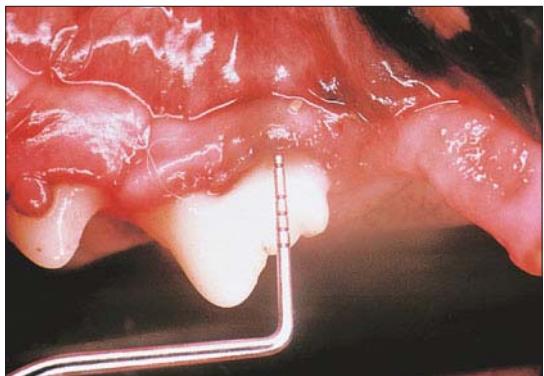


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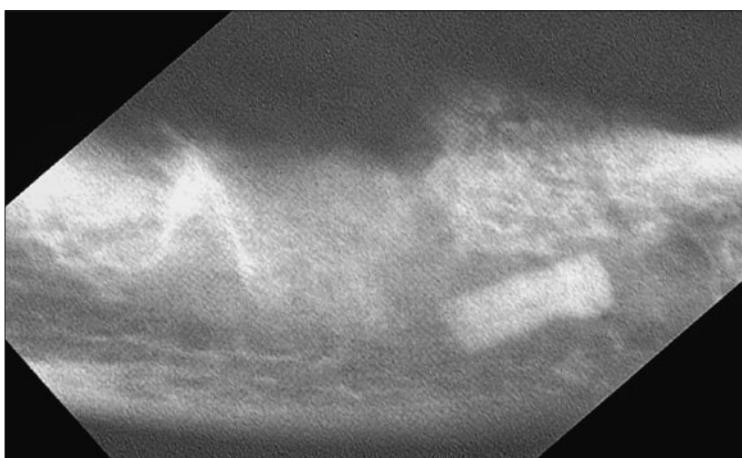
86 A removable palatal obturator, either acrylic retained by the cheek teeth or a simple vinyl polysiloxane plug, can be placed over the defect and adjacent tissue before eating and removed after eating. The obturator serves to shunt food from the turbinates while eating or drinking.

87 This maxillary second premolar (87) has a measured probing depth (pocket depth) of 5 mm with 2–3 mm of gingival recession around the distal root.

- i. What is the attachment loss around the distal root?
- ii. What is the significance of this attachment loss for this tooth?



87



88

88 Dental extractions do not always go according to plan. What course of action would be most appropriate in the following circumstances?

- i. Following full periodontal therapy, attempted extraction of an otherwise healthy tooth root has forced it into the mandibular canal in an 18-year-old cat (88).
- ii. Continuing minor hemorrhage from the sockets five minutes after closed extraction of periodontally diseased incisor teeth in a dog.
- iii. A large oronasal fistula becomes evident having extracted the maxillary canine tooth from a dog with severe gingivitis and periodontitis.

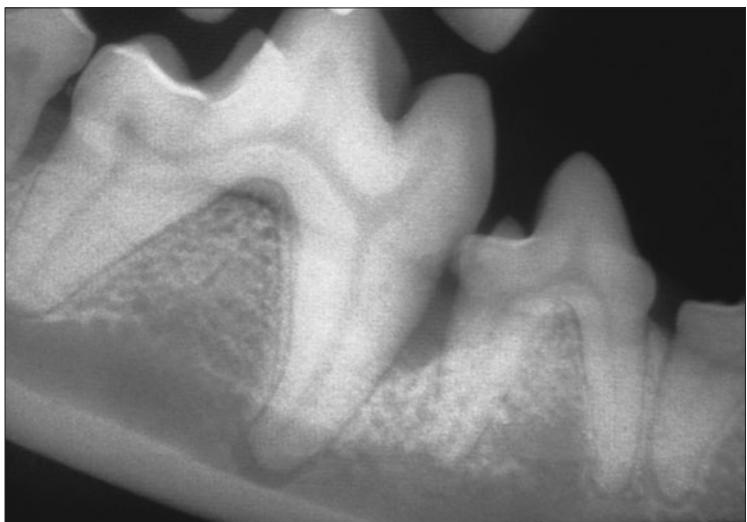
87, 88: Answers

- 87 i. The attachment loss around the distal root of this premolar is 7–8 mm.
- ii. Probing depth (pocket depth) measures the distance from the apical limit of the pocket to the free gingival margin. A sulcus depth of 3 mm or less is normal in a dog, while the cat has a normal sulcus of 1 mm or less. A probing depth of 5 mm indicates there is the beginning of periodontal disease with the loss of periodontal ligament attachment to the root cementum. Gingival recession is where the free gingival margin moves apically from the cementoenamel junction (CEJ). When there is gingival recession along with an increased probing depth this shows there is even greater periodontal ligament loss and bone loss around this tooth and/or root. The combination of the gingival recession measurement and the probing depth is called the attachment loss. It provides a more accurate measurement of the periodontal health status of a tooth.
- 88 i. It is generally stated that all root remnants should be removed; however, the whole patient must be considered. Extraction of the root in this case would considerably prolong anaesthesia, with associated risks to the patient. The root was healthy and the attempted extraction was being performed in a cleaned mouth. In such circumstances it would be reasonable to leave the root where it was, close the gingiva over the alveolus, obtain a radiograph for future comparison, advise the owners of the problem, and arrange follow-up. With an infected root tip there is a serious risk of abscessation or osteomyelitis so it would be more appropriate to obtain surgical access through the bone directly over the displaced tooth root for its removal.
- ii. In most cases, hemorrhage from incisor extraction sockets will not be a serious problem. Application of direct pressure with a damp swab and/or cold compresses and/or suture placement to close the gingiva across the affected sockets are likely to control the hemorrhage. Additionally, the use of tissue-compatible hemostatic agents, such as a calcium alginate dressing placed loosely into an affected alveolus, can be beneficial. It is a good idea to perform a bleeding test before surgical procedures which have the potential for hemorrhage. A simple method of screening for problems involves stabbing the mucosal surface of the lip or cheek with a hypodermic needle or a special ‘mucosal bleeding test’ device. In animals with adequate hemostasis, bleeding will stop within 2.6 minutes, often much less. This is not entirely reliable and more sophisticated tests should be performed in breeds with recognized clotting defects.
- iii. Oronasal fistula should be expected in cases with advanced periodontal disease affecting the maxillary canine and, to a lesser extent, premolar teeth, so this possibility should be discussed with the owner before surgery is performed. There is a high risk of flap breakdown if fistula closure is performed in inflamed tissue, so in most cases it is best to delay attempts at closure of the fistula until the gingival inflammation has subsided. It may be possible to reduce inflammation sufficiently by delaying the extraction and implementing a rigorous oral hygiene program so that surgical extraction and fistula closure can be combined at a single session.



89

- 89 i. Name the lesion on the fourth premolar (89), and describe a method of characterizing its severity.
ii. What is the prognostic significance of this lesion?
iii. What are the therapeutic options?



90

- 90 i. Describe the radiologic findings on this radiograph (90).
ii. How would you determine whether the described lesions are associated with disease?

89, 90: Answers

89 i. A furcation lesion which represents bone resorption between the roots of multirooted teeth. The severity of furcation lesions can be graded: *Class 1*: the division between the roots can be felt with a probe but is less than 3 mm deep. *Class 2*: a probe can pass horizontally into the furcation for more than 3 mm but not all the way through. *Class 3*: a probe can be passed all the way through the furcation to the opposite aspect of the tooth (e.g. buccal to lingual on a maxillary second premolar in a dog). Ideally, in charting, each aspect of the division between roots is evaluated and graded, e.g. a buccal and lingual score is given for the furcation area of the mandibular first molar of the dog.

ii. This lesion indicates the presence of chronic, advanced periodontitis. Generally, the presence of furcation lesions significantly worsens the prognosis for long-term retention of teeth despite therapy because it is more difficult to clean such areas as they are prone to retain food debris and plaque.

iii. Many procedures have been advocated to eliminate furcation exposure: odontoplasty, root amputation, obliteration with restorative material, and guided tissue regeneration. The latter procedure is currently the most popular but is limited to class 2 furcations at the present time. This procedure consists of a flap approach with maximum tissue conservation by making incisions very close to the gingival margin. A full-thickness flap is elevated taking care not to tear or damage the vascularity of the flap. Flap vitality is critical because flap necrosis usually results in failure to regenerate the furcation. The bony margins of the defect are exposed by curettage and all soft tissue tags are removed in order to prevent soft tissue from filling in the healing wound. The roots are cleaned and smoothed so that irregularities do not interfere with flap or membrane adaptation to the tooth. An occlusive membrane is adapted to the tooth and over the bony walls of the furcation defect in such a way as to create space for bone growth and occlude overlying soft tissue from the defect during healing. The soft tissue is closed over the defect and well adapted to the tooth so that fibrin or a blood clot can seal the furcation defect away from oral bacteria.

90 i. A deep infrabony pocket is evident on the mesial aspect of the mesial root of the mandibular first molar, also involving the distal root of the fourth premolar. In addition, there is a distinct periapical radiolucent area associated with the same root. This lesion may be normal anatomy or represent pathology. Where it represents normal anatomy, it is a radiographic artifact due to the root apex dipping into the mandibular canal or lying in close proximity to the canal. Where it represents pathology, it is an extension of a chronic pulpitis or an inflammatory reaction due to pulpal necrosis.

ii. The infrabony pocket can be confirmed by periodontal probing and is associated with the presence of periodontitis. The fact that the periapical radiolucency appears to be an extension of the root shape, rather than a round ballooning lesion, is suggestive for normal anatomy. Comparison should always be made with other teeth of the same type in the same animal. A contralateral radiograph is indicated, particularly if the tooth seems healthy, e.g. no sign of crown fracture or pulpal involvement, on clinical examination.

91, 92: Questions

91 What causes these frustrating 'stomatitis' lesions in cats (91)?

91



92 i. Identify this structure (92, arrowed).

ii. What surgical procedure(s) is (are) occasionally performed on this structure, and why?

91

91, 92: Answers

91 ‘Stomatitis’ simply means inflammation of the tissue lining the mouth. In cats, it is now commonly used to refer to a chronic clinical entity affecting some or all of the alveolar mucosa, glossopalatine folds (fauces), and oropharyngeal tissues. The most severely affected areas typically are the buccal alveolar mucosa ('buccitis') and the fauces ('faucitis'); either or both may be involved. Unless the teeth have been extracted or lost, there is almost always severe gingivitis in the vicinity of the lesions. The tongue and mucoperiosteum of the hard palate are rarely affected. In spite of a lot of work examining several possible causes, there is no accepted cause for this condition. It is possible that a large part of the problem is that we are dealing not with one ‘condition’ but with several conditions that end up with a similar effect because of the inevitable bacterial contamination that occurs. Briefly, the following have been investigated: bacterial infection (huge numbers of bacteria are present in the mouths of all cats, so why are some cats affected and not others; no specific bacterium has been isolated with any consistency in affected cats, and the list of bacterial species that have been identified is very long); viral infection (FCV and FVR are discussed in 103, and FIV and FeLV will result in immunopathy but are not consistently identifiable in affected cats); immunopathy of some sort (neutrophil dysfunction has been ruled out, but many other possible immunopathies are waiting to be tested once reliable reagents are available for cats). It is important to differentiate these lesions from eosinophilic granuloma (which generally responds well to treatment), and squamous cell carcinoma (by far the most common tumor, benign or malignant, in the mouth of the cat) – any red, asymmetric chronic or raised lesion in the mouth of a cat should be biopsied.

92 i. The mandibular frenulum.

ii. The procedures performed to correct impingement of the frenulum on the gingival margin are frenectomy and frenotomy. Abnormally high insertion relative to the gingival margin may be of developmental origin. Alternatively, recession of the gingival margin from disease can cause frenulum impingement and result in further recession, especially where thin gingiva and little alveolar bone overlies a prominent root. Although ‘muscle impingement’ has been implicated, most frenulum attachments merely transmit tension from more apically located facial muscles.

Frenectomy means removal of the frenulum from the raised surface all the way to the bone. An incision is made from mucosal surface to bone along the entire length of the frenulum and the intervening muscle, connective, and elastic tissue is excised. Frenotomy means incision through the frenulum, usually adjacent and parallel to the attached gingiva. The incision may be partial-thickness or full-thickness. It usually cuts across the frenulum whereas the frenectomy incision usually parallels the frenulum. Because the fibers are removed in frenectomy, the wound may be closed from side-to-side with sutures. Frenotomy incisions are often not closed so that the fibers do not rejoin and recreate tension on the gingival margin. Alternatively, the sagittal frenotomy incision may be sutured in a transverse fashion. Compared with frenotomy, frenectomy appears to be more predictable in correcting the problem.

93, 94: Questions

93 The curette on the right has been sharpened many times incorrectly compared with the curette on the left (93).

- i. What incorrect sharpening technique has created the pointed tip of the curette on the right?
- ii. What are three basic sharpening techniques for use on curettes and scalers?
- iii. What is the proper angle between the face of a curette and the surface of a flat stone?



94 i. What radiographic technique is being used here (94a) for taking a radiograph of the maxillary fourth premolar in a dog?

- ii. Describe the geometric principle involved and positioning used in this technique.

93, 94: Answers

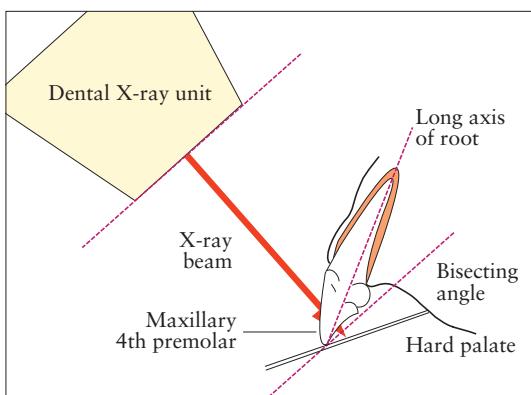
93 i. A point is created on a curette when too much pressure is placed on the toe of the instrument during sharpening, or when both sides of the instrument are sharpened in this fashion. The entire working tip of the curette should be placed evenly against the stone.

ii. (1) The moving flat stone technique: here, the instrument is held securely in the hand off a counter edge or against a sharpening guide. The stone is placed against the working tip in the appropriate angle and then moved steadily in short strokes back and forth against the instrument. (2) The stationary flat stone technique: here, the stone is placed on a solid surface or in a stone holder and the instrument is placed on the stone at the appropriate angle and moved steadily back and forth across the surface. (3) The conical stone method: here, a narrow conical stone is moved in a sweeping stroke across the face of the working tip towards the toe of the curette.

Any of the three techniques can be used successfully if done properly and frequently to maintain sharp instruments.

iii. The proper angle formed by the face of the curette when placed on a flat stone and the stone surface is 100–110°.

94 i. The bisecting angle technique is depicted (94b), which is one of the two basic intraoral radiographic techniques, the parallel technique being the other (see 134). Because of the morphology of the oral cavity, the lack of a vaulted palate in particular, the film cannot always be placed parallel to the teeth being radiographed. If the film and the teeth cannot be positioned parallel to each other, the image on the film will either be shorter or longer than the actual teeth. To obtain a radiographic image on the film which is equal in length to the teeth, the bisecting angle technique is used.

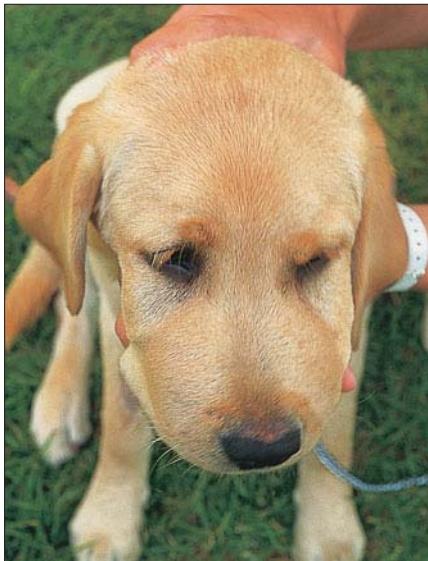


94b

ii. The bisecting angle technique involves the application of the geometric principle of equilateral triangles. In equilateral triangles, if two triangles share a side and both have an equal angle at their apex, then the opposite sides are the same length. When utilizing the bisecting angle technique, the intraoral film is placed in a position to allow for projection of the tooth onto the center of the film. The angle formed by the intraoral film and the long axis of the tooth is visualized. An imaginary line bisecting this angle is visualized. The central X-ray beam is then directed perpendicular to this line, which is the case when the flat end of the cone is parallel to the bisecting angle.

95, 96: Questions

- 95 i. What is the primary differential diagnosis in this eight-month-old dog on a balanced diet (95a, b)?
ii. What is the mechanism for the development of this problem?



95a



95b

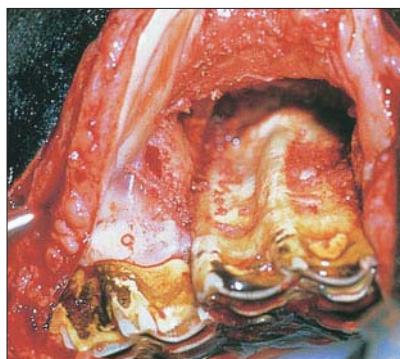
- 96 What alternative to repulsion is available for tooth removal in the horse?

95, 96: Answers

95 i. Renal secondary hyperparathyroidism. Radiologic changes in renal secondary hyperparathyroidism include generalized bone loss with a greater extent of loss occurring in the bones of the skull. The bones of the head are affected before involvement of the axial skeleton or long bones. The mandible is affected first followed by the bones in the maxilla. The earliest radiologic evidence of bone loss is loss of the lamina dura (the radiologically apparent radiopaque line surrounding the tooth roots; see 59); bone loss continues in the interdental and interradicular regions with severe cortical bone loss eventually occurring.

ii. The skeletal changes occur secondary to chronic renal insufficiency, which results in secondary hyperparathyroidism. The ‘classic explanation’ is that phosphorus retention occurs as the kidneys progressively lose their ability to excrete phosphorus; phosphorus retention decreases extracellular calcium due to the mass law equation; the parathyroids are chronically stimulated to maintain extracellular calcium concentration within the normal range. An alternative theory has been proposed, namely the ‘vitamin D trade-off hypothesis.’ According to this theory there is a decrease in vitamin D synthesis in the proximal renal tubules; decreased serum vitamin D levels result in loss of negative feedback on the parathyroid gland; decreased serum vitamin D levels also result in a decreased serum calcium level; an increase in serum parathyroid hormone (PTH) level occurs as a result of decreased serum vitamin D and calcium.

96 An alternative method to extract the more mesial cheek teeth is achieved by buccotomy (96). This surgical procedure entails a horizontal incision through the cheek, followed by removal of the buccal bone of the alveolus and delivery of the tooth in a buccal direction. The dissection through the soft tissues of the cheek must negotiate the dorsal and ventral branches of the facial nerve, the buccal venous plexus, and the parotid duct. When the oral cavity is entered at the dorsal or ventral buccal cleft, the tooth to be removed can be positively identified and a mucogingival flap is raised to expose the buccal cortex of the maxilla or mandible. The buccal bone plate overlying the diseased tooth is removed either with an oscillating saw, a surgical bur, or a chisel to expose the reserve crown and roots of the tooth. Space for extraction is created by a longitudinal cut in the tooth, again using a bur. After removal of the tooth, the alveolus may be packed with medicated bandage which is led out through a stab wound to the side of the face to be withdrawn a few inches at a time over the following 14 days. The oral defect is plugged with a cap of dental impression compound and the buccotomy wound is closed in four layers, starting with the oral mucosa. Extraction by this route is restricted to maxillary cheek teeth 1–3 or 4 and mandibular cheek teeth 1–4 because of the position of the masseter muscle, paranasal sinuses, and local vasculature.



96

97, 98: Questions



97

97 The bony portion of the jaw in which the dental roots are located is called the alveolar process (97).

- i. What is the structure and composition of the alveolar bone?
- ii. What is its relationship with the teeth?
- iii. What is the lamina dura?



98

98 Which type of bonding agent would be appropriate for this restoration (98)?

97

97, 98: Answers

97 i. The alveolar process consists of an outer bony plate of varying thickness and covered by periosteum (the cortical bone), an inner, heavily-perforated bony lamella (the alveolar bone proper or lamina cribiformis), and cancellous bone (spongiosa) between the two bony plates and between the alveoli of adjacent teeth. The outer cortical plate is continuous with the inner plate (lamina cribiformis) at the orifice of the alveolus and this part of the alveolar process is called the alveolar crest. The structure of the cortical plates and of the cancellous bone is similar to that of other bones. The cortical plate of the mandible is thicker than that of the maxilla. The dry weight of alveolar bone is made of about 70% inorganic material (calcium phosphate crystals of the hydroxyapatite type and amorphous calcium phosphate) and 30% organic material (90% collagen).

ii. The alveolar crest is located at about 1 mm below the neck of the tooth. The alveolar bone is a tooth-dependent structure, developing with the eruption of the tooth and resorbing after its loss. The lamina cribiformis is attached to the trabeculae of the cancellous bone. The multiple foramina of this inner plate correspond to the Volkman canals and connect the periodontal ligament to the bone marrow spaces. Blood and lymph vessels as well as nerves pass through these openings. The surface of the alveolar bone proper adjacent to the periodontal ligament is made of multiple layers of bone parallel to the surface of the alveolar wall, which are penetrated by bundles of Sharpey's fibers embedded almost perpendicular to the surface.

iii. On a radiograph, the lamina cribiformis appears as a radiopaque line distinct from the spongiosa, which is called the lamina dura. This denser line appears because of an overlapping effect and not because it is more mineralized than the surrounding bone.

98 A self-cure or dual-cure dentin-bonding agent. Under amalgam, light-activated materials would not cure. There are now multiple-purpose dual-cure agents which bond to dentin, etched enamel, metal, composite, and amalgam. These can be used both for light-cure composites and for amalgam bonding. Bonding amalgam is a recent trend in human restorative dentistry, replacing the lining of the cavity preparation with cavity varnish before placing the amalgam. When amalgam is bonded, although bond strengths are not high, a far superior dentinal seal is formed which nearly eliminates postoperative sensitivity. This same sealing action occurs when these multiple purpose (or other moist dentin) bonding agents are used with composite restorations. Universal bonding agents bond to both etched enamel and to acid-treated dentin through micro-mechanical retention. The fourth and fifth generation bonding agents produce dentin-bonding by using an initial hydrophilic agent which allows the composite to flow into the opened dentinal tubules. A hybridized layer of composite and collagen forms the interface between the dentin and the overlying restoration if the dentin has not been allowed to dehydrate. Over-drying the dentin collapses the collagen fibers, preventing a good bond. The hybridization layer – although not contributing significantly to the bond strength – acts as an efficient sealant preventing leakage of oral fluids and bacteria. Multipurpose bonding agents allow the veterinary dentist to use one bonding system for multiple uses rather than to stock a number of different adhesive systems.



99

99 Describe this lesion (99) and the clinical picture associated with it, and suggest methods of treatment.

100 A three-year-old, 20-kg mixed-breed dog is presented because of severely comminuted, maxillary and mandibular fractures with multiple premolar and molar fractures following a gunshot wound to the head.

- Briefly describe the appropriate initial management of this case.
- What type of fixation device would be appropriate for this type of injury?
- What potential complications are possible with the percutaneous skeletal fixation devices pictured here (100)?



100

99, 100: Answers

99 An infrabony pocket resulting from periodontitis on the palatal aspect of a dog's maxillary canine. These pockets are typically crescent-shaped with the widest part centered on the mid-palatal surface. The lesion usually ends in a pointed fashion at the mid-mesial and mid-distal aspect of the canine. Clinically, these lesions are often seen in older dolichocephalic and small-breed mesaticephalic dogs, such as Dachshunds and Toy Poodles. There may be a unilateral purulent or serohemorrhagic nasal discharge and sneezing or coughing during eating and drinking. Typically, the gingival margin is preserved near the cementoenamel junction on the palatal surface due to the flat palatal architecture. Usually, the soft tissue of the gingival margin is only slightly inflamed and well adapted to the tooth because the most active disease process is much deeper. The lesions are usually discovered on periodontal probing rather than visual inspection and may even be difficult to detect on radiographs. The pockets are often quite deep (more than one-half the length of the canine) and there may be nasal bleeding on probing when the palatal bone of the alveolus has been resorbed to the level of the nasal membrane.

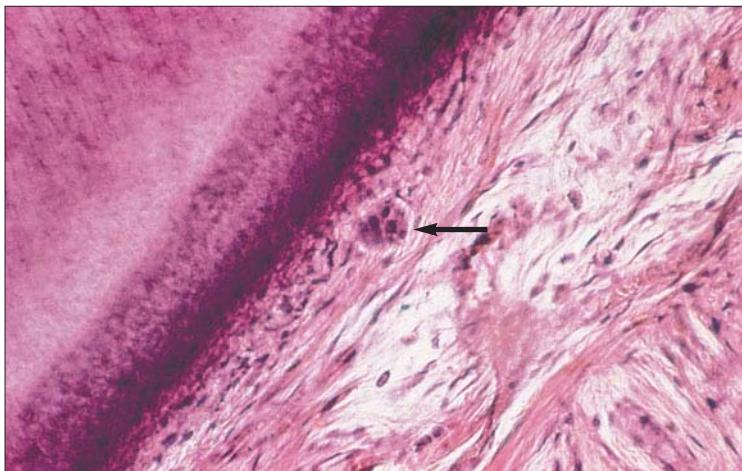
Treatment depends of the integrity of the buccal bone. Where the buccal bone is totally missing, extraction and soft tissue closure after extraction are indicated. When the bone on the buccal surface has been preserved, guided tissue regeneration is the best method to salvage affected teeth. Evaluation for pulp vitality should be carried out, especially when a combined periodontal–endodontic lesion is suspected. Regular follow-up re-evaluation is recommended. Repeated guided tissue regeneration attempts or extraction are indicated for failing cases.

100 i. Initially, the patient should be assessed for problems that may be associated with head trauma, including upper airway obstruction, hemorrhage, edema, and cerebral injury. In addition, the patient should be evaluated for shock and other injuries. After stabilization of life-threatening problems, attention may be focused on the management of the jaw fractures.

ii. External fixation using Kirschner wires or Steinman pins placed into each fracture fragment and embedding the exposed cut ends of the pins into acrylic bridges. The inherent advantages of external fixation include: (1) They are minimally invasive. (2) The fracture fragments and associated soft tissue and blood supply are not disturbed. (3) The implant is not located at the fracture site. External fixation devices are particularly useful in the management of fractures in which there is a large amount of soft tissue trauma, a high degree of comminution, or a large bony defect.

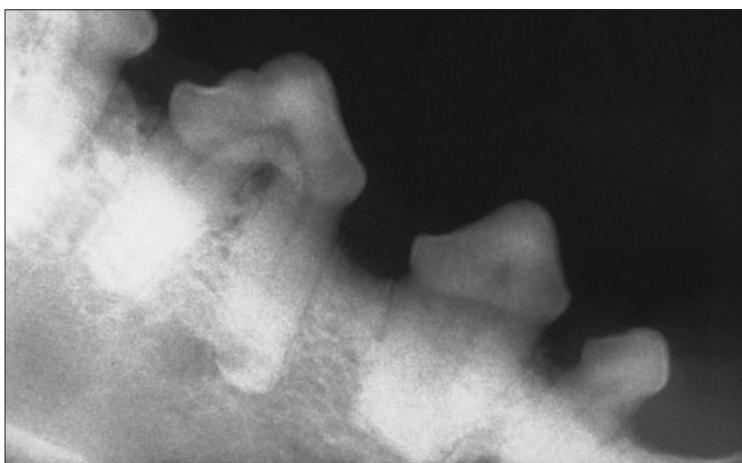
iii. The rostral pins in the maxilla and mandible may have potentially traumatized the rostral dentition. The atraumatic application of pins in the rostral mandible and maxilla is difficult because of the limited amount of bone and the large root structures in these areas. Sequelae to inadvertent dental trauma during placement of external fixation devices include endodontic disease with periapical lesions and possibly chronic draining tracts.

101, 102: Questions



101

- i. What are the cells visible on this microphotograph (101, arrowed) of the periodontal ligament of a dog?
- ii. What is the origin and clinical importance of these cells?
- iii. Where in the oral cavity can similar cells be found, and what are they called?



102a

- i. 'Left' and 'Right' markers are generally not used on dental films, contrary to conventional radiography. If the embossed dot on the film is facing up, which part of the dog's dentition is this (102a)?
- ii. In general, how can the teeth on dental films taken of a dog be identified?
- iii. Is this any different in the cat?

101

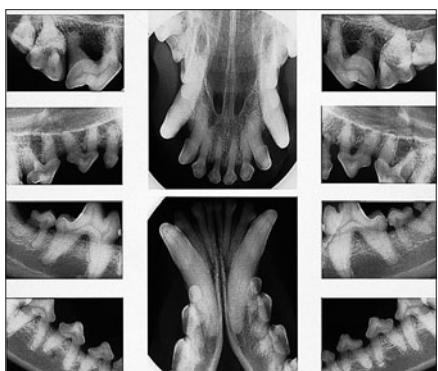
101, 102: Answers

- 101 i. These clusters of epithelial cells are known as the epithelial cell rests of Malassez.
- ii. They are remnants of Hertwig's epithelial root sheath. The double layer of epithelial cells of this sheath grows around the dental papilla. The cells initiate the differentiation of odontoblasts on the periphery of the dental papilla and the odontoblasts in turn form the dentin of the root. As the root is formed, the sheath is stretched and fragments. In erupted teeth some of these epithelial cells persist next to the root surface within the periodontal ligament. The epithelial cells of Malassez play a role in the histogenesis of the periapical cyst, lateral periodontal cyst, and (intraosseous) ameloblastoma. Their role in the repair and maintenance of the periodontal ligament is unclear, but probably minimal.
- iii. Remnants of the dental lamina are occasionally seen in the dense connective tissue of the gingiva as clusters of epithelial cells, known as the cell rests of Serres. It is thought that these cell rests may be involved in the pathogenesis of peripheral ameloblastoma (acanthomatous epulis) in the dog, squamous odontogenic tumor (in man), and gingival cysts.

- 102 i. The premolar region of the right mandible.

ii. Dental films have an embossed dot on one corner pointing toward the X-ray source. Given the fact that the dot must have faced toward the X-ray source, there is only one way that the film could have been placed in the mouth. This enables you to orient processed dental films as to left side/right side. By orienting the embossed dot towards you ('bubble up'), you will be observing the dentition from the outside. The set of whole-mouth films are spread out on the view box with the patient's midline in the center (102b). The patient's dentition will be spread out such that films to your right will be the patient's left side and films to your left will be the patient's right side, as (generally) on a dental chart. Orienting films with the embossed dot up assumes that intraoral technique was used; this is the case for all recommended standard views in the dog. The first step when identifying a set of films is to place all films with the embossed dot up. Subsequently, mandibular films are placed on the lower half of the view box, and maxillary films on the upper half. Useful landmarks are the palatine fissures, floor of the nasal cavity, three-rooted teeth (maxilla), and mandibular canal. Next, the maxillary films are oriented such that crowns point down, and mandibular films such that crowns point up. Left from right can now be determined by identifying the molars distally and the premolars mesially.

iii. Intraoral technique is also recommended in the cat, except for the caudal maxilla (see 146). If the extraoral, parallel technique is used for the maxillary premolars and molar in the cat, these films should be placed on the view box with the embossed dot down.



102b

103, 104: Questions

103 How would you proceed with diagnosis and management of this cat (103), which is drooling and has not been eating for a few days?



103

104 The dog in this photograph has lesions limited to the oral cavity and oral mucocutaneous junctions (104) and no systemic signs of illness.

- Which immune-mediated diseases should be considered in this patient?
- Which laboratory tests should be performed to diagnose immune-mediated disease in this patient?



104

103

103, 104: Answers

103 Ulcerations of the tongue and palate are common in cats with primary acute viral infections such as herpesvirus (FVR) and calicivirus (FCV). Careful clinical examination may reveal dehydration, and other lesions (ocular and nasal discharges) that are indicative of FVR/FCV infection are usually also present. More generalized gastrointestinal signs or weakness may indicate panleukopenia viral infection. Other than viral isolation, there are no specific tests that will confirm the diagnosis of FVR or FCV infection, and there is no particular benefit to having the diagnosis confirmed (except in a cattery situation, in which issues of prevention may be very important). Lingual or palatal ulcerations resulting from FVR or FCV infection almost always heal within a few weeks of onset. The loss of condition, or in more severe cases, onset of clinical dehydration, may be obvious from results of hematocrit or CBC examinations, and panleukopenia would be an important differential diagnosis if the total white cell count is very low. To date, there is no direct evidence that FVR or FCV is a primary cause of chronic severe stomatitis or faucitis. Calicivirus can be isolated from oral or pharyngeal fluids in many cats with chronic stomatitis (carrier status and virus replication during periods of stress for the host can account for this finding), and there are strains of calicivirus that will consistently produce faucitis lesions in specific pathogen-free cats; however, these cats do not go on to develop the chronic lesions that are so frustrating to manage. The typical cat with chronic stomatitis does not have lingual or palatal lesions. Differential diagnosis is much more important for chronic oral lesions (see 91). Since treatment is symptomatic – nursing care, nutritional support, antimicrobial treatment to prevent secondary bacterial infections – the most important indicator is the condition and behavior of the cat. Clinically evident dehydration requires immediate management – intravenous fluid therapy if severe, or subcutaneous bolus therapy in less severe cases.

104 i. Pemphigus vulgaris and bullous pemphigoid are immune-mediated skin diseases in which oral lesions are frequently found. Oral involvement, which may include gingivitis, stomatitis, and glossitis, occurs in approximately 90% of patients with pemphigus vulgaris and may be the initial manifestation of the disease in about 50% of cases. Lesions of the skin and/or mucocutaneous junctions are present with bullous pemphigoid; approximately 80% of patients develop oral lesions at the initial onset of disease or later during the course of disease.

ii. Histologic and immunologic examination of oral gingival and mucosal biopsies should be obtained. Multiple biopsy specimens should be obtained from early lesions to increase the likelihood of identifying the characteristic histologic and immunologic lesions. Immunologic examination of the biopsy specimen is done to demonstrate immunoglobulin and/or complement deposition at characteristic sites for each of the immune-mediated diseases. Consultation with the diagnostic laboratory before sample collection is recommended to determine correct sample collection and handling for optimal diagnostic value.

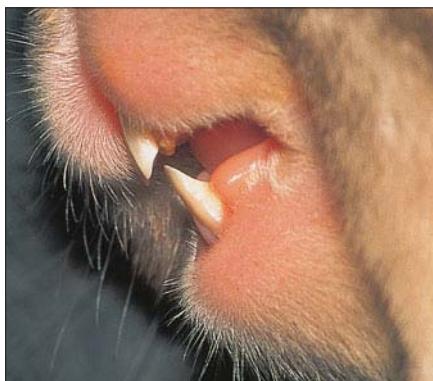


105

105 The owner of this one-year-old dog recalled that the deciduous precursor of this maxillary canine (105) was fractured and extracted a few weeks later.

- i. What is your diagnosis?
- ii. What are the therapeutic options?

106 This photograph (106a) shows the normal incisor occlusion in an adult, standard-sized rabbit. The tips of the chisel-shaped mandibular incisor teeth occlude between the maxillary first and second incisors when the jaw is relaxed. The breeding of animals to alter their appearance frequently has a detrimental effect on the function of the affected anatomic structures. As with dogs which have been bred for a short muzzle and 'flat' face, rabbit breeds with this tendency suffer from increased respiratory problems and jaw length mismatch.



106a

- i. What is the main structural change in the head of dwarf breed rabbits when compared with their naturally occurring wild counterparts?
- ii. At what age are dwarf rabbits with incisor malocclusions usually presented to the veterinarian, and why?
- iii. Several treatment options are available for rabbits with incisor malocclusion as a result of jaw length mismatch. Briefly what are they?

105, 106: Answers

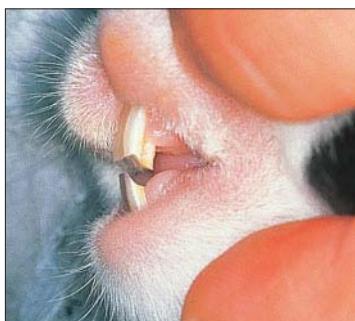
105 i. Enamel hypoplasia is evident. The ameloblasts of the tooth germ of the permanent canine were damaged during the first months of life, and subsequently no enamel was formed (see 14 and 110). There are two plausible explanations in this case. The fracture of the deciduous canine may have been complicated (i.e. causing pulp exposure), with resultant pulp necrosis and periapical pathology. The periapical inflammation may have affected the underlying permanent tooth germ. Alternatively, the permanent tooth germ may have been damaged during the extraction of the deciduous tooth.

ii. Given the fact that only one tooth is involved, restoration is indicated. A composite restoration using the acid-etch technique and a dentin-bonding agent will yield the most esthetic result. Alternatively, a metal-alloy jacket crown can be used.

106 i. The dwarf breeds of rabbit have a shorter head than normal. The main area affected is the base of the skull. This affects the length of the upper jaw and location of the temporomandibular joints. Although the mandible is usually reduced in length, the degree of shortening is often insufficient so that there is a relative mandibular prognathism.

ii. A high proportion of dwarf rabbits have relative mandibular prognathism with malocclusion of the incisor teeth. This may be observed in newborn rabbits, but most cases are presented at between 9 and 18 months of age. A case of incisor malocclusion in a three-month-old dwarf rabbit with relative mandibular prognathism is shown (106b). This condition was not visible until the lips were lifted. It frequently takes 9–18 months for the incisor teeth to wear in such a way that they no longer occlude with the opposing teeth. As the teeth can then grow unimpeded, it is not long before the teeth become visibly elongated. This is the most common reason for owners to present affected animals. The second most frequent reason is loss of weight or condition. This was the case in this 13-month-old dwarf rabbit (106c). The owners were not aware that the visible elongation of the mandibular incisors was abnormal and they had not noticed that the tips of these teeth were penetrating the nasal skin. This abnormality drastically restricts the ability of affected animals to prehend and chew food.

iii. The most frequent treatment used in cases such as those described in (ii) is tooth shortening. Extraction or attempts at arresting tooth growth are two other possible dental treatments. In severe cases, especially those with additional problems, euthanasia is the most humane option.



106b

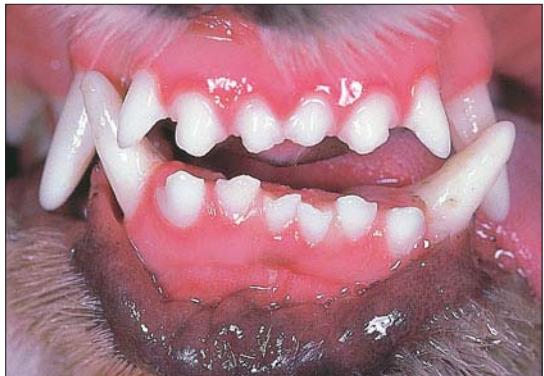


106c

107–109: Questions

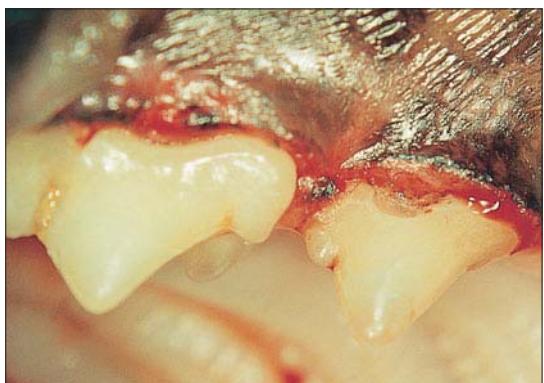
107 i. What is the condition shown (107)? Describe the dental findings and their possible variables.

ii. What are the treatment options?



107

108 As noted in 34, teeth like this (108) are likely to be painful, and something must be done for these cats. While the initial thought may be to restore the tooth, restoration is rarely indicated as treatment for feline odontoclastic resorption lesions (FORLs) in any tooth because follow-up studies have shown that the results are very poor. The lesion will recur and the tooth will often fracture out of the mouth, potentially leaving exposed and painful root fragments. Restoration is discussed further in 175. Clinically painful teeth should be extracted (see 20 and 35), but is it essential to remove all of the tooth?



108

109 i. Why is dentin sensitive?

ii. What generally prevents bacterial access to the pulp when a vital tooth's patent dentinal tubules are exposed?

107

107–109: Answers

107 i. Wry malocclusion. Wry malocclusion may involve the cranium and the dentition to varying degrees, or the dentition only. In this case a unilateral mandibular prognathism with deviation of the dental midline is present. A normal scissors bite in the opposite incisors, mandibular incisal arch distortion, and asymmetry to the incisal plane are evident. Wry malocclusion can be found in all domestic mammals. It rarely causes soft tissue trauma or impairs masticatory function in domestic carnivores. Trauma to the premaxilla or mandible of a neonate or juvenile can result in an acquired wry malocclusion. Non-traumatic cases are generally considered to be of genetic origin.

ii. Wry malocclusion often is very difficult – if not impossible – to correct. Treatment options may include removing individual teeth that are causing a traumatic occlusion, to give the patient a more comfortable bite. If this is performed in a case considered to be of genetic origin, it is recommended that the patient is neutered.

108 As noted in **61**, teeth with FORLs affecting the root but with an intact crown and gingival margin are usually asymptomatic, and deliberate retention of roots in selected cases ('crown amputation') can lead to a pain-free mouth and healthy gingiva over the extraction wound. Crown amputation is a justifiable option if: (1) There is no stomatitis in the area immediately adjacent to the tooth (i.e. the inflammation at the site of the lesion does not extend apical to the mucogingival junction). (2) There is no periodontal pocketing extending apical to the proposed level of amputation of the tooth. (3) There is no radiographic or clinical evidence of necrotic endodontic or periapical disease affecting that tooth. If all of these three criteria are met (even if there is extensive radiographic evidence of root resorption), the crown and enough root may be removed so that the remaining root is well below the level of remaining bone, and the gingival tissues are sutured over the retained root.

109 i. The 'dentin–pulp complex' is a living tissue. There are presently three theories to explain the sensitivity of dentin. The direct innervation theory is based on the presence of nerve endings alongside many of the odontoblastic processes within dentinal tubules, which can be stimulated directly. These nerve fibers, however, do not extend to the dentinoenamel junction. The hydrodynamic theory, which currently predominates, is based on the belief that fluid movement in the dentinal tubules stimulates the nerve endings. The transduction theory, for which there is less support, is based on the assumption that the odontoblasts act as receptors.

ii. Healthy pulp is enclosed within a solid casing, the tooth. Pulpal blood vessels are thin-walled so that pressure within the pulp is at or near to arterial blood pressure. This pressure is sufficient to force tissue fluid to flow out through patent dentinal tubules which are exposed on the tooth surface. Under natural circumstances, air and fluid pressure within the oral cavity rarely matches this pressure, so bacteria have difficulty entering the pulp. Provided that the odontoblasts have not been irreparably damaged, the exposed dentinal tubules become sclerotic and are sealed by the progressive formation of intra-tubular dentin.

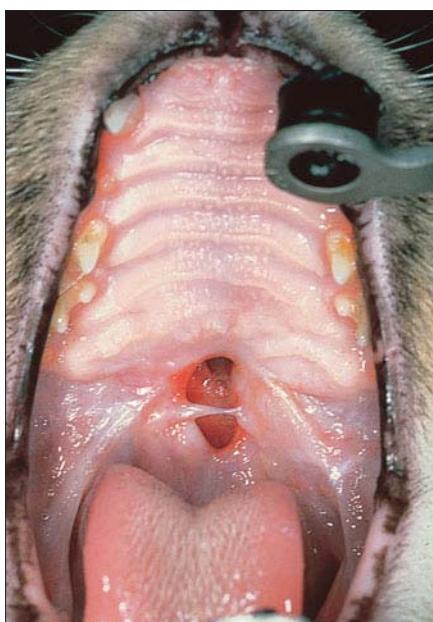


110

110 What is known about the etiology of the disorder seen here (110)?

111 This is an intraoral view of a three-year-old cat that was presented because of a 10×15 mm caudal hard palatal defect of one-year's duration (111a). Several attempts to repair the defect with sliding flaps had been unsuccessful.

- i. What are the causes of centrally located hard palatal defects?
- ii. Large defects located in the caudal aspect of the hard palate can be frustrating to repair, and postoperative dehiscence is a potential complication. What surgical procedure utilizes flaps based on the blood supply to the hard palate and adjacent soft tissue structures?
- iii. What salvage procedure may be indicated when repeated attempts at surgical repair have been unsuccessful?



111a

110, 111: Answers

110 The etiology of enamel hypoplasia is associated with periods of high fever, infections, nutritional deficiencies, disturbances of the metabolism, and systemic disorders. Epitheliotropic viral infections, particularly those caused by morbilliviruses, such as distemper, are well-known causes, and was also the cause in the case depicted. In most cases a differentiation between a generalized disturbance and a local one can be made.

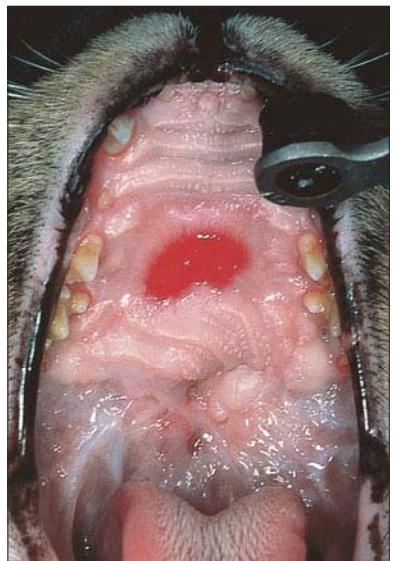
A metabolic disturbance over a longer period during the enamel development will cause generalized enamel defects. Symmetric belt-like defects and discolorations are found on the dentition where the enamel was formed during the systemic disturbance. In cases of generalized enamel defects, all teeth are usually affected.

A metabolic disturbance of short duration during the development of enamel can be recognized by defects limited to a circumscribed area of the affected teeth. Local enamel defects typically occur symmetrically and on homologous teeth. Only those ameloblasts which, at the time of the disturbance, had just started enamel formation, are affected. Trauma is a common cause of localized enamel defects.

111 i. Centrally located, acquired hard palatal defects are mainly of traumatic origin: bite wounds, electrical cord injury, gunshot wounds, foreign body penetration, and pressure necrosis from a foreign body wedged between the two sides of the maxillary dental arcade.

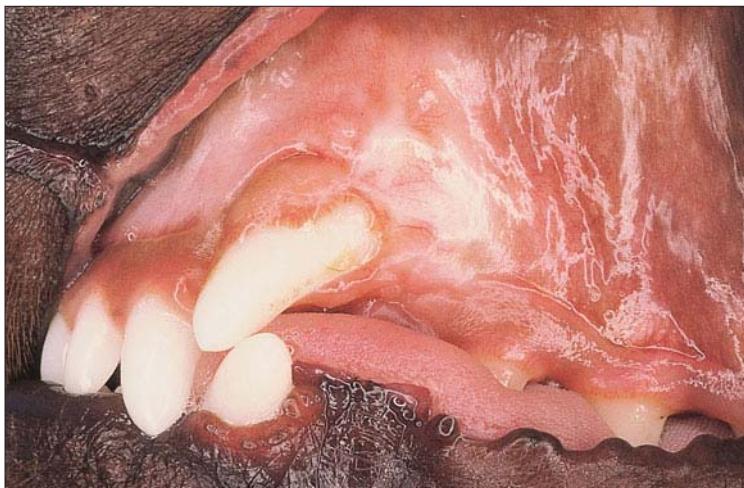
ii. The split palatal U-flap can be utilized to repair large caudal hard palatal defects. In this technique a large mucoperiosteal U-flap is created rostral to the defect and then split along the midline. Each side of the U-flap is gently elevated, taking care not to damage the major palatine arteries as they exit through the major palatine foramina approximately 5–10 mm palatal to the maxillary fourth premolars. Following débridement of the edges of the palatal defect, the first half of the U-flap is rotated into the palatal defect and sutured in place with synthetic absorbable suture material. The second half of the U-flap is then rotated rostral to the first half of the U-flap and sutured to the edge of the first flap. The rostral aspect of the palate from which the U-flap is harvested is devoid of a mucoperiosteal covering. This exposed bone at the donor site is left to heal by second intention and generally will epithelialize within 1–2 months (**111b**).

iii. The use of an obturator may be considered. Isolated case reports describe the use of soft silicone rubber, acrylic, or metal alloys for this purpose.



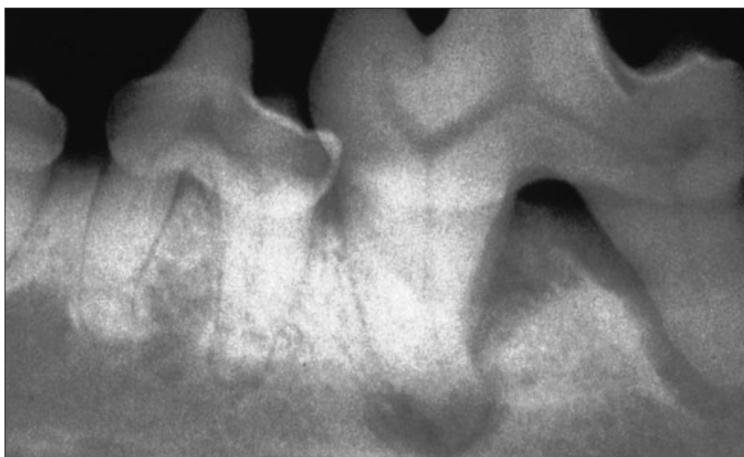
111b

112, 113: Questions



112a

- i. Explain why this dog's malocclusion (112a) should be corrected.
- ii. How would you correct this malocclusion?
- iii. If this condition were to occur in a show prospect, how would you resolve the conflict between orthodontic treatment, American Kennel Club (AKC) regulations, and American Veterinary Medical Association (AVMA) ethics?



113

- i. Identify the pathology evident on this radiograph (113).
- ii. Describe how these lesions occur.
- iii. How are these lesions classified?

112, 113: Answers

112 i. A rostrally deviated maxillary canine (or so-called ‘lance canine’) can impair prehension and can impinge upon opposing teeth and/or the labial mucosa, resulting in occlusal and/or soft tissue trauma. The deviated canine disrupts the normal periodontal contour, thus creating a plaque-retentive area. The occlusal trauma and plaque retention increase the likelihood of focal periodontitis.



112b

ii. Orthodontic correction. Fixed dental attachments (i.e. hooks, buttons) are placed on the deviated canine and on one or more anchor teeth. The maxillary fourth premolar and the maxillary first molar are often used as anchor teeth. Elastic traction (i.e. power chain, rubber bands) creates constant force on the canine. The force is a mesiodistal tipping around a buccolingual axis. Commonly employed appliances consist of hooks or buttons with a power chain or rubber band stretched between them.

iii. The AKC dog show rules state that altering the natural appearance of a dog for the purpose of correcting an abnormality is cause for disqualification of that animal. The AVMA states that performing a procedure for the purpose of concealing a congenital or inherited abnormality that sets the animal apart from the breed standard is unethical. Specifically, any procedure that will alter the natural dental arcade is unethical. Should the health or welfare of the individual patient require correction of such genetic defect, it is recommended that the patient is neutered. Genetic counseling is indicated to discourage repeat breeding.

113 i. There is a combined periodontal–endodontic lesion visible on both roots of the mandibular first molar.

ii. Periodontal disease and endodontic lesions can occur as combined lesions. Periodontal disease that progresses to involve the exposure of lateral endodontic canals, open dentinal tubules on exposed root surfaces, or the apex can result in endodontic lesions. Conversely, a periapical lesion of endodontic origin may spread periodontally. The ‘true’ combined lesion is when a periapical lesion of endodontic origin exists on a tooth that is also periodontally involved and the infrabony pocket extends to a point where the two lesions merge. The interrelationship of these systems can be established through the communication of the apical foramen as well as through lateral, accessory, and/or furcation canals.

iii. *Type I:* endodontic–periodontal lesions (primary endodontic lesions with secondary periodontal involvement). *Type II:* periodontal–endodontic lesions (primary periodontal pocket(s) with secondary pulpal involvement). *Type III:* ‘true’ combined lesions (concurrent primary periodontal lesions and primary pulpal lesions).

114, 115: Questions



114

- 114 i. Classify this type of tooth fracture (114) according to the WHO classification of dental fractures.
ii. What are the treatment objectives indicated?



115

- 115 What are the elements of a complete 'bite' evaluation in the dog (115)?

113

114, 115: Answers

114 i. This is a complicated crown–root fracture. The ‘complicated’ refers to the fact that pulp exposure has occurred, and ‘crown–root’ to the fact that enamel, dentin, and cementum are involved in the fracture line. This type of fracture by definition extends under the level of the gingiva and may extend under the level of the alveolar crest. The term ‘slab fracture’ is commonly used for this type of fracture but does not specifically imply pulp exposure or subgingival involvement. In this particular case, the pulp is considered vital because there is still some bleeding evident.

ii. The primary treatment objectives (if conservative treatment is elected) are to prevent endodontic disease caused by the pulp exposure, and periodontal disease caused by the distortion of the normal gingival contour. An additional treatment objective may be to restore the normal morphology of the tooth.

The decision to perform a partial coronal pulpectomy (pulpotomy) or a total pulpectomy (non-surgical endodontic treatment) is based on the duration of the pulp exposure, the degree of contamination, the age of the patient, the appearance of the pulp on probing, and the availability of follow-up examination. While a partial coronal pulpectomy offers the advantage that the tooth is expected to remain vital and therefore stronger, a total pulpectomy has a more predictable and higher success rate (see 43, 146, and 25). Crown–root fractures involve the periodontal ligament and may lead to periodontitis because of the altered gingival contour. A small fracture fragment and the overlying unsupported gingiva can be removed to restore a physiologic contour. A fracture extending under the level of the alveolar crest may be treated by creating a periodontal flap (see 159), removing the fracture fragment and performing an osteoplasty, and repositioning the flap in a more apical position. Deep crown–root fractures lead to an irreversible periodontitis and are an indication for extraction. Crown restoration is optional but may help in restoring the gingival contour (see 43) and in protecting a non-vital tooth from further trauma (see 152).

115 Normal occlusion implies normal interdigititation of teeth, integrity of the dental arches, and normal functioning of the temporomandibular joints. The normal interdigititation of teeth, or ‘bite’, of a dog is characterized by the anisognathic relationship of the two dental arches (the lower jaw is slightly shorter and narrower) and can be described as follows: (1) The incisal edge of the lower incisors occludes against the cingulum of the upper incisors (a *scissor bite*). (2) The lower canine is centered between the upper canine and upper third incisor, without touching either of them. (3) The tips of the crowns of the lower premolars fit into the interdental spaces of the upper premolars, with each lower premolar placed mesial to the upper premolar. (4) The palatal surface of the upper fourth premolar occludes with the buccal surface of the mesial part of the lower first molar; the occlusal surface present on the distal part of the lower first molar occludes with the occlusal surface of the upper first molar.

From the above, it is clear that the evaluation of the interdigititation of teeth should not only include the incisors, but the canines and premolars as well. A full orthodontic evaluation includes the following aspects: (1) Incisor relationship. (2) Canine relationship. (3) Premolar alignment. (4) Distal premolar/molar occlusion. (5) Head symmetry. (6) Number and position of individual teeth.

116, 117: Questions



116a

- i. What are the various techniques for taking vinyl polysiloxane impressions (116a)?
- ii. What is the purpose of the two-step technique?
- iii. Briefly describe how the two-step technique is performed.



117

- 117 What was this poor horse's main problem (117)?

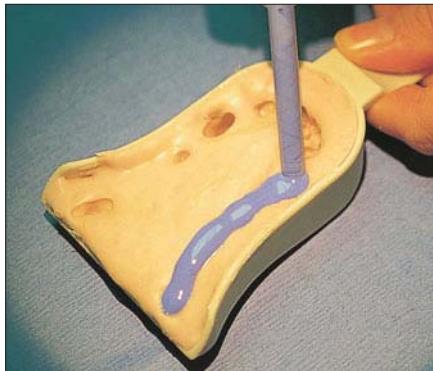
116, 117: Answers

116 i. (1) The one-step putty/wash technique. (2) The two-step putty/wash technique. (3) The double-mix technique. (4) The single-mix technique.

ii. The two-step over-impression will change a stock tray into a custom tray in the putty/wash technique. This reduces the large dimensional change which occurs when injection materials are used in a full-arch tray.

iii. (1) An over-impression is taken with putty-type impression material and a suitable impression tray. The use of a solid tray and tray adhesive is recommended.

Place only enough putty in the tray to cover the teeth (116b). Excessive putty puts pressure on the tray's side walls and increases the chance of distortion. (2) Wiggle the tray in the mouth before the putty has set to create an enlarged over-impression. After the putty has set, remove the tray from the mouth. (3) After a clean, dry field is achieved, apply a small amount of light-body impression material or 'wash' around the tooth that is being prepared for a crown restoration as well as a thin coat (1–2 mm thick) over all the teeth to be included in the over-impression. An air syringe can be used to blow the impression gently into the sulcus. Note that the wash material should not be placed over the palate. Impression material in the palate will shrink because of the bulk and distort the lingual margins of prepared teeth. (4) To seat the impression, apply very light pressure and allow the filled impression tray to slowly settle into place. Slightly pull on the lips so that the excess material can gently flow out from underneath the tray passively with no compression until completely set. If an elastomeric impression is removed before it is completely set, it will distort. (5) Remove the impression in a rapid movement down the long axis of the teeth. (6) Inspect the impression: the margin of the prepared tooth must be entire and the crown preparation distinct and without defects. If any putty shows through in the preparation area, the impression should be taken again. Exposed set putty creates a pressure spot which will rebound when the impression is removed and result in a casting that is too small.



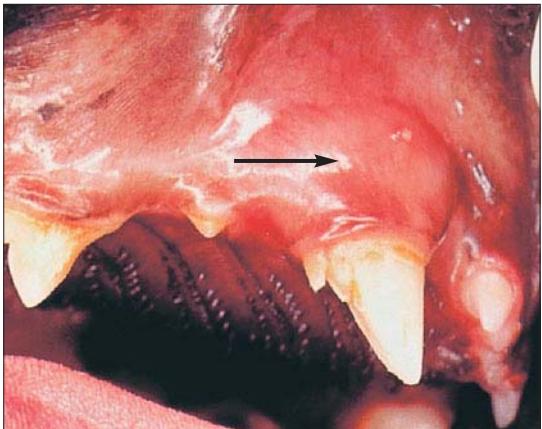
116b

117 There are seven right maxillary cheek teeth. The extra tooth is distal to the third molar and has no opposing tooth. The extra tooth continued to erupt, making it impossible for the horse to chew on the right side. All the right maxillary cheek teeth became long and showed extreme sheer mouth (very steep occlusal surface angle) (117). The left cheek teeth did all the mastication and were short. Extra (supernumerary) teeth are fairly rare, but certainly occur. This is a tragic case, as proper dental care would have allowed this horse to lead a normal, dental-pain-free life.

118, 119: Questions

118 This six-year-old domestic shorthair cat was presented for examination (118). The right maxillary canine crown is fractured and there is also a small draining sinus tract visible over the root area (arrow).

- i. What are two possible causes of the sinus tract in this case?
- ii. What locations of this sinus tract will give you a clue as to the source of the opening?
- iii. What additional steps can be taken to confirm your diagnosis?



118



119

119 The crown of this dog's maxillary fourth premolar (119) was fractured and the pulp chamber was exposed. It is not known when the injury occurred.

- i. Describe the radiologic findings.
- ii. What is the most likely etiology?
- iii. What are your treatment options?
- iv. What follow-up treatment would you recommend?

118, 119: Answers

118 i. (1) Endodontic disease associated with the exposed pulp secondary to the complicated crown fracture. (2) Periodontal disease.

In this case the sinus tract developed secondary to periodontal disease associated with a crown-root fracture with a loose root fragment.

ii. A sinus tract coronal to the mucogingival line is typically associated with periodontal disease. If the lesion is at or apical to the mucogingival line, there is endodontic disease with a periapical abscess draining through the alveolar mucosa.

iii. To confirm your diagnosis when an oral sinus tract is detected, use a periodontal probe to check for periodontal ligament attachment loss around the tooth and take an intraoral radiograph. Placing a gutta-percha point into the sinus when taking an intra-oral radiograph will often dramatically point out the source of the tract. This is particularly helpful when the sinus is located in the alveolar mucosa away from the tooth or in the case of the canine tooth where the root lies above the premolar roots.

119 i. The complicated crown fracture, i.e. the pulp is exposed in the fracture line, is evident on the radiograph. There is a distinct, rounded, radiolucent area associated with the apex of the distal root. Apical rarefaction on a radiograph usually indicates the presence of soft tissue around the tooth root apex. Such tissue can be a granuloma, cyst, or abscess. Although the radiologic signs are often suggestive of the type of lesion, definitive differentiation between these three entities relies on histopathologic examination of the tissue.

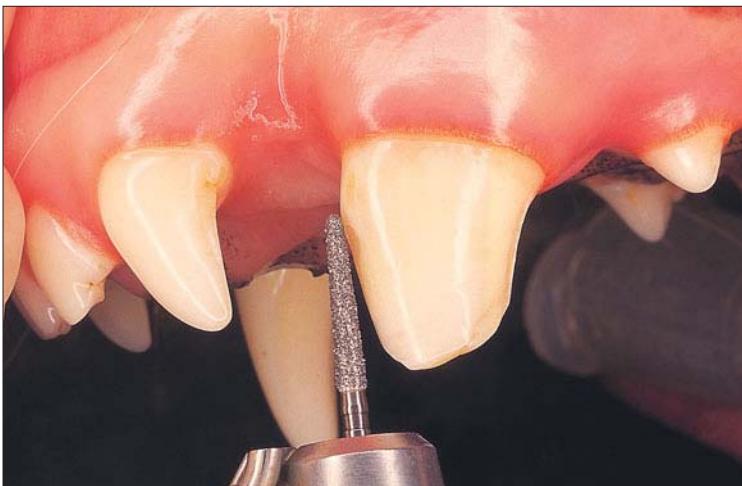
Remember that not all apical rarefaction is pathologic in dogs and cats. The periapical bone of healthy canine teeth often appears radiolucent in the dog. Comparison should always be made with other teeth of the same type in the same animal. A distinctly round radiolucent area, however, is usually pathologic.

ii. The periapical lesion seen is the result of an irreversible pulpitis or pulp necrosis resulting from the traumatic pulp exposure. Periapical lesions result as an inflammatory response to chronic pulpitis or necrotic, and generally infected, pulp. Bacteria play a key role in the pathogenesis of periapical lesions, even though bacteriologic culture often yields no growth.

iii. Treatment options include extraction and endodontic therapy. If there is evidence of periodontitis in addition to the endodontic lesions, then extraction is generally the treatment of choice. Endodontic therapy should be limited to periodontally sound teeth.

iv. In the case of endodontic therapy, the result of the treatment needs to be checked radiographically 6–12 months postoperatively. If the treatment has been successful, the periapical radiolucency should have filled in or be filling in with bone. If the radiolucency is getting larger, this indicates that there is still an ongoing inflammatory process resulting in bone destruction. The most likely cause of this happening is that inflamed or necrotic pulp tissue is still present in the apical segment of the root. Treatment options now include further endodontic therapy or extraction of the tooth.

120, 121: Questions



120

120 When performing crown preparations of canine teeth (120), what anatomic features must be considered? How much tooth must be reduced?

121 i. The unit pictured (121) can be used for what two heated gutta-percha techniques?

ii. To what temperature is the gutta-percha warmed?

iii. What are the advantages of heated gutta-percha?



121

119

I20, I21: Answers

120 One of the most important considerations when performing a crown preparation is the occlusion with other teeth, e.g. in the case of the mandibular canine tooth, the proximity of both the maxillary third incisor and canine tooth. The mandibular canine tooth must be reduced at the distal lingual wall to allow for clearance of the maxillary canine tooth and the mesial lingual wall for the maxillary incisor. In addition, consideration should be given to allow for clearance of the soft tissues in the diastema between the maxillary teeth. How much reduction depends on the type of crown employed. A commonly used guideline would be 1 mm for metal crowns and 1.5 mm for porcelain-fused metal crowns. An additional consideration would be the shape of the tooth and the fitting of the crown afterwards. As the tooth is curved, a portion of the mesial buccal wall may have to be removed to eliminate the overhang that may exist at the gingival margin. Other considerations would be to create precise margins, and to inspect these margins and the fit before seating the crown. The crown should not have any gaps between the tooth and crown. The margin should be very smooth and free of plaque-retentive areas. If the crown has gaps greater than 0.2 mm, new impressions should be taken and the models returned to the dental laboratory for remake.

121 i. The Successfil™ unit by Hygenic® can be used to heat a cannula of gutta-percha with a needle on the end that is placed in an injection gun. The cannula needle is placed into the root canal and the melted gutta-percha is injected under pressure through the cannula needle. In shorter canals the needle is slowly withdrawn as the gutta-percha is injected into the canal until the canal is full. In longer canals it may be necessary to inject some melted gutta-percha, withdraw the cannula, and reheat it while a plunger is used to push the gutta-percha apically after it has cooled slightly. Additional gutta-percha is injected and the process is repeated until the canal is full.

This unit will also heat a syringe of gutta-percha that can be used in a second technique. A file is inserted into the heated syringe end and withdrawn slowly while the plunger is gently pushed. This will coat the file end with warm gutta-percha. The file is immediately inserted into the root canal to the apex. After allowing it to set for a few seconds it is twisted counterclockwise and gently removed, leaving the gutta-percha in place. This is condensed vertically with a plunger. The process is repeated until the canal is adequately filled. A combination of the two techniques can also be used to fill large, long canals.

ii. The heating unit warms the gutta-percha in the cannulas or syringe to 90°C (195°F). Cannulas come in several consistencies of gutta-percha which determines its ability to flow when heated.

iii. Heating gutta-percha makes it more malleable to flow into irregular canal areas, lateral or accessory canals, and condenses more compactly for a solid hermetic apical seal. Inadequate apical fill is the most common reason for failure of a root canal procedure. Heated gutta-percha techniques can be used to create a more complete obturation of the root canal. Other units are also made that use heated gutta-percha cannulas or that warm gutta-percha inside the canal before lateral condensation.

122, 123: Questions

122 i. What are the main problems that may be encountered with alginate impressions and that result in an unusable study model like the one shown (122a)?
ii. How can these problems be avoided?



122a



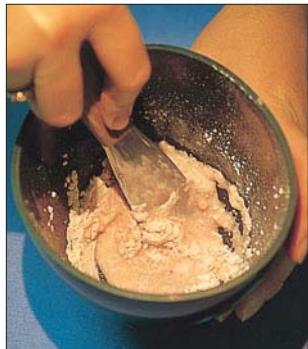
123

123 This is a Lentulo® paste filler (123).
i. How is it used?
ii. What are its advantages?
iii. What are its disadvantages?

122, 123: Answers

122 i. Too grainy material; tearing; air bubbles; irregularly shaped voids; distortion.

ii. *Grainy alginate* can be avoided by proper mixing technique; the amount of alginate needed for the size of the tray should be measured. Cold water will slow down the set of the alginate and therefore increase the working time; conversely, warm water will speed up the set and decrease the working time. All the water should be added to the alginate at one time. Pour the water into the premeasured powder, stirring slowly with the spatula (122b). Once the powder is wet, vigorously swirl the wet alginate against the sides of the bowl until there are no lumps of powder left in the mixture. This process should be completed in less than one minute. *Tearing* can be caused by inadequate bulk, moisture contamination, premature removal, and prolonged mixing. To avoid inadequate bulk, a tray of the correct size should be used. The tray should fit the animal's mouth, allowing room for all the teeth, without making contact with the impression tray. *Air bubbles* can be avoided by using the correct technique, avoiding the incorporation of bubbles during spatulation and loading the tray. *Irregularly shaped voids* can be prevented by ensuring that the impression is clean and free of debris. Therefore, saliva and dental calculus should be removed. A final rinse and dry should be done immediately before the impression is taken. *Distortion* can be prevented by holding the tray steady in the mouth until the alginate has set; this is very important. The alginate will set in approximately 3–7 minutes, depending on the type used. Touching the alginate around the top of the impression tray periodically can help to determine when it has set. To remove the tray, grip the front of the tray and firmly snap it off. Premature and improper removal will cause distortion. Once the desired impression is obtained, the stone can be poured immediately. If pouring is delayed, the impression should be wrapped in a dampened paper towel and refrigerated. Alginate is sensitive to air, heat, and loss of moisture, so the stone should be poured within 30 minutes and the cast should be left to set for two hours.



122b

123 i. Paste fillers are used with a slow-speed handpiece and a reduction contra-angle to deliver root canal sealers to the apical third of the root canal at the beginning of the obturation stage of standard root canal therapy. The instrument is inserted, loaded with sealer, to the apical portion of the canal, and rotated as it is withdrawn from the canal. The twist of the paste filler is in a counterclockwise direction and it unloads the sealer as the instrument is withdrawn, being rotated clockwise.

ii. The primary advantage of using a paste filler is in obtaining a uniform coating of sealer at the apical end of the canal and on the canal walls, ensuring that the open dentinal tubules will be sealed when gutta-percha is vertically or laterally condensed in the canal.

iii. The instrument must be turned slowly, utilizing an expensive reduction-gear contra-angle, and it will break easily if stressed. Stress will be applied to the paste filler when it is rotated within a curved canal, or if it is inserted in a canal that is too narrow.

124, 125: Questions

124 Halitosis is a very common complaint among pet owners.

- i. What conditions may cause halitosis? What are their respective importance?
- ii. How is halitosis produced?
- iii. How can it be assessed?



125

125 Fractured root tips are a common occurrence in the cat (125), either as a result of odontoclastic resorption or iatrogenic as a complication of extraction.

- i. Name two alternatives to conventional extraction of root tips which have been reported in the literature.
- ii. Comment on these two techniques.

124, 125: Answers

124 i. Halitosis may have extraoral and oral causes. Extraoral causes are related to diet (e.g. garlic in humans), metabolic diseases (diabetes, uremia), and infections (respiratory infections, e.g. pneumonia). Halitosis originating from the oral cavity is mostly due to bacterial activity in the mouth. It can be enhanced by oral tissue destruction during disease, by oral stagnation of food, and by stagnation of saliva in a specific area (e.g. lip fold) as well as by reduction of salivary flow. Halitosis is associated with oral causes in 85% of people affected. Periodontal disease is a very common cause of halitosis. Gastric conditions are not a common cause of halitosis as gas cannot come out from the stomach, except during the process of belching.

ii. Halitosis of extraoral origin is due to the presence of malodorous substances in the bloodstream which pass through the alveolar membrane of the lungs into the respired air. These substances may have a metabolic origin or a digestive origin (food). Halitosis originating from the mouth is due to the production of malodorous volatile gas by the putrefactive action of bacteria on exogenous and endogenous protein substrates such as exfoliated epithelium, salivary components, food debris, and blood. Anaerobes (especially Gram-negatives) associated with periodontal disease produce volatile sulfur compounds (VSCs), such as particularly hydrogen sulfide and mercaptan, which are responsible for bad breath.

iii. Halitosis is commonly assessed by organoleptic methods. With subjective methods, it is generally accepted that three levels (weak, moderate, strong) can be recognized. However, this is not accurate, especially if assessment of the same dog over a period of time or comparison between dogs is necessary. The use of a panel of 'blind' examiners has been shown effective in halitosis research. Selection, calibration, and training of the examiners is necessary for optimal results. An objective method based on the measurement of VSCs with an electrochemical sensor has been shown accurate and reliable.

125 i. The two alternative techniques are 'atomization', or burring out root tips, and intentional partial extraction and retention of root tips.

ii. The removal of retained root tips by burring them out is not recommended. Atomizing a root tip involves drilling away the remaining tooth substance using a round bur in either a low- or a high-speed handpiece with water irrigation. The procedure largely relies on tactile sensation to differentiate between bone and tooth substance. In atomizing a root of a maxillary or mandibular premolar or molar, the close proximity of the nasal cavity or the mandibular canal should be remembered. Atomization is a last resort and any need for it should be avoided by a gentle, well-planned extraction technique (20) from the outset. Coronal amputation with elective retention of the roots using a flap technique for the management of odontoclastic resorptive lesions has been investigated (108). The results showed that the retained roots tended to continue resorbing. At the present time, elective retention of roots should not be used as a primary treatment technique. However, it may be appropriate to consider leaving a healthy root fragment in place if it fractures during extraction. Radiographs a few months postoperatively are recommended to ensure that the root remains healthy or is resorbing. Root segments with endodontic disease or periodontal involvement extending to the level of the root fracture should always be extracted.

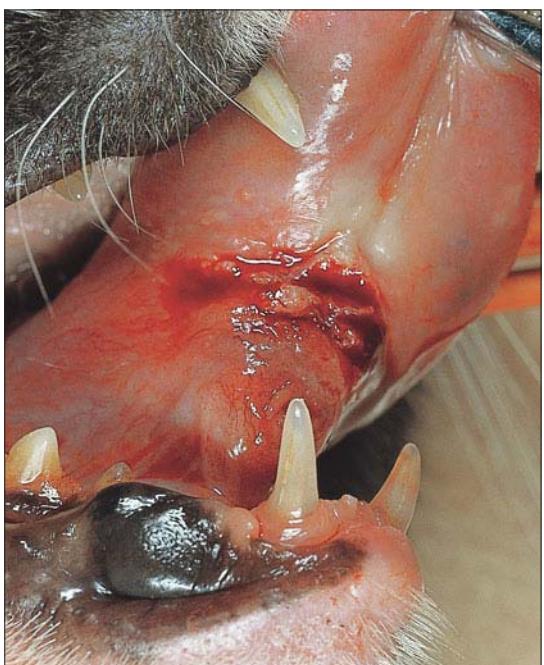
126, 127: Questions

- 126 i. What is a dental index?
ii. Name and characterize one index for plaque and one index for gingival inflammation.

127 These are two histopathologically confirmed squamous cell carcinomas (127a, b). How would you summarize the clinical presentation and biologic behavior of this tumor type in the dog and cat?



127a



127b

126, 127: Answers

126 i. An index is a numeric score based on defined diagnostic criteria. The presence and/or severity of pathologic conditions are expressed by assessing a numeric value. A wide variety of indices exist, primarily for use in humans but also for veterinary use. Some indices were developed primarily for use in epidemiologic studies, while others are more applicable to individual patients. An index should be simple, objective, reproducible, quick, and practical.

ii. The Plaque Index (PI) is used to assess the thickness of plaque along the gingival margin. It uses a scale of 0 to 3. Grade 0 indicates no plaque adjacent to the gingival margin. Grade 1 indicates plaque adhering to the free gingival margin visible only when a probe is run across the tooth surface. Grade 2 indicates a moderate accumulation of soft deposits within the gingival pocket, on the gingival margins and/or adjacent tooth surface, which can be seen without staining or use of a probe. Grade 3 indicates an abundance of soft debris at the gingival margin and interdental space.

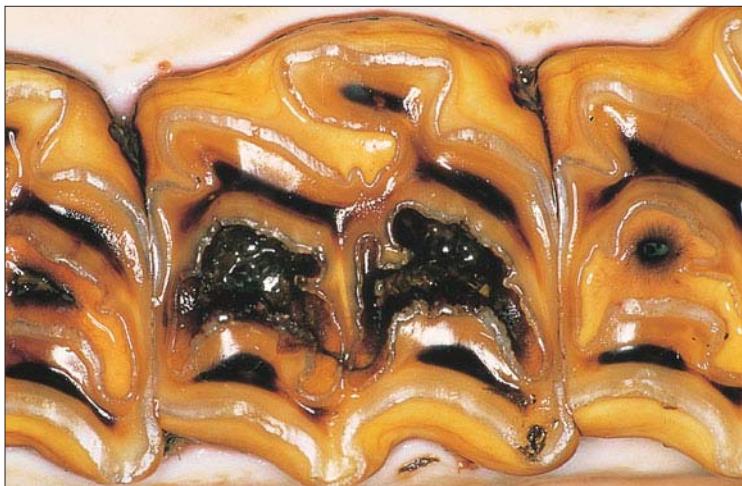
A plaque index commonly used in veterinary dentistry is based on the percentage of the buccal aspect of the crown covered by plaque. A score of 1 means that up to 25% of the buccal aspect is covered by plaque, a score of 2 indicates 25–49% coverage, a score of 3 indicates 50–74% coverage, and a score of 4 indicates 75–100%.

The Gingival Index (GI) is used to assess gingival inflammation. It uses a scale of 0 to 3. Grade 0 indicates no inflammation. Grade 1 indicates mild inflammation with slight edema, slight change in color, and no bleeding on probing. Grade 2 indicates moderate inflammation with redness, edema, glazing, and bleeding on probing. Grade 3 indicates severe inflammation, marked redness, edema, ulceration, and a tendency for spontaneous hemorrhage.

127 The gross appearance of oral squamous cell carcinoma (SCC) may vary from prominent exophytic lesions to flat, ulcerative lesions. As can also be seen in **165**, chronic oral ulceration or non-healing wounds are suspicious for SCC and should be biopsied. Bone infiltration is variable in the dog but usually very prominent in the cat, with relatively little of the tumor being visible in the oral cavity. The radiologic findings of SCC also greatly vary from minimal bone involvement, to patterns dominated by bone destruction or new bone formation.

The biologic behavior of SCC is very species- and site-dependent. In general, SCC in the cat carries a much worse prognosis compared with the dog, with local recurrence due to deep infiltration being the most important cause of treatment failure. Regional lymph node and distant metastasis of SCC of the gingiva is rare, while metastasis of tonsillar and sublingual SCC is common. In general, SCC of the rostral part of the oral cavity is associated with the best prognosis, not only because of its biologic behavior but also because it is technically easier to obtain tumor-free surgical margins. The response of SCC to radiation therapy is good in the dog and poor in the cat.

128, 129: Questions



128

128 i. What lesion of equine teeth is evident here (128)?

ii. At what stage would this lesion become clinically evident, and what would be the presenting signs?



129

129 i. Name these three types of commonly used manual endodontic instruments (129).

ii. Describe the purpose of each, how they are fabricated and used, and their relative strength.

127

128, 129: Answers

128 i. Cemental necrosis is the equine equivalent of caries and arises by dissolution of hypoplastic cementum and the enamel which encircle the two infundibular lakes in each maxillary cheek tooth. There are no infundibula in the mandibular teeth and therefore this condition is confined to the maxilla. Although the disorder can be seen in 80% of horses aged 15 years and over, only a tiny minority of these animals will show clinical signs. In order of frequency, lesions are seen in cheek teeth (CT) 4, 5, 1, 2, 3, and 6.

ii. It is only when the necrosis reaches the pulp chamber that the tooth becomes devitalized, and even then the infection may be contained in some instances. Extension of infection through the apical foramen precipitates suppuration in the adjacent tissues, but pathologic fractures of the teeth along a line of weakness between the infundibular lakes accelerate this process. The suppuration in tissues adjacent to the tooth roots is responsible for some cases of secondary empyema of the maxillary sinuses.

Horses with maxillary periapical dental abscessation, regardless of mode of origin, are likely to present with a facial swelling, possibly with discharging tracts when CT 1–3 are diseased and secondary maxillary sinusitis with a putrid nasal discharge when CT 4–6 are involved. In clinical practice, almost all facial swellings which arise rostral to the rostral limit of the facial crest are caused by dental abscessation, and yet very few swellings caudal to this line (i.e. over the maxillary sinuses) themselves arise through periapical suppuration. Only those patients where displaced fragments of tooth irritate the oral mucosa are likely to show evidence of dysphagia.

129 i. The instruments pictured are, from top to bottom, a reamer, a Hedström file, and a Kerr file or K-file.

ii. Endodontic reamers and files help to remove pulp from the root canal, but they are primarily used to débride the contaminated dentin lining the root canal and to shape it for convenient filling; they are available in different styles, lengths, and diameters.

Reamers are an early edition of the file, but are still preferred by some practitioners. They are twisted, square metal rods with fewer flutes or twists per millimeter than a file. Reamers are designed to be used in a twisting, auger-like motion that carries filings from the depth of the canal to the access site.

The two most common styles of files are the Kerr file (K-file) and the Hedström file. The shape of a Hedström file is that of inner-stacked cones. Its carrier effect is produced by a straight pull of the file. Hedström files produce a clean, but not cylindrical or smooth, wall. They are best used to cleanse and shape the coronal portion of the canal.

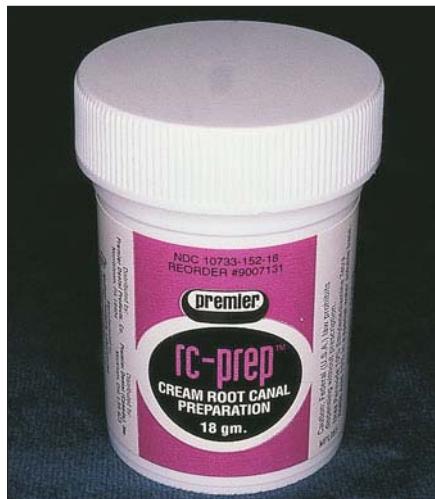
The K-file is similar in design to a reamer, but has a tighter twist and is operated either in a push-and-pull motion or by being rotated clockwise 90° and pulled coronally. It will break easily if lodged tightly in the canal, and also if twisted counterclockwise in an effort to dislodge an embedded file. K-files produce a clean, smooth, cylindrical canal wall and, because of their design, are best used to cleanse and shape the apical portion of the canal.

K-files are stiffer and stronger, size for size, than the Hedström files because of their style of manufacture. To create K-files, a square, rhomboid or triangular rod is twisted, creating cutting flutes. A Hedström file is created when a spiral groove is machined into the rod. It is weaker than a K-file because its central core has been reduced in diameter.

130–132: Questions

130 RC-Prep™ (Premier Dental Products Co., Norristown, PA) is a viscous liquid compound consisting of 15% ethylenediamine tetra-acetic acid (EDTA) and 10% urea-peroxide in a water-soluble base (130).

- i. How is RC-Prep™ supplied, and what is its purpose?
- ii. How is this product used?



130

131 You are looking at an intraoral radiograph of an eight-year-old Basenji (131). The marker dot is elevated on the film as you view it.

- i. What is the designation of the three-rooted tooth indicated by the arrow, according to the modified Triadan system?
- ii. What are the advantages of using the Triadan system?
- iii. What are the disadvantages of using the Triadan system?



131

132 A 14-year-old, male castrated domestic long-hair cat is presented for dental scaling and polishing. The owners report that the cat is healthy and the dental disease does not appear to bother the cat; he has an excellent appetite. The cat has periodontal disease, is thin and tachycardic (>200 beats per minute), and a systolic murmur is heard over the left apex. In reviewing the medical records, the cat weighed 5.9 kg three years ago and presently weighs 4.5 kg.

- i. What would you specifically evaluate on your physical examination?
- ii. What diagnostic tests are indicated?

129

I 30–I 32: Answers

130 i. Either in 15 ml curved-tip syringes or in 18 g or 227 g bulk jars, which are less expensive. It is a chelating and lubricating material that will soften inorganic debris and lubricate the endodontic file. It is used during the initial root canal preparation.

ii. RC-Prep™ is either deposited through the access site into the pulp chamber with the curved-tip syringe or delivered to the root canal on the tip of an endodontic file during root canal preparation in standard root canal therapy. If a bulk jar is used, a small amount is first transferred from the bulk jar to a clean sponge or a gauze pad. It is then deposited onto the file tip. RC-Prep™ is used either by itself or it may be used alternating, during root canal preparation, with irrigation solutions such as 2.6–5.25% sodium hypochlorite, physiologic saline solution or REDTA® (Roth International Ltd, Chicago, IL).

131 i. Number 207. It is the left maxillary third premolar that happens to have three roots. The second premolar is absent. The Triadan system utilizes a three-digit number to designate each tooth. Quadrants are designated by the first digit and rotate from right maxilla → left maxilla → left mandible → right mandible; the rotation is designated with numbers 1 through 4. The quadrant numbering continues with numbers 5 through 8 for primary teeth. Each individual tooth has a two-digit designation, beginning with 01 for the first incisor (the one closest to the midline) and continuing in ascending order to the distal end of the arch in each quadrant. In the dog, the last maxillary tooth is normally number 10 and the last mandibular tooth is normally number 11.

The ‘Rule of Four and Nine’ is used to provide consistency among varying species. The number 04 always designates a canine and the number 09 always designates a first molar. The number normally used for a tooth that is not included in the dental formula of a given species is not used on its chart. For example, in the cat, which normally does not have the maxillary first premolar, the numbers 105 and 205 are not used. This system works for dogs, cats, rodents, pigs, horses, cattle, sheep, etc.

ii. (1) The Triadan system is adaptable to computer use. (2) Each tooth has a unique number; there is no confusion when referring to left, right, maxillary, or mandibular teeth. (3) The system is consistent and easy to use with a variety of species, even those with a reduced dentition. (4) It is convenient to use in conjunction with anatomic charts.

iii. (1) The Triadan system is difficult to remember if not used on a regular basis. (2) Tooth function and anatomic connotation are not identified by the number.

132 i. Palpation for the presence of a thyroid nodule.

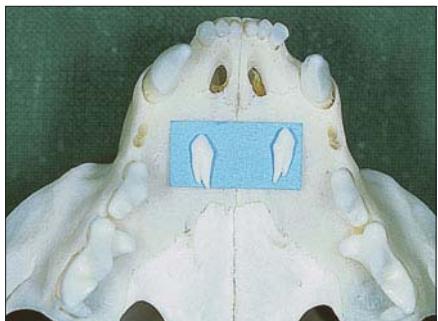
ii. The patient should have a minimum database (CBC, biochemical profile, urinalysis) before general anesthesia. The signalment and history are compatible with hyperthyroidism; a serum T4 should be measured regardless of whether a thyroid nodule is present or not. Anesthesia for an elective procedure should be delayed until the cat is treated for the hyperthyroidism, if present. If the cat is not hyperthyroid, an alternative explanation for the weight loss, tachycardia, and cardiac murmur should be identified.

133, 134: Questions

133a

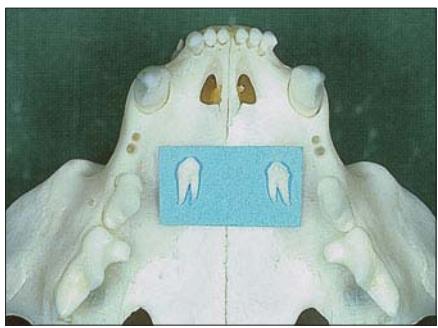


133b



133 What is the anatomic-zoologic importance of the small teeth shown (133a–c)?

133c



134a

134 i. What radiographic technique is being used here (134a) for taking a radiograph of the mandibular first molar in a dog?
ii. Where in the oral cavity can it be used?
iii. Describe this technique.

133, 134: Answers

133 The most mesial maxillary premolar in the cat is the second premolar. The normal dental formula of the cat is identical with that of virtually all other members of the Family Felidae, Subfamily Felinae, namely:

$$I \frac{3}{3} : C \frac{1}{1} : P \frac{3}{2} : M \frac{1}{1} = 30$$

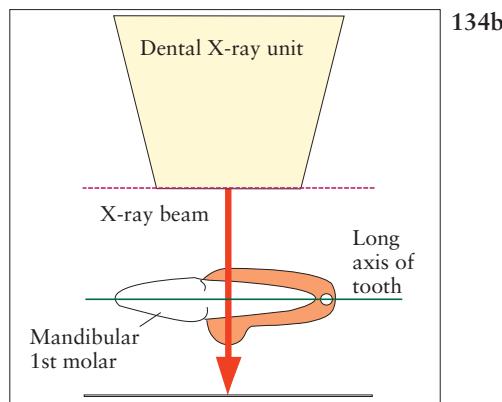
The maxillary second premolar (P2max) has received considerable attention from zoologists, its absence being interpreted as indicating a tendency towards reduced dentition in the cat, as compared with the original carnivore dentition. The P2max was found to be absent in 3.4–28.4% of cat populations worldwide, and it was postulated that the tendency towards absence of P2max increased from North to South. The tooth is also frequently absent in the cheetah (*Acinonyx jubatus*), caracal (*Felis caracal*), manul (*Otocolobus manul*), leopard cat (*Felis bengalensis*), and lynx (*Lynx lynx* and *L. rufus*). The tooth varies considerably in size and position. The P2max is generally described as a single-rooted tooth, although two (often fused) roots occur. In one study, 20% of P2max present had a dichotomous or partly fused double root, while 2% had two fully formed roots. This is of clinical importance if extraction of this tooth is indicated.

Illustrated are three cat skulls with (133a) unilateral absence of P2maxL and a normally shaped P2maxR; (133b) bilaterally present P2max with dichotomous roots; and (133c) bilaterally present P2max with fully formed double roots.

134 i. The parallel technique, which is one of the two basic intraoral radiographic techniques (134b).

ii. The parallel technique is a very accurate technique but it can only be used if the dental film can be placed parallel to the tooth, which may be difficult due to the shape of the oral cavity. Using intraorally placed dental films, the only teeth in the dog or cat that allow film placement parallel to their roots are the mandibular premolars and molars. The parallel technique is also used for the extraoral view of the maxillary premolars and molar in the cat.

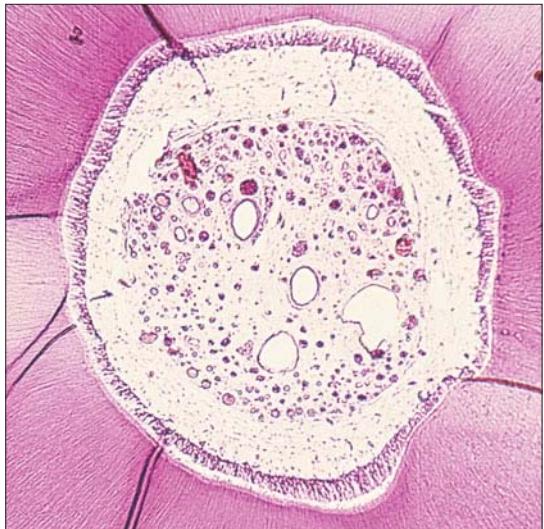
iii. The intraoral film packet is placed parallel to the tooth being radiographed. The plane of the film should be parallel to the plane of the tooth. The central X-ray beam is directed perpendicular to the structure being radiographed and the film. If you notice that a slight angle is formed by the tooth and the film, a satisfactory film will be produced by directing the central X-ray beam perpendicular to the tooth. If the angle is greater than 15°, then a bisecting angle technique should be used (see 94). The radiographic image will be elongated if the bisecting angle technique is not used.



135, 136: Questions

135 This is a low-magnification, cross-sectional view of a dog's tooth root (135).

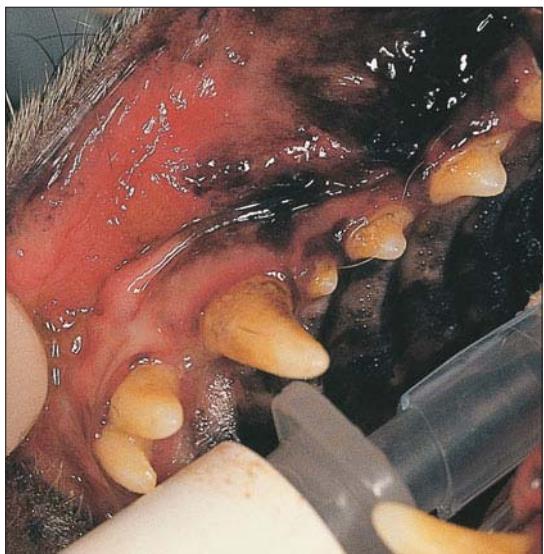
- i. What cell layers are visible in the pulp?
- ii. What nerve fibers are present in the pulp, and what is their clinical significance?



135

136 This dog had a history of a shifting limb lameness. In addition to findings noted in the oral cavity (136), the clinical and laboratory examination revealed lethargy, mild peripheral lymphadenopathy, mild fever, and confirmed proteinuria with no other abnormalities on a complete urinalysis. The results of a complete blood count and biochemical profile were within normal limits.

- i. This patient should be evaluated for which autoimmune disease?
- ii. Which diagnostic tests are indicated to evaluate for autoimmune disease?



136

133

135, 136: Answers

135 i. The most peripheral layer consists of the odontoblasts, which are closely associated with the predentin and dentin (see 3, 70, and 109). The odontoblasts are columnar in the pulp chamber and more cuboidal in the root canal. Under the odontoblasts is the cell-free zone (of Weil), which typically is fairly wide in the dog. The next layer is the cell-rich zone, which contains fibroblasts and undifferentiated mesenchymal cells. Intertwined with this zone is the parietal nerve plexus layer (or subodontoblastic plexus of Raschkow). The fibroblasts form the pulp matrix, while the undifferentiated mesenchymal cells may become involved in the production of tertiary dentin. The pulp proper or pulp core consists of loose connective tissue and contains the large blood vessels, lymphatic vessels, and nerves.

ii. The dental pulp is richly innervated and contains sensory and postganglionic sympathetic fibers, which can be divided as relatively large-diameter, myelinated A- β and A- δ fibers, and small-diameter, unmyelinated C-fibers. The terminal nerve fibers lose their myelin sheath and arborize to form the plexus of Raschkow, with a few A- δ axons continuing between the odontoblasts and accompanying the odontoblastic processes in the dentinal tubules. This partially explains why dentin is sensitive. Stimulation of the A- δ fibers is responsible for momentary, sharp, provoked, and localizable pain. This is indicative of a vital pulp with an intact pulpodental complex. As pulpitis progresses and the pulp degenerates, C-fiber pain predominates; this is characterized by a more constant, diffuse, throbbing pain.

136 i. Systemic lupus erythematosus (SLE) is an autoimmune disease that affects multiple organ systems. Polyarthritis and/or polymyositis are common in SLE and may result in a stiff gait or a shifting limb lameness. Cutaneous lesions are common and include lesions affecting the body, limbs, head, mucocutaneous junctions, and oral cavity. Major signs of SLE include non-erosive polyarthritis, polymyositis, bullous dermatitis, proteinuria, and immune-mediated hemolytic anemia and/or thrombocytopenia and/or leukopenia. Minor signs include oral ulceration, pleuritis, myocarditis, pericarditis, peripheral lymphadenopathy, fever of unknown origin, dementia, and seizures.

ii. The diagnosis of SLE is based on a combination of clinical signs and laboratory tests. The extent of the diagnostic evaluation is determined by the clinical signs and initial laboratory database. Serologic tests used to support a diagnosis of SLE include an indirect fluorescent antinuclear antibody test (ANA test) and lupus erythematosus cell test (LE cell test). The diagnosis of SLE is usually made when two major signs are present with a positive serologic test. A probable diagnosis is made when one major sign and a positive serologic test are present or two major signs with negative serologic tests. When evaluating the results of ANA and LE cell test results the laboratory should be consulted to determine the significance of the ANA titers and the possibilities for false-positive and false-negative results.



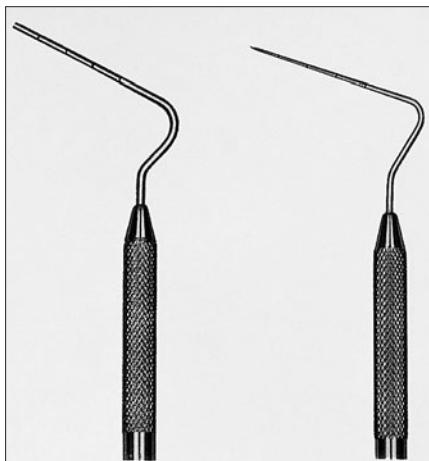
137

137 An eight-year-old horse has sustained a traumatic injury to the left mandible and, apart from an acute swelling in the region, there is an open wound at the ventral aspect of the jaw. A lateral radiograph confirms a fracture which appears to involve the roots of the third cheek tooth (137). Suggest how this case should be managed.

138 i. What are the two instruments shown (138)?

ii. What is the difference between them?

iii. How are they each used?



138

135

137, 138: Answers

137 Fracture of the body of the mandible should always be considered in cases of acute swelling of the jaw. External palpation, intraoral examination, and a careful radiographic investigation are used for diagnosis. The principles which relate to the treatment of facial trauma are no different to those which apply to other wounds: control of hemorrhage and preservation of vital functions such as respiration in the acute phase; anatomic restoration and restoration of normal dental occlusion; removal of devitalized tissue; and control of secondary infection. It is rare for facial wounds to be so severe that surgery is required to stop hemorrhage and to maintain patent nasal airways. Open wounds over the sinuses may necessitate removal of loose bone fragments and débridement of gross contamination. An implanted irrigation catheter can be a useful measure to flush away blood and debris and should always be used when the sinus wall has sustained a full-thickness penetration. The provision of broad-spectrum antibiotic cover during the immediate post-traumatic period should be routine. Most bone fragments retain periosteal or endosteal attachments and heal uneventfully, but occasionally devitalization leads to sequestration with a discharge to the nose or skin surface. These should be dealt with by surgical removal as and when they arise. Grossly deforming depression fractures should be treated by elevation as soon as possible after the trauma, otherwise a fibrous union will form in a matter of days. Many fractures of the mandible show little displacement of the bone fragments and surgical fixation is often not necessary. However, teeth may be devitalized either by infection through the fracture line or by disruption of their vascular supply. The decision whether or not to extract depends on radiographic findings, but this should be delayed at least until a firm fibrous union of the fracture site is present. Attempts to extract before this time may exacerbate any displacement of the mandibular fragments.

138 i. The instrument on the left is an endodontic *plugger* and the instrument on the right is an endodontic *spreader*. These instruments can come on long handles such as these, as double-ended instruments, or as finger instruments with a short working tip and a finger grip for use in small teeth. They come in various widths and lengths of the working tip.

ii. The plugger has a blunt end to the working tip and the spreader has the pointed tip.
iii. The plugger is designed to push gutta-percha towards the apex during root canal obturation. With its blunt tip it presses against the gutta-percha and condenses it vertically. It can be used with heated gutta-percha placed into the canal and then condensed vertically, seating a single gutta-percha point apically or in true vertical condensation techniques where sized pluggers are used to condense sections of sized gutta-percha into the root canal.

The spreader is designed to compress gutta-percha laterally during obturation. The working tip can be warmed or used cold and is slid down alongside the gutta-percha to condense it laterally against the canal wall. Additional gutta-percha is placed either with warm gutta-percha techniques or using additional gutta-percha points that is again condensed laterally with the spreader. This process is repeated until the canal is completely filled. Using either or both instruments during root canal obturation creates a denser fill and can optimize filling irregularities in the canal.

139–141: Questions

139 This is an example of a porcelain-veneer bridge used for the replacement of a traumatically lost maxillary second incisor in a dog (139). How would you classify this type of bridge, and name its components?

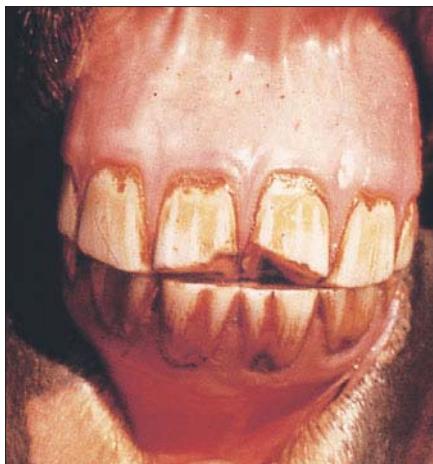


139

140 Changes affecting one section of the dentition can affect other areas. This is more important in species with aradicular hypodont teeth than those with brachyodont teeth (short-crowned, anatomically rooted teeth which stop erupting once they are in occlusion).

- i. What effects may incisor overgrowth have on the aradicular hypodont cheek teeth (premolars and molars) of rabbits and chinchillas?
- ii. What effect will intraoral overgrowth of the cheek teeth of the above-mentioned species have on their incisor occlusion? What is different in the case of a guinea pig?
- iii. What force is required to arrest the eruption of aradicular hypodont rabbit and rodent teeth?
- iv. What happens to continuously growing teeth if eruption is arrested?

141 During the examination of a horse on behalf of a prospective purchaser, an oral inspection was performed to assess age and oral conformation. What significance should be attached to the pattern of wear found on the incisor teeth (141)?



141

139–141: Answers

139 A three-unit, fixed-fixed bridge: it is a one-piece bridge with the retainers fixed at either end of the pontic, consisting of three dental units. The portion of the bridge replacing the missing second incisor is known as the pontic. The pontic is suspended by two retainers, in this case jacket crowns, placed on the abutment teeth, the first and third incisors. The connecting porcelain (known as joints) between the retainers and pontic are stained to create the illusion of interdental spaces.

140 i. The main two effects are: (1) Overgrown incisor teeth tend to interfere with the action of the jaw, preventing normal chewing movements (principally side-to-side in rabbits, rostral to caudal in rodents); this can result in abnormal wear of the cheek teeth. (2) The mouth is prevented from closing fully; this interferes with cheek tooth function reducing wear of these teeth and permitting intraoral overgrowth of the cheek teeth.

ii. It prevents a return to normal occlusion once the incisor problem is alleviated unless the whole dentition is assessed and treated appropriately. Primary cheek tooth overgrowth, as occurs when an insufficiently abrasive diet is fed to the true herbivores being discussed, prevents full closure of the mouth. As a result there is secondary overgrowth of the incisors which may no longer function normally. The occlusal planes of rabbit and chinchilla cheek teeth are almost horizontal, so overgrowth of these teeth simply forces the mouth open. In the guinea pig the occlusal planes are at an angle of about 30°. This angulation, combined with the rostrocaudal divergence of the dental arcades, creates a rostral force on the mandible as the mouth is forced open by the overgrown teeth. As the temporomandibular articulation of rodents permits a wide range of rostral displacement, the mandible is forced into a prognathic alignment so the incisor teeth no longer occlude at a normal angle.

iii. A force of between 1 and 7 g. When applied continuously, such forces may even lead to the intrusion of the teeth back into their sockets.

iv. The aradicular hypodont teeth of rabbits, guinea pigs, and chinchillas continue growing even when eruption is arrested. This results in root elongation. As the periapical germinal tissues penetrate deeper into their supporting structure, influences from their new, abnormal, environment tend to influence the growing teeth, leading to root deformity. If the cause persists, the root apices of these teeth will eventually penetrate all the way through their supporting bone. At this stage the animals usually show evidence of pain and there is palpable swelling on the ventral surface of the mandible.

141 The pattern of wear on the first incisors arose by abrasion and is highly suggestive that the horse is a crib-biter and/or wind-sucker. In many countries it is the legal responsibility of a vendor to declare whether or not a horse is free from stable vices (stereotypic behavior). However, in the face of the findings shown, the examining veterinarian should observe the resting horse carefully for any tendency to display these stereotypes, and in any event the client should be advised of the possible significance of the dental changes.

142, 143: Questions

142 The clinical appearance of dental caries in a dog is shown (142).

- i. Define dental caries, and comment on the etiology.
- ii. Describe the clinical aspects of dental caries in the dog and cat.



142

143 This is an intraoperative view of a partial maxillectomy in a dog (143). The tumor in question was diagnosed as a squamous cell carcinoma, and mandibular lymph node palpation and thoracic radiographs showed no obvious signs of metastasis. This surgical procedure is designed to effect a 'surgical cure'. How do you decide what to remove, and how do you go about removing sufficient tissue?



143

142, 143: Answers

142 i. In a broad sense, dental caries is defined as a microbial disease of the calcified tissues of the tooth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth. The etiology is complex and there is no consensus on the relative importance of acid-producing bacteria, proteolytic bacteria, and the role of chelation.

ii. In dogs, the most common type and site of dental caries is occlusal caries (G.V. Black type I) affecting the mandibular and maxillary molars. The fissured areas of the occlusal surfaces of these teeth provide an ideal harbor for the microorganisms causing caries. Once the dentinoenamel junction is reached, the caries lesion spreads into the dentin, undermining the enamel, while at the same time moving towards the pulp. The undermined enamel may fracture. Inflamed or exposed pulp is associated with pain.

In dogs, the typical early chalky-white, soft lesions are often overlooked. Dental caries is generally diagnosed in an advanced stage: multiple, highly pigmented yellow or brown lesions affecting several (pre)molars with a hard, leathery, or sclerosed surface. As soon as a clinically detectable dental caries lesion has occurred, the choice of treatment is restorative dentistry or extraction, depending on the extent of the lesion.

Cervical dental caries occurs on either buccal, lingual, or interproximal surfaces. In dogs with gingival recession or severe periodontal disease the dental caries process may readily commence in the exposed cementum or dentin (root caries).

True caries in cats is rare; feline odontoclastic resorptive lesions are a different dental disease.

143 The tissue must be removed ‘en-bloc’, because there are no simple surgical limits in the maxilla to follow. For a squamous cell carcinoma, a 10-mm margin of grossly normal tissue beyond the lesion is recommended as the minimal amount to resect. Standard radiographs do not reveal sufficient detail to define three-dimensional abnormalities, especially in a complicated structure like the maxilla and nasal cavity. CT scans are more useful in this respect, though the grossly palpable and visible limits are usually the only help at hand. Once the extent of the resection is decided, incisions through soft tissue and bone are made with scalpel (for soft tissue) and dental bur or osteotome (for bone) to isolate the tissue. This often requires transecting major vessels and risking extensive hemorrhage. Knowing where the major vessels (infraorbital artery, palatine artery, sphenopalatine artery, facial artery) run is essential. If the hemorrhage cannot be stopped by pressure or identification and clamping of a specific vessel, ligate the carotid artery on that side through an incision in the neck rather than risk injury to deeper tissues (especially nerves) by chasing the source of hemorrhage directly. The closure of the oronasal defect created during a maxillectomy is surprisingly simple in most cases, provided that the mucosa of the cheek is not involved. The buccal mucosa is dissected so as to form a tension-free flap that is sutured to the palatal incised edge. If the buccal mucosa is not available to form a flap to cover the defect, it is necessary to be more creative. In some cases, tissue from the lower lip can be used.

144, 145: Questions



144

144 What are the treatment options for the malocclusion in this one-year-old dog (144)?



145

145 A ten-year-old, male castrated Welsh Corgi is presented for depression and loss of appetite. Physical examination reveals the presence of severe periodontitis (severe gingival inflammation and recession, grossly mobile teeth, severe halitosis) and associated buccal mucosal inflammation (145). The patient appears slightly depressed and painful on oral examination. No other significant abnormalities are found on physical examination.

- i. What is your initial assessment of and plan for this patient?
- ii. When is anesthesia and management of this patient's oral disease an appropriate plan of action?

144, 145: Answers

144 The treatment options for linguoversion of the mandibular canines and other malocclusion syndromes causing palatal trauma (see 33) include: (1) orthodontic treatment; (2) crown-height reduction; and (3) extraction. The therapeutic decision-making is based on the dental expertise available, predictability of results, required follow-up examination, desire to maintain normal structure, and expense.

Various methods for orthodontic correction of linguoversion of mandibular canines have been described and are being used. An acrylic inclined-plane bite plate is one of the more commonly used techniques. The acrylic appliance, which can be made by a dental laboratory based on impressions and stone models, or directly made in the oral cavity, is placed on the maxilla, which allows the palate to heal. Metal inclined planes and various types of expansion devices are also used. The disadvantage of orthodontic correction include the expense, multiple anesthesias, and plaque accumulation underneath the appliance. However, the main advantage is that the canine teeth are movedatraumatically and predictably into the correct or into a non-traumatic position.

Surgical crown-height reduction of the mandibular canines to a level which takes them out of palatal occlusion, followed by a capping the vital pulp is another option. This procedure may fail if pulp necrosis occurs. It is controversial how common this complication is, which makes follow-up examination imperative, even though it necessitates another anesthesia and adds to the cost.

A third option is extraction of the mandibular canines. The mandibular canines occupy a major part of the rostral aspect of the mandibles, and extraction weakens the structure considerably. In addition, the tongue may hang out if the mandibular canines are absent.

Note that all orthodontic problems must be considered hereditary except in cases of malocclusion following known injury during development. Genetic counseling is therefore generally indicated and neutering may be recommended.

145 i. The history and clinical signs are non-specific findings. Depression and loss of appetite may result from numerous problems including painful, inflamed, or infectious oral diseases. A minimum database should be collected in this patient to evaluate for specific problems (e.g. uremia) or evidence of a systemic disease. A complete blood count, biochemical profile (renal parameters, hepatic enzymes, electrolytes, albumin, globulins, glucose, phosphorus, calcium), and urinalysis should be evaluated.

ii. If the minimum database is unremarkable, management of the severe periodontal disease should be considered. The presenting problems of depression and appetite loss may or may not be a result of the severe periodontal disease. Management of the periodontal disease and evaluation of the patient's response to treatment will assist with the evaluation of the presenting concern. Following treatment of severe periodontal disease the patient may return to normal activities and appetite. If the patient does not respond, additional diagnostic tests should be recommended.

146, 147: Questions



146

146 This tooth fractured eight hours ago when the dog tried to catch a rock (146).

- i. List two endodontic treatment options for this tooth.
- ii. What are the advantages and disadvantages of each?



147

147 i. Describe the radiologic findings shown (147).

ii. Is there any pathology present in this cat? If so, describe the abnormality and suggest the cause.

iii. How would you determine if the described lesion(s) is/are associated with disease?

146, 147: Answers

146 i. (1) Elective total pulpectomy and root canal therapy. (2) A partial coronal pulpectomy (pulpotomy) and vital pulp treatment.

ii. The advantage of elective total pulpectomy and root canal therapy is its high long-term success rate. One disadvantage of this treatment is that the procedure takes longer, resulting in higher initial costs and longer anesthesia. Also, a non-vital, endodontically treated tooth may be more prone to subsequent fracture. This effect is due mostly to the tooth structure removed during access and canal preparation and also to the tooth becoming more brittle due to the loss of the organic component. Another disadvantage of pulpectomy of an immature tooth is that further maturation and dentin production is arrested.

A partial coronal pulpectomy (pulpotomy) is faster and easier to perform and therefore less costly. If successful, the pulp remains vital. For an immature tooth, this allows the tooth to become stronger as secondary dentin is formed. A partial coronal pulpectomy involves the atraumatic removal of the coronal 2–8 mm of pulp (depending on the size of the tooth), both to eliminate contaminated tissue and to provide space for a restoration. Calcium hydroxide $[\text{Ca}(\text{OH})_2]$ is applied to the pulp stump, followed by a base such as a hard-setting $\text{Ca}(\text{OH})_2$ -material. Then a final leakage-free restoration is placed.

Calcium hydroxide is generally accepted as the standard material for pulp capping. Its very high pH causes superficial necrosis of the underlying pulp, but dentinal bridging occurs underneath. Concern has recently been raised that $\text{Ca}(\text{OH})_2$ is not ideal, not only because of its caustic effect but also because it interferes with the bond strength of the overlying restoration. Alternative techniques and materials, e.g. mineral trioxide aggregate, are under investigation. One disadvantage of vital procedures, whether performing a partial coronal pulpectomy or merely a pulp capping, is their higher failure rate. If the pulp were contaminated or suffering a traumatic, irreversible pulpitis, the tooth would require full root canal therapy in the future. Vitally treated teeth should be monitored for five or six years, as failures can occur long after treatment. Pulp vitality testing in animals under clinical circumstances is difficult, and radiography remains the most practical means of follow-up examination.

147 i. An immature tooth. The pulp chamber and root canal are wide and there is only a thin layer of dentin present. Tooth root development is incomplete. Tooth root length and apical closure have yet to be achieved.

ii. In this instance there is no obvious pathology. The tooth is healthy on clinical examination and the extent of tooth root development is as expected in a young cat. The incomplete root development with an open apex is often mistaken for a pathologic lesion. If this radiograph had been of a canine tooth in an adult cat, it would have represented pathology. A vital pulp is required for continued tooth root development. Consequently, injury resulting in pulpal necrosis would have stopped tooth root development and tooth maturation and an immature tooth would have been present in the mature/adult animal.

iii. If one suspects pulpal pathology, a contralateral radiograph would be indicated to determine if both teeth were at the same stage of development.

148, 149: Questions

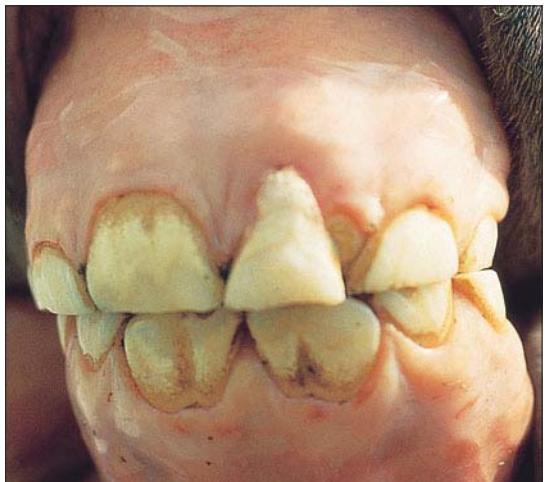


148

148 The illustration (148) shows a seven-year-old dog with a right suborbital draining sinus tract.

- i. What are the possible dental and non-dental causes of this syndrome?
- ii. What is the recommended treatment for each of the listed dental causes?

149 This is a three-year-old, Quarter Horse filly. What dental procedure is indicated from this picture (149)?



149

145

148, 149: Answers

148 i. *Dental causes:* (1) Periapical abscess of the distal, mesiobuccal, or palatal root (or a combination thereof) of the right maxillary fourth premolar. (3) Periapical abscess of the mesial root of the right maxillary first molar. (4) Periapical abscess of the distal root of the right maxillary third premolar. (5) Combined periodontal–endodontic lesion of any or all of the above three teeth.

Non-dental causes: (1) Soft-tissue fight wound abscess. (2) Foreign-body abscess, such as a gunshot wound or wood impaction. (3) Maxillary fracture and bone sequestration. (4) Nasal or maxillary neoplasia.

ii. Causes 1–3. Standard endodontic treatment of teeth affected with periapical abscess is indicated, if the teeth are solid and tooth root(s) are not fractured. This procedure may need to be performed in conjunction with surgical endodontic treatment in one or two stages, depending on the severity and chronicity of the infection. If the tooth or teeth are not salvageable, extraction is indicated along with appropriate débridement, irrigation, and closure of the socket. If only standard root canal therapy is performed, the draining wound should also be treated and the client advised that subsequent surgical root canal therapy may be required. If the sinus tract is secondary to failed standard root canal therapy, either the tooth should be reinstrumented or surgical endodontics performed, or both. An alternative is extraction of the tooth, débridement of the socket and the sinus tract, and closure of the extraction site.

In small animal dentistry, surgical endodontic treatment is necessary in a very small percent of endodontic cases and is most commonly needed in patients with recurrent periapical pathology. Typically, the swellings might recur at two- to three-month intervals following therapy with oral antibiotics. In a retrospective study of 257 root canal treatments on dogs, only 1.5% required surgical endodontic treatment. Indications for surgical root canal therapy include failure of standard root canal therapy to resolve periapical abscessation and intraoperative complications of standard root canal therapy. Cause 4. If a periodontal–endodontic lesion exists, the tooth or teeth must be treated for both periodontal and endodontic disease in order to achieve a successful, stable condition. The prognosis is much worse if the tooth is mobile, in which case extraction should be considered.

149 The left maxillary first incisor is a persistent deciduous tooth and should be extracted. A persistent deciduous incisor should be extracted if any of the following conditions are present: (1) The contralateral incisor is permanent and in wear. (2) The opposing incisor is permanent and in wear. (3) The permanent incisor has erupted behind the deciduous incisor.

In this case, all three conditions are present. The deciduous tooth can be extracted by elevation or luxation. The mesial aspect of the second incisor should be rasped off, creating an opening so the permanent incisor can move facially, creating good occlusion.

It is also common for a fragment of an unexfoliated deciduous crown or root to remain in place. The fragment may be removed by making an incision over it, elevating the gingiva off the fragment, and then elevating under the fragment. Frayed gingival edges should be trimmed.

150, 151: Questions

150 How are impression materials classified? Give a concise, systematic classification of the various materials.



151a



151b

- 151 i. Seen here are two examples of what condition in the dog (151a, b)?
ii. Where else in the oral cavity may lesions of similar origin be found?
iii. What is the recommended treatment?

150, 151: Answers

150 There are several ways by which impression materials can be classified. One way is to classify them according to whether the hardening process is reversible or irreversible, or chemically or temperature-induced, and whether the resulting product is elastic or inelastic. The inelastic materials are rarely used as impression materials in veterinary dentistry, except for bite registration.

	<i>Rigid (inelastic)</i>	<i>Elastic</i>
Set by chemical reaction (irreversible)	Plaster Zinc oxide	Irreversible hydrocolloids (alginates) Non-aqueous elastomers
Set by temperature change (reversible)	Wax	Reversible hydrocolloids

The elastic impression materials include the irreversible hydrocolloids, better known as the alginates, which are commonly used in veterinary dentistry. The reversible hydrocolloids are commonly briefly referred to as hydrocolloids. They are rarely used in veterinary dentistry. The non-aqueous elastomers are rubber-like materials. They are further classified as follows:

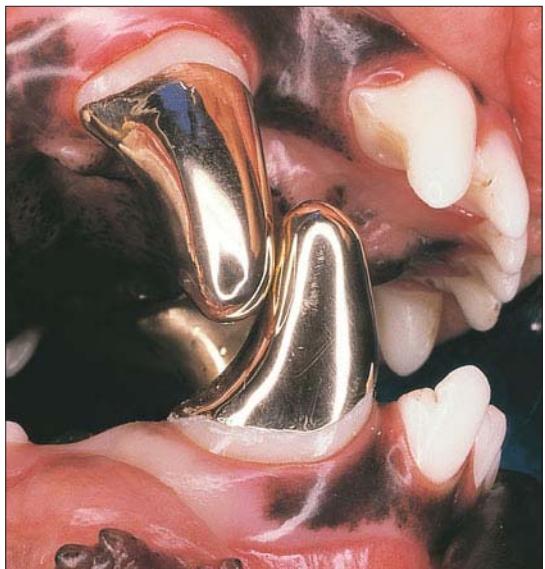
<i>Types of non-aqueous elastomers</i>	<i>Comments</i>
Polyether	e.g. Impregum-F® (Espe America)
Polysulfide	Also known as rubber-based materials
Condensation polymerizing silicone	Largely replaced by the addition polymerizing silicones
Addition polymerizing silicone	Better known as vinyl polysiloxane, e.g. Express™ (3M™), President (Coltène/Whaledent), Reprosil® (Caulk)
Light-cured elastomers	Single-component light-activated, used with transparent trays

Vinyl polysiloxane materials are commonly used in veterinary dentistry. They are generally available in three viscosities: heavy body or putty; regular body or medium viscosity; and light body, low viscosity or 'wash'.

- 151 i. These are examples of labial and buccal mucosal hyperplasia of self-inflicted, traumatic origin, commonly known as 'gum-chewing lesions'. Originally described in small, excessively barking dog breeds, it may be found in other breeds, as well as in cats.
ii. Excessive loose mucosal folds and indurated hyperplastic mucosa may also be found sublingually.
iii. Surgical excision is indicated in selected cases. Resected tissue should be submitted for histopathologic examination to confirm the diagnosis and exclude neoplasia.

152, 153: Questions

152 A prosthetic crown is a restoration which replaces a part of the natural crown. What are the indications to perform a crown prosthesis in the dog?



152



153

- 153 i. What technical errors caused by incorrect positioning can be seen on this radiograph (153)?
ii. Explain how the tooth length can appear incorrect on the radiograph.
iii. Describe a technique for obtaining a better image of the two mesial roots of the maxillary fourth premolar.

152, 153: Answers

152 The main general indications for prosthetic crowns are fractured teeth, extensively decayed teeth, or teeth that cannot withstand normal attrition. The dentition of domestic dogs (and cats) maintains its function even if parts of the dentition are missing or not functional. A crown fracture with pulp exposure requires endodontic treatment but prosthodontic build-up of the crown is optional. The role of a prosthetic crown in the restoration of the normal gingival contour was discussed in 43.

Fractured teeth should be restored if they are important to the normal function of a working dog. In working dogs, reduced crown height often leads to a diminished biting ability and to a functional handicap. A canine tooth that is shorter than normal, however, does not always cause problems in a working dog. If the remaining coronal portion of the tooth is healthy and long enough, and the dog is functioning well during training, crowning is not essential. However, there will always be a risk of repeated fracture of that canine tooth or fracture of one of the other canine teeth because the normal balance of the biting grip with four canine teeth has been lost. Furthermore, the exposed dentin will easily and more rapidly wear down.

Another indication for a prosthetic crown is to prevent further breakdown of the remaining tooth structure to prevent coronal fracture, for example: (1) in cage-biting dogs with worn canine teeth on the distal aspect (cage-biter syndrome); (2) in dogs with severely abraded teeth caused by destructive behavior like chewing on rocks or fences; and (3) in dogs with very extensive caries, severe pitting, or hypoplasia of the dental hard tissue.

Show dogs with a missing tooth do not need a prosthetic device for dental function. However, applying a prosthetic crown creates a normal esthetic appearance.

153 i. The main error seen here is elongation. In addition, superimposition of the two mesial roots of the maxillary fourth premolar is evident, which is the normal result of the standard lateral view of the maxillary fourth premolar. Some cone-cutting has occurred on the mesial aspect of the film, because the X-ray cone was not centered on the film.

ii. Foreshortening or elongation occurs if the X-ray beam is not perpendicular to the bisecting angle plane. Foreshortening of the film image may result if the X-ray beam is directed too steep, or more perpendicular to the plane of the film, similar to the shadow effect of midday sun on a tree. Elongation of the film image results if the X-ray beam is directed too low, or more perpendicular to the long axis of the tooth, creating the shadow effect of early morning or late afternoon sun on a tree.

iii. The standard lateral view of the maxillary fourth premolar results in an image with the two mesial roots superimposed. In order to separate these two roots, an additional, slightly oblique view is indicated. ‘SLOB’ is an acronym for Same/Lingual – Opposite/Buccal and refers to the direction of the incoming X-ray beam as an aid in identification of roots of multirooted teeth. The root on the radiograph closest to the incoming X-ray beam is the more lingual (palatal) root. When the radiograph is taken with the X-ray beam directed slightly from caudally, the mesiopalatal root will be projected distally to the mesiobuccal root.

154, 155: Questions

154 i. Why is an impression tray used (154)?

ii. What are the important characteristics of impression trays?



154



155a

155 Diagnosis of dental problems in rabbits and rodents is difficult due to the behavior of the patient, and size and anatomy of the region of interest making examination difficult.

i. Radiography is especially useful for investigation of suspected and known dental disease in rabbits and rodents. Which radiographic views are most useful?

ii. What type of radiographic film should be used, and why?

iii. What obvious lesions are shown on this lateral radiograph of a rabbit with dental disease (155a)?

151

154, 155: Answers

154 i. An impression tray is used to prevent distortion while taking the impression and when pouring the stone model.

ii. The most important characteristic of an impression tray is that the tray must be tri-dimensionally stable. If the tray is not rigid enough, the hydraulic pressure will displace the tray; when the impression is removed, the memory of the tray will rebound to its original dimension, making the impression smaller than the actual teeth. A proper fit should be ensured. The tray should have sufficient depth to allow impressions of the full length of the canine teeth, and large enough to perform full-mouth impressions without the tray contacting the teeth. A perforated tray is used for alginate while a solid tray combined with tray adhesive is used for other impression materials.

155 i. In the majority of cases a combination of lateral, dorsoventral, and rostrocaudal radiographic views of the head are most useful. In some cases, intraoral and oblique views are also helpful.

ii. Non-screen or dental film is most appropriate for radiography of the dentition as very high definition is required to show the necessary fine detail. Cassette film with high-definition screens may give reasonable results when examining large rabbits but does not give high enough definition to make out the finest detail.

iii. (1) This lateral radiograph shows that the rabbit has relative mandibular prognathism resulting in malocclusion and abnormal wear of the incisor teeth. (2) Abnormal functional forces are affecting the mandibular incisors tipping them ventrally, opening the periodontal space on the dorsal aspect of their roots. (3) The same forces are interfering with the eruption of the maxillary first incisors so their roots are elongating with the periapical tissues starting to perforate the palatal cortex of the incisive bones. (4) There is significant thinning of the cortical bone and distortion of the ventral mandibular border where the elongated premolar and first molar tooth roots are elongating. This was palpable in the conscious animal. (5) There is increased radiolucency around the imperfectly superimposed root apices of the mandibular second molar teeth. (6) The cheek tooth occlusal line is very irregular with obviously overgrown crowns on the mandibular premolars with reduction of the crown height of the opposing teeth. (7) At least one of the roots of the third maxillary premolar teeth has perforated its supporting bony alveolar bulla.

Compare the radiographic features with those seen on the prepared skull from this rabbit (155b). A piece of blue nylon thread has been placed in the lacrimal canal to show its position. The roots of the first two maxillary premolars are perforating through the maxillary zygomatic process. Also the roots of the next three teeth have all penetrated through the alveolar bulla in the orbit.



155b

156–158: Questions

156 This is a late two-year-old horse (156). What corrective dental procedures are indicated?



156

157 How does dietary texture affect the development of periodontal disease in the dog and cat (157)?

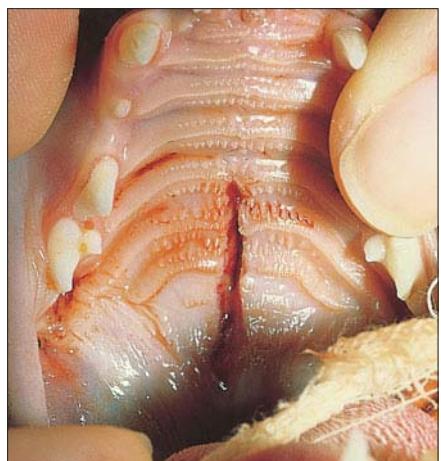


157

158 i. This is an example of a traumatic condition, commonly seen in the cat (158). What is it, and what syndrome can it be part of?

ii. What are the other possible maxillo-facial components of this syndrome?

iii. What are the treatment options for this specific injury?



158

153

156–158: Answers

156 A second premolar cap (persistent deciduous second premolar) is present, as well as a wolf tooth (first premolar). The cap should be extracted as there is a clean demarcation between the deciduous and permanent teeth. The cap is grasped with a dental forceps and rolled lingually. If any root speckles are broken off, they will be on the lingual side where the horse might work them out with its tongue. A good guideline for eruption of the premolars is: *Second premolars*: 2 years, 8 months. *Third premolars*: 2 years, 10 months. *Fourth premolars*: 3 years, 8 months.

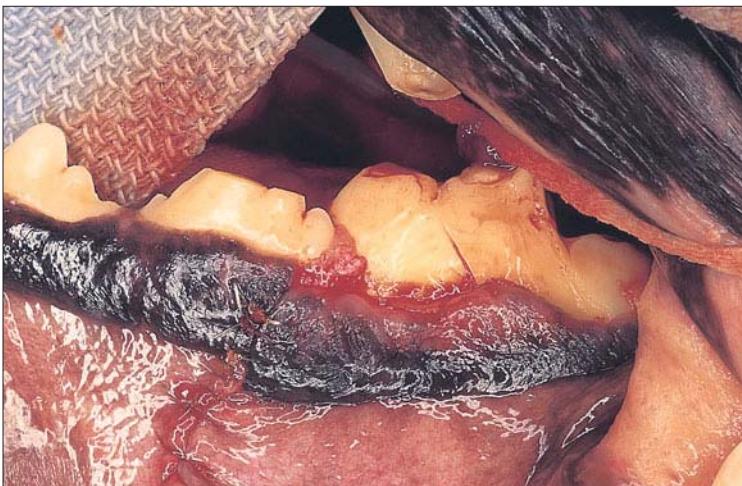
The wolf tooth should be extracted as some wolf teeth do cause problems with a bit, and the second premolar cannot be properly beveled back, rounded, and smoothed (bit seat) with the wolf tooth present.

157 A number of studies have provided evidence of an interaction between dietary texture and oral hygiene in dogs and cats. The evidence in dogs suggests that soft foods generally result in greater plaque and calculus accumulation than hard diets. However, even on hard diets, periodontal disease is evident. In cats, there is some contradiction between studies. In one study, cats developed little, if any, gingivitis or calculus if started at an early age on dry foods. In contrast, another study, feeding a dry food compared with other diets was shown to retard calculus accumulation in four of six teeth examined, but was associated with lower gingival inflammation for only one tooth. A 12-month study showed that the rate of calculus accumulation was greatest during the first three months, irrespective of whether a dry or a wet food was fed. However, by 12 months the overall accumulation of calculus was higher for wet foods. Further research is required to evaluate the effect of dietary texture on the development and progression of periodontal disease.

158 i. A traumatic cleft of the hard palate, which can be part of the so-called high-rise syndrome. This syndrome describes the injuries sustained, mainly by cats, falling at least two stories. Contrary to dogs, the survival rate in cats is high under such circumstances. A cat usually falls in a splayed-leg position and lands on all four limbs; the head then bounces against the landing surface.

ii. (1) Soft tissue facial abrasions; avulsion of the lower lip. (2) Dental fractures. (3) Mandibular fractures, in particular mandibular symphysis separation. (4) Temporo-mandibular joint luxation and fracture of the condyloid process (see 83).

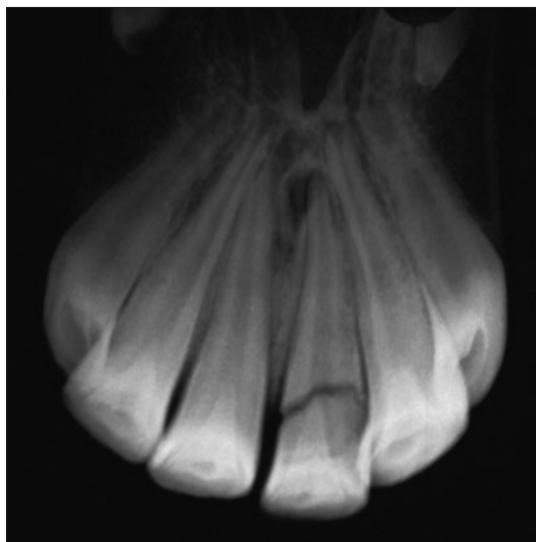
iii. Traumatic cleft of the hard palate in the cat can easily and effectively be managed by approximating the displaced bony structures by gentle digital pressure, followed by suturing of the torn palatal soft tissues in a simple interrupted pattern. Flushing and suctioning the nasal cavity is indicated if large blood clots are present, which may have a marked beneficial effect on the habitus and appetite of the patient. The benefit of this initial management outweighs the risk inherent in leaving this injury to heal by second intention, although this has been shown to be sufficient in most cases. However, occasionally this healing does not take place and a persistent oronasal fistula results; the latter condition is far more difficult to manage.



159

- 159 i. Identify the periodontal surgical technique demonstrated here (159).
ii. What are the indications for periodontal flap surgery?

160 The radiograph shows a fractured maxillary second incisor in a horse (160). What is the treatment of choice?



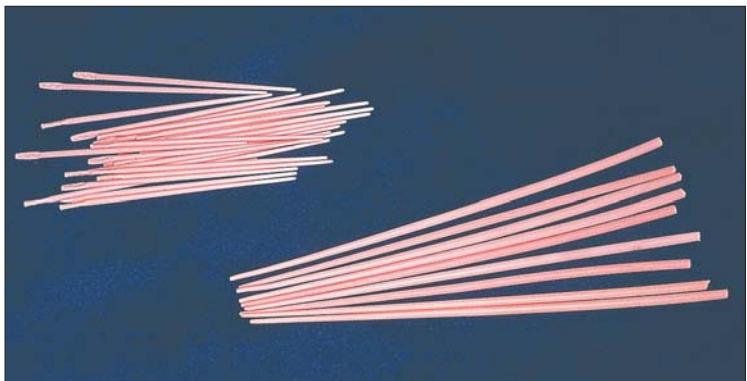
160

- 161 i. What is the purpose of dental charting?
ii. What are two general methods of demonstrating dental and soft tissue changes?

159–161: Answers

- 159 i.** This is a periodontal flap.
- ii. The primary indication is the presence of advanced periodontitis with deep infrabony pockets which are not fully accessible by a closed approach. Periodontal flap surgery improves the access to deep pockets and allows better visualization and therefore a greater cleanliness of the root surfaces. Secondarily, flap surgery is used as an approach for bone grafting and guided-tissue regeneration. Flaps are also indicated for the elimination of pockets through recontouring or removal of soft or hard tissue – often called ‘resective therapy’. Flap surgery can also be used to reposition attached gingiva and correct mucogingival defects. Root coverage, increasing the amount of keratinized mucosa, and ridge augmentation fall under this category. Revision of tissue contour for better hygiene is possible with flap surgery. These techniques can be used to improve the environment for restorative or prosthetic treatment – such as in crown lengthening. Gingival or periodontal abscesses can be drained or definitively treated with flaps. Flaps may also be indicated to access a biopsy site.
- 160** The recommended treatment includes removal of the coronal fragment, endodontic therapy, smoothing of the sharp edges, and filling with a suitable restorative. The treatment objective is to keep the root remnant in place for a long enough period so that it will slowly grow out of the socket, but prevent lateral drifting and tilting of the adjacent teeth, providing an acceptable incisor occlusion requiring little aftercare. An apicoectomy is not necessary, since the ‘osteolytic process’ visible is not a pathologic phenomenon but the projection of the incisive canal, a normal anatomic structure.
- 161 i.** Dental charting is done to create a written record of the condition of the animal’s mouth. If a thorough charting is done each time the animal is presented for dental treatment, progression or improvement of periodontal health status can be evaluated along with tooth position, hard tissue changes such as caries, resorptive lesions, crown fractures, or wear. Soft tissue changes, such as swelling, gingival recession or hyperplasia, inflammation or ulceration, are also noted on the chart. Dental treatments such as extractions, endodontic treatment, restorations, root planing, or periodontal surgery can also be noted on the chart for quick reference. Using an anatomic dental chart gives a readily visible summary of what is happening in the mouth without having to read through a mass of written record notations. Various printed stick-on anatomic dental charts are available.
- ii. Anatomic dental charts can be recorded using symbols or letter codes to note tooth abnormalities and periodontal status including pocket depth, calculus deposits, degree of gingivitis, recession or hyperplasia, mobility, and furcation involvement. Therapeutic procedures can also be noted with either method. A key for symbols or letter abbreviations should be available for easy interpretation. Care must be taken to record the changes on the correct side of the chart corresponding to the appropriate side of the animal’s mouth. Most anatomic dental charts portray the left side of the mouth on the right side of the chart and the right side of the animal’s mouth on the left. With consistent use of these charts and symbols or letter codes, oral charting can be done accurately and efficiently.

162, 163: Questions



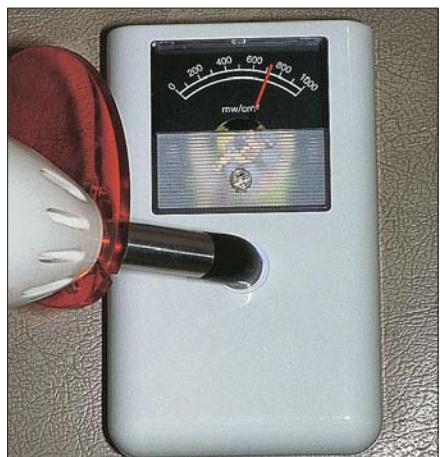
162

162 Shown here are various sizes of gutta-percha points (162).

- What is gutta-percha?
- For what purpose is it used in veterinary dentistry, and what are its main advantages?
- Are there other dental uses for gutta-percha?

163 This photograph shows an instrument being used with the light-cure unit (163).

- Name this device, and describe its function.
- Why is this important?
- Briefly describe the photo-initiated polymerization process.



163

162, 163: Answers

- 162 i.** Gutta-percha is an inert, flexible material harvested from the maser wood tree and is more commonly used in the softened b-form, which is more flexible and less brittle than the natural a-form. Distributed to the clinician in the b-form, the material transforms to the less flexible and more brittle a-form as its shelf-life expires. Today, most gutta-percha used is actually gutta-bullata, which is harvested from a different species of tree. It has better properties and is more readily available. Gutta-percha points, as either product are commonly called, are only 15–22% gutta-percha. Gutta-percha points consist of 56–79% zinc oxide, the remainder of the material comprising metal sulfides, wax, and resins. Standardized (ISO) gutta-percha points, like absorbent points, are supplied in sizes 15 to 80, and in lengths of 30 mm and 55 mm to correspond to standardized file sizes.
- ii.** Gutta-percha is the most popular endodontic core-filling material used. It is non-irritating to the periapical tissues. Gutta-percha is highly compactable and adapts well to the shape of the prepared root canal by lateral and vertical condensation. It is physico-chemically stable and does not shrink.
- iii.** Gutta-percha is radiopaque and can be used as a marker in draining tracts. It also serves conveniently to help clinicians to identify visually the root canal during apicoectomy procedures.

- 163 i.** The device is a radiometer. It measures the output in mW of light in the active range between 400 and 500 nm.
- ii.** A minimum power output of $>300 \text{ mW cm}^{-2}$ is recommended for activating light-cured composites. Many of the modern curing units emit $500\text{--}1000 \text{ mW cm}^{-2}$ power when new. A reduction in light emission of only 10% can significantly reduce the depth of cure of some composites. In a poorly polymerized light-cure restoration, the resin in contact with the dentin contains a higher proportion of unreacted monomer. A number of factors can act to decrease the curing light output, including: (1) degradation of the light filter (which selects out light in the infrared and visible wavelengths above 500 nm and UV light with wavelengths shorter than 400 nm); (2) weakening of the light bulb output over time (bulb degradation); (3) fractured fibers in units using flexible fiber-optic bundles; and (4) contamination of the light wand tip with composite resin or other debris. When choosing a light-cure gun, it is recommended to check the output power in the active range. Fiber-optic lines allow a lighter activating wand but may attenuate the light slightly, and fibers can fracture with rough handling. Liquid light transfer lines alleviate the problem with fiber bundles but can be costly.
- iii.** Free radicals are produced when an initiator molecule, after absorbing energy from the visible-light source (predominantly at 470 nm), reacts with an amine activator. The free radicals initiate the polymerization reaction, which begins at the surface towards the curing unit and progresses to the deeper regions.

164, 165: Questions

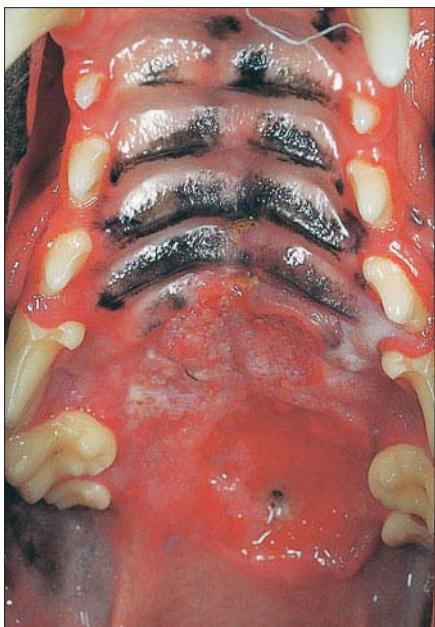


164

164 Dental plaque (164) is made of bacteria.

- i. What is the sequence of events leading to the formation of dental plaque?
- ii. Is dental plaque unique?
- iii. What is the bacterial composition of plaque, and how does it change with disease?

165 This nine-year-old dog was referred for treatment of suspected chronic stomatitis and an oronasal fistula (165). Multiple courses of antibiotic treatment, oral rinses, and corticosteroids had not been successful in resolving the problem. What course of action is indicated?



165

164, 165: Answers

- 164 i. The oral cavity is colonized by bacteria soon after birth. After tooth eruption, the tooth surface and the dentogingival sulcus constitute new ecological niches. The tooth surface is covered by an acellular organic film of salivary origin, the dental pellicle. Salivary proteins are adsorbed onto the hydroxyapatite of the tooth surface. Initial plaque formation begins with fixation of bacteria on the pellicle. Not all bacteria are able to attach to the tooth surface. Initial colonization is due to specific bacteria (*Streptococcus sanguis*, *Actinomyces* sp.) that can both attach to the tooth surface and provide attachment to other bacteria. Multiplication of attached bacteria and fixation of new bacteria provide initial growth. Co-aggregation reactions between initial bacteria and other bacteria (that are unable to attach to tooth surfaces) provide further growth of the dental plaque. Such a co-aggregation reaction between a filamentous bacteria and cocci is termed ‘corn-cob’ because of its appearance.
- ii. There is not one dental plaque but different dental plaques that differ according to their ecological niche (smooth surface, pits and fissures, gingival sulcus, etc.). Hence, *Streptococcus mutans*, which is responsible for caries and represents only 1% of the salivary flora, is not a predominant bacteria in supra- or subgingival plaque, but represents 25% of the flora in an occlusal fissure. Physicochemical conditions on the tooth surface and in the gingival sulcus or in the periodontal pocket are not the same; subsequently, supragingival plaque and subgingival plaque differ.
- iii. Dental plaque is composed of aerobic, facultative, and anaerobic species. With the development and worsening of periodontal disease, subgingival plaque composition changes from aerobic, Gram-positive, non-motile species to anaerobic, motile, Gram-negative species. With periodontitis, anaerobes represent 80–90% of subgingival plaque. Most commonly recognized periodontopathogens in dogs and cats include *Porphyromonas* spp., *Prevotella* spp., *Peptostreptococcus* spp., and Spirochetes.

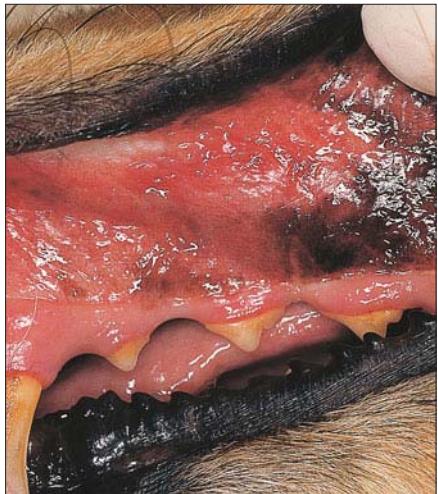
165 A complete physical examination should be performed and a minimal database established. An examination under general anesthesia can then be performed. Careful probing and intraoral radiographs are indicated to determine the extent of the bony defect underlying the oronasal fistula and to establish whether any nasal pathology is present. Other advanced diagnostic imaging techniques (e.g. CT) may be useful if available. The most important diagnostic procedure includes taking one or more incisional biopsies of representative areas of the ulcerated tissue. Palpation and fine-needle aspirate of the regional lymph nodes (the mandibular lymph node in particular) is also indicated. Exfoliative cytology may be useful, but probably not bacteriologic examination, though this can be performed for the sake of academic completeness.

Multiple biopsies of this case were diagnosed as squamous cell carcinoma with ulceration and deep infiltration. Given the extent and the diffuse nature of the disease, euthanasia was advised. This case illustrates the wide spectrum of clinical presentation of oral squamous cell carcinoma (see 127). Both in the dog and cat, chronic ulcerative lesions should always be biopsied to exclude the possibility of squamous cell carcinoma. However, care should be taken in reading out biopsies of chronic stomatitis as epithelial hyperplasia and metaplasia associated with the latter condition may be over-interpreted and confused with neoplasia.

166, 167: Questions

166 This ten-year old, spayed female Collie (166) has a serum urea nitrogen of 70.3 mmol l^{-1} (99 mg dl^{-1}) and creatinine of 885 mmol l^{-1} (10 mg dl^{-1}).

- i. What is the diagnosis?
- ii. What factors are responsible for the oral changes in this patient?
- iii. What treatment would be beneficial for this patient?



166

167 Following root canal treatment on this incisor (167), which restorative material would you choose to restore the access site, and why? What are the important characteristics of this material?



167

166, 167: Answers

166 i. Uremic stomatitis. The uremic patient also has signs of systemic disease. Clinical signs associated with uremia may include depression, lethargy, halitosis ('uremic breath'), loss of appetite, weight loss, vomiting, diarrhea, and oral ulceration. Diagnostic evaluation of the uremic patient will indicate significant elevation of the serum creatinine, urea nitrogen, and phosphorus. Uremia may be secondary to postrenal disorders or renal failure (acute or chronic) with chronic renal failure the most common cause of 'uremic stomatitis'.

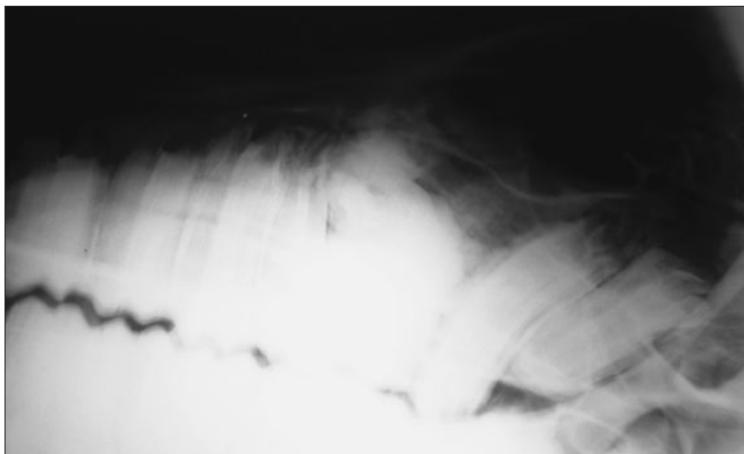
ii. Irritation of soft tissues from ammonia produced by degradation of urea by urease-producing oral bacteria; uremic vasculitis and thrombosis resulting in necrosis and sloughing of the rostral tongue; alterations of the immune response secondary to uremia.

iii. Treatment of the primary renal or postrenal problem causing the uremia should be the major focus. Decreasing the blood urea nitrogen level will decrease the urea in saliva and gingival crevicular fluid available for ammonia production. Topical or systemic treatment to decrease oral urease-producing bacteria will decrease ammonia production. Oral pain is a significant problem in some patients and the topical application of lidocaine gel or a sucralfate paste may help to alleviate the oral pain.

167 A composite restoration would provide the best esthetics with the least amount of tooth loss. The polymerization of composites can be either chemically activated (auto-cure), visible-light activated (light-cure), or dual activated (dual-cure). Advantages of chemically activated composites include: (1) no need for a curing light; (2) polymerization shrinkage is uniform throughout the mass, thus decreasing the tendency of the restoration to pull away from the bonded surface; and (3) polymerization is slower, thus decreasing the forces placed on the bonded surface. Advantages of the light-activated composites include: (1) longer working time, with polymerization initiated when the operator is ready; and (2) faster cure for immediate finishing.

The word 'composite' describes a material which has two constituents which are insoluble in each with a definite interface between them. Composites contain an organic resin matrix, an inorganic filler, and a coupling agent that bonds the two together. Composites with higher amounts of filler have superior physical and mechanical properties. Traditional or macrofilled composites have filler particles of 8–100 mm and a filler loading of 60–70% by volume. Microfilled composites have smaller particles (0.02–0.04 mm) with a load of 20–55% by volume. The lower fill load gives the composite less strength, but it can be polished to the smoothest surface. Small-particle composites were developed with a particle size of 1–5 mm and a 65–77% fill in an attempt to keep a smooth, highly polishable surface but achieve the best physical and chemical properties. The newest category of composites is the hybrids, with 60–65% filler load of a broad range of particle size (0.06–1.0 mm average size). This gives the hybrids a surface which rivals the polishability and smoothness of the microfilled composites, and physical properties almost as good as the small particle composites. One might choose a small particle or hybrid composite for this lesion. An even more polishable surface could be achieved by using a microfilled composite for the final surface layer.

168, 169: Questions



168

168 This lateral-oblique radiograph of the maxillary cheek teeth and paranasal sinuses was made from a five-year-old Thoroughbred mare presented with a persistent putrid unilateral nasal discharge (168). Identify five dental abnormalities shown on the radiograph.



169

169 List and describe the handpieces and types of burs pictured here from left to right (169).

168, 169: Answers

168 (1) A supernumerary third cheek tooth (CT3) which is slightly displaced mesially. (2) A grossly deformed CT4. There is a marked bony proliferation between this tooth and CT3 which is so severe that it could represent a developmental anomaly rather than an inflammatory reaction. (3) A diastema between CT4 and CT5 which has led to the passage of food into the maxillary sinuses. This latter is seen as a granular density in the floor of the sinus airspace. (4) An overgrown CT5. (5) An impacted CT6. This tooth should have erupted and be in wear in a mare of this age, but the roots show the characteristic buckling associated with an obstructed eruption pathway.

The management of such an array of dental disease represents a major challenge. Treatment would necessitate a facial flap for extraction of the deformed CT4 as well as the supernumerary CT3. This would create a large oronasal fistula which might well be slow to heal once the sinus suppuration had been eliminated. The overgrown CT5 should be reduced into line with the other teeth in the arcade and it would be hoped that the forward drift of this tooth would allow CT6 to erupt. Supernumerary cheek teeth are not infrequently bilateral in horses so that the contralateral dental arcade should be assessed. The more common location for supernumerary cheek teeth in horses is distal to the maxillary third molar (CT6) (117).

169 (A) Low-speed handpiece: rotation speeds range from 1,000–20,000 r.p.m. The slower speed, acquired through the use of a gear-reduction turbine, provides higher torque than the high-speed handpiece. Most low-speed handpieces in veterinary dentistry do not have water flush for cooling, and it is important to remember that any cutting of dentin on a vital tooth at speeds over 3,000 r.p.m. requires water coolant to avoid pulp injury. The low-speed handpiece is used to drive prophylaxis angles for polishing teeth, finishing devices for restorative work, burs, filling spirals, drills, reamers, and cutting disks. Slow-speed handpieces also accept contra-angle attachments and HP burs. (B) HP bur (or 'HandPiece' bur) with a large shaft which fits directly into the slow-speed handpiece. Used for low-speed, high-torque cutting. (C) Prophylaxis ('prophy') angle with attached rubber polishing cup. (D) The contra-angle changes the working angle by 75° by starting with a 15° back angle before its 90° working angle, and holds latch burs and polishing mandrels for use with polishing disks. (E) RA (Right Angle) bur with a latch-type shaft, used in the contra-angle attachment. (F) Mandrel with restorative disks. (G) The gear-reduction contra-angle slows the rotation by a set ratio, i.e. 4:1 or 10:1 for use with Lentulo® paste carriers, Gates–Glidden burs, reamers, etc. (H) Lentulo® paste carrier. (I) Gates–Glidden bur. (J) High-speed handpiece turbine which rotates at 300,000–400,000 r.p.m. when not under a load. Its speed drops to 100,000 r.p.m. or less when cutting tooth. It has low torque and will completely stall if too much pressure is applied during use. The bur chuck holds the bur in the head of the handpiece. Some handpieces use a chuck key, while others have a push button feature to allow quick bur changes. Some have fiber-optic lights to add illumination directly to the bur's working site. (K) FG (Friction Grip) burs are available in regular, short shank, long shank, or surgical length (very long shank).

170 A young adult dog is presented for treatment of a fractured canine with pulp exposure; the fracture occurred while the dog was boarding at a local kennel. The owners are concerned that the tooth is painful. The dog has had a poor appetite and has been lethargic since they brought her home the previous evening. She vomited a yellow liquid this morning; this is not unusual for her after she has been boarded at a kennel. Physical examination was unremarkable except for the fractured tooth and dehydration estimated at 5%. Preanesthesia blood work findings included:

BUN 63.9 mmol/l (urea 90 mg/dl) (normal 4.3–21.3 mmol/l; urea 6–30 mg/dl)
Creatinine 265 mmol/l (3.0 mg/dl) (normal 62–115 mmol/l; 0.7–1.3 mg/dl)
Sodium 132 mmol/l (normal 145–155 mmol/l)
Chloride 98 mmol/l (normal 104–117 mmol/l)
Potassium 7.0 mmol/l (normal 4.0–5.4 mmol/l)
Total calcium 13.0 mg/dl (normal 9.8–12.8 mg/dl)
Albumin 35 g/l (normal 26–36 g/l)
Urine specific gravity 1.020

- i. What is your assessment of these laboratory data?
- ii. What other laboratory tests are indicated?



171

171 This dog was presented for treatment of periodontal disease (171). The owner's primary complaint is halitosis.

- i. What is the problem in this patient?
- ii. Which breeds are predisposed to developing this problem?
- iii. What dental disease may be associated with this problem?
- iv. What are the treatment recommendations for this problem?

170, 171: Answers

170 i. The extent of blood testing before anesthesia is dependent upon physical examination findings, historical information, preventive health care provided (e.g. heartworm prevention), and the patient's age. Lethargy and reluctance to eat are non-specific clinical signs which may result from oral disease and pain or many other diseases. Patients that have systemic signs of disease, as does this patient, should have a minimum laboratory database to include a complete blood count (CBC), renal function tests, electrolytes, liver enzymes, and urinalysis. Anesthesia and treatment of the fractured tooth should be delayed until the patient has been managed medically and is stable for anesthesia.

The abnormalities identified in this patient include azotemia, hyponatremia, hypochloridemia, hyperkalemia, and hypercalcemia. Based on the history and laboratory results, hypoadrenocorticism should be high on the differential diagnosis list. Differential diagnoses for azotemia are prerenal, renal, and/or postrenal in origin. Postrenal azotemia may be ruled out based on history and physical examination. The urine specific gravity may be helpful in differentiating renal from prerenal causes of azotemia. The urine specific gravity indicates abnormal concentrating ability in this patient; however, the ability to concentrate urine is altered in patients with hypoadrenocorticism. Hypoadrenocorticism may cause decreased renal medullary sodium concentration and therefore a decreased ability to concentrate urine. Prerenal azotemia is commonly associated with hypoadrenocorticism and should resolve with appropriate fluid therapy. Patients in which the azotemia does not resolve with appropriate fluid therapy may have concurrent acute or chronic renal damage.

ii. A CBC was performed in this patient and the lack of a stress response was consistent with a patient with hypoadrenocorticism. An ACTH-stimulation test is recommended to confirm a diagnosis of hypoadrenocorticism.

171 i. Lip fold dermatitis (pyoderma). Malodor from the mouth may be the result of halitosis secondary to oral disease or associated with skin or lip disease around the mouth.

ii. Dogs with excessive mandibular labial tissue are commonly affected and there is a breed predisposition in Cocker Spaniels, Springer Spaniels, St. Bernards, and Irish Setters. Lip fold or skin fold dermatitis may also occur following partial mandibulectomy or maxillectomy if skin or lip folds are created during wound closure.

iii. Increased plaque accumulation on teeth adjacent to the lip/skin folds may enhance the development of more severe gingivitis/periodontitis.

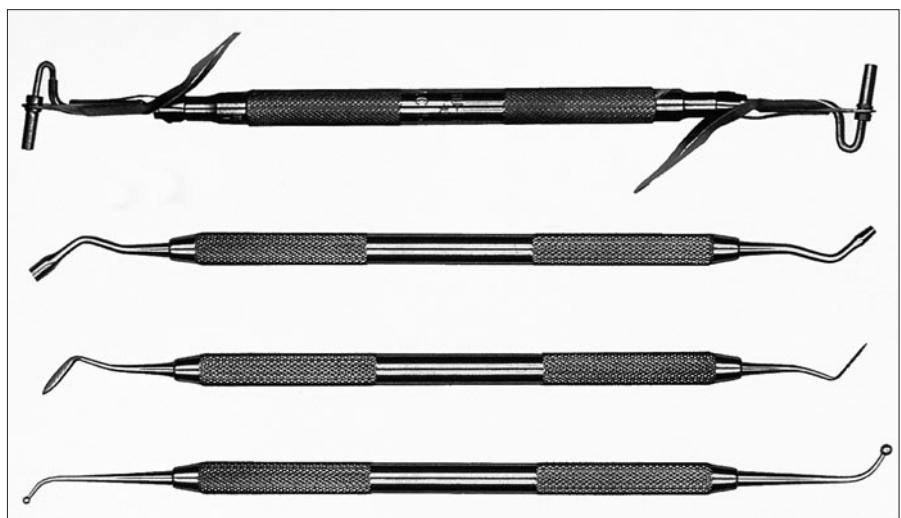
iv. Medical treatment involves twice-daily cleaning, for 10–14 days, of the area with a benzoyl peroxide shampoo, followed by drying the area (manually or with a mild astringent), and topical application of a benzoyl peroxide gel. Cases with severe inflammation may benefit from an initial few days of topical antibiotic/steroid cream or systemic anti-inflammatory/antibiotic administration. Unless surgically corrected, the dermatitis tends to become chronic. Benzoyl peroxide gel is applied as needed for prevention and is aimed at controlling the inflammation and preventing recurrences. Lip fold excision (cheiloplasty) should be considered in severe cases.

172, 173: Questions



172

172 This is the buccal view of a dog presented because of discomfort during eating (172). The owner also reports that blood is sometimes seen mixed with drooled saliva. What next steps are indicated in order to obtain a diagnosis for this dog?



173

173 These are four instruments used for placing an amalgam restoration (173).

- Identify each instrument.
- What function is each instrument used for when doing an amalgam restoration?

172, 173: Answers

172 The affected areas seen are those associated with ‘ulcerative stomatitis’. These lesions are often referred to as ‘contact ulcers’ or ‘kissing ulcers’, and are seen on areas of the oral mucosa or lateral edge of the tongue where the tissues are in contact with the plaque-laden surfaces of teeth. A thorough oral and physical examination and history are very important first steps in diagnosis. Rule in or out: systemic infection; autoimmune diseases (mucocutaneous junction lesions, or lesions generalized in the mouth, including the hard palate); cold agglutinin disease (lesions of the edges of the tongue or lips, and tips of the tail or ears); epidermal necrolysis secondary to administration of medications; access to toxins; abnormal chewing habits. Breed can be important: Maltese dogs are the classic ulcerative stomatitis breed, and King Charles Spaniels develop eosinophilic pharyngeal ulcers. Another lesion that has similar microscopic features but that occurs in a different area of the mouth is acute necrotizing ulcerative gingivitis (ANUG). In the classic ANUG case, the lesions develop along the gingival margin and affect the interdental papillae. Ulcerative stomatitis and ANUG are generally thought of as indicating a local immunopathology; unfortunately, there are no specific tests currently available that confirm the abnormality, and the dog usually is systemically healthy. Bacterial culture will yield a rich harvest, but is a waste of time as there will always be bacterial contamination of these lesions. Biopsy may be helpful, but usually is non-specific for ulcerative stomatitis – it will help to rule out autoimmune conditions. You are very unlikely to get a ‘confirmed’ diagnosis – ulcerative stomatitis is a diagnosis made by elimination and response to treatment.

173 i. These instruments are (top to bottom): amalgam carrier; amalgam condenser; amalgam carver; amalgam burnisher.

ii. An amalgam carrier is used to transport the amalgam from the amalgam well to the restorative site.

An amalgam condenser is used to compress the soft amalgam firmly into the restoration and compact it. Additional amalgam can be placed in larger restorations and condensed again until a slight overfill is created. During proper condensation the amalgam becomes very silver in color as the liquid mercury is brought to the surface during the compaction process. This compaction of the amalgam particles is what creates a strong restoration.

The amalgam carver comes in several shapes and is designed to trim away and shape excess amalgam so it is flush with the walls of the restoration. This is done immediately after the amalgam is condensed.

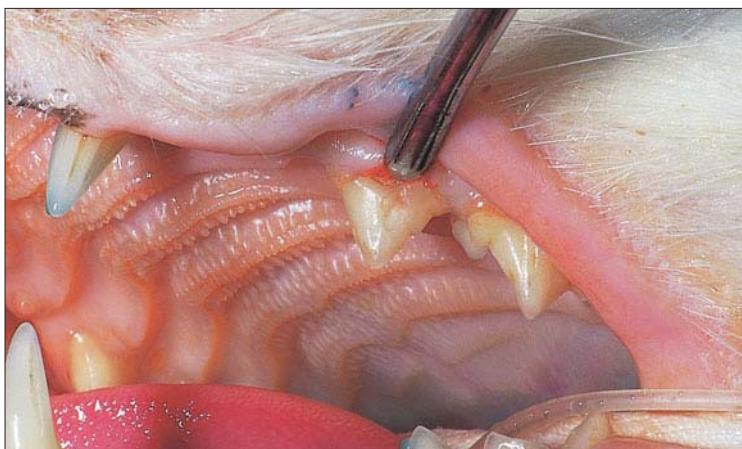
The amalgam burnisher is used to smooth the surface of the amalgam restoration just before hardening and makes the restoration more corrosion-resistant. Rubbing the surface of the amalgam creates a satiny appearance that will have some shine to it. For many amalgam products, polishing of the amalgam surface cannot be done before 24 hours, so creating a smooth surface with the burnishing is important to reduce plaque accumulation.

174, 175: Questions



174

- 174 i. What is the most likely cause of the discoloration of the teeth in this two-year-old dog (174)?
ii. Describe the development of this condition.
iii. How can the color vary in this condition?
iv. How can this condition be prevented?



175

- 175 A cat presents with a Grade-2 odontoclastic resorption lesion (175) for which, even given the poor long-term prognosis, the owner requests restoration.
i. Which restorative material would you choose, and why?
ii. Name another common use for this material when restoring endodontic access openings.

174, 175: Answers

174 i. Tetracycline staining.

ii. Tetracycline reacts with calcium to form a tetracycline–calcium orthophosphate complex. In the period of mineralization during the development of teeth, tetracycline administration can cause permanent discoloration of the hard dental tissue in the deciduous and permanent dentitions. The location of the pigmentation in the crown coincides with the part of the tooth developing at the time of administration of tetracycline. The longer the administration the wider the area affected: the discolouration may vary from diffuse bands of varying widths at different levels, to totally discolored crowns. Enamel defects have been mentioned in human literature.

iii. The color may vary from lemon-yellow (tetracycline, demeclocycline) to yellow–gray and/or brownish (chlor- and oxytetracycline). Minocycline causes a blue–grayish pigmentation. Oxytetracycline gives the least discolouration and doxycycline appears to cause very little dental discolouration. The color can change to a darker shade due to the exposure to light.

iv. Tetracyclines can cross the placenta and are excreted with the mother's milk. To prevent discolouration of the dental hard tissues the administration of tetracyclines should be avoided during pregnancy and the development of the deciduous and permanent dentitions.

175 i. A restorative glass-ionomer, or possibly a resin-modified glass-ionomer. Restoring these small teeth requires the least amount of additional tooth loss as possible. Preparing a retentive preparation for an amalgam restorative would require losing more tooth structure and would therefore be a poor choice of material. For a cervical lesion, the apical extent often lies on dentin rather than enamel. A composite may not be the ideal material either. When a composite restoration polymerizes, the micromechanical bond to etched enamel at the coronal, mesial, and distal margins is stronger than the physicochemical bond of the dentinal bonding agent at the gingival margin. Polymerization shrinkage in an axial direction then pulls restoration from the gingival margin, opening the margin and allowing leakage. Conventional glass-ionomer materials have been well accepted in the repair of cervical lesions in humans because of their prolonged fluoride release and their ability to form a chemical bond to tooth structure. They can be placed without tooth preparation other than a conditioning agent (often an acrylic acid), thereby conserving dentin. Then the tooth is rinsed and slightly dried but not desiccated. The glass-ionomer must be mixed using precise proportions, or by using premeasured capsules. It is immediately placed into the defect before it loses its shiny appearance. Glass-ionomer is sensitive both to desiccation and to water absorption while setting. Applying a coat of varnish protects it from both of these dangers.

ii. As an intermediate restorative material. Eugenol interferes with the polymerization reaction of composite materials; any root filling procedure which uses eugenol must therefore be covered with an intermediate restorative material to protect the final composite restoration. Since glass-ionomer bonds to the dentin inside the tooth, it also adds to the leak-proof seal of the restoration. When using amalgam, a glass-ionomer intermediate layer provides a firm base for condensation of the amalgam.

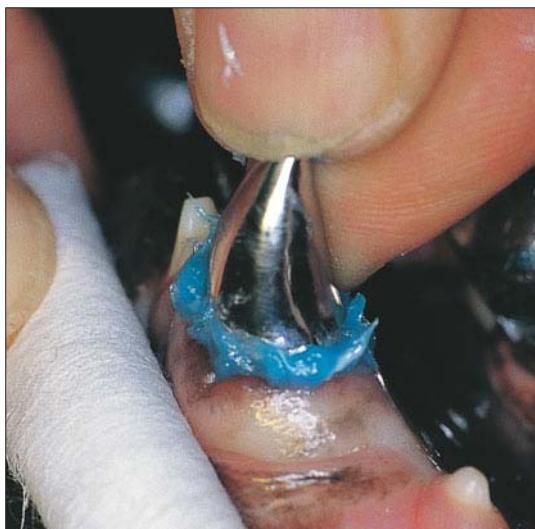


176

- i. What anatomic variation is evident on this radiograph (176)?
- ii. On which other teeth in the dog and cat is the same anomaly occasionally seen?
- iii. What is the clinical importance of this condition?

177 Metal crowns (with or without using posts or post-and-core techniques) should be cemented with a strong cement to obtain an optimal retention. Conventional cements (like zinc phosphate) have low values for tensile strength, which casts doubts on their suitability in working dogs.

- i. Which cements have more strength and should be used for cementing metal crowns on the teeth of working dogs?
- ii. One step in the cementation technique of metal crowns is shown (177). Describe the complete procedure.



177

176, 177: Answers

176 i. The mandibular first molar has a supernumerary root in the furcation area. Supernumerary roots generally present as a small third root in teeth that normally have only two roots. The most commonly affected tooth is the maxillary third premolar (see 131).

ii. Other teeth, e.g. the mandibular fourth premolar, first molar, or second molar, are rarely affected. The mandibular third molar occasionally has two roots instead of one; this is more a double formation rather than a true supernumerary root. Supernumerary roots also occur in the cat, also mainly on the maxillary third premolar. In one study, this condition was noted in 10.3% of maxillary third premolars; the size of the extra root in these teeth varied from near normal to slender. The maxillary first molar in the cat may have one or two roots.

iii. A supernumerary root may be regarded as an incidental finding in the absence of other pathology. Occasionally, the supernumerary root distorts the normal gingival contour, giving rise to periodontitis. A supernumerary root is clinically important when endodontic treatment or extraction of the tooth involved is indicated. A supernumerary root, even a small one, has a root canal which forms part of the tooth's endodontic system. Failure to recognize this anomaly when endodontic treatment is indicated, and subsequently leaving this root untreated, may result in failure of the endodontic treatment. The presence of a supernumerary root complicates an extraction procedure and the tooth needs to be sectioned accordingly. This is one reason why pre-extraction radiographs are required (see also 195).

177 i. Retention of conventional prosthetic crowns is largely dependent on the preparation design (see 218). The space between the tooth surface and the metal crown should be filled with a thin layer of cement. Adhesive bonding techniques and electrolytically etching or sandblasting of the inside of the metal crown can be used to obtain the best retention. The choice of cements used to fix metal crowns on the teeth of working dogs is of importance. Composite resin cements have recently been developed and combine a high tensile and some compressive strength. They also have the capacity to bond to tooth structure. The resin Panavia™-cement, a composite of low viscosity, was found to be effective and provided a long-term success and adequate retention of metal crowns on canine teeth in working dogs. Panavia-cement shows good biocompatibility, no detrimental effect on the pulp, and no microleakage of the crown.

ii. Before cementation the tooth should be polished, cleaned with water, and air-dried. The inside of the metal crown should be rinsed with alcohol to remove any traces of oil. After air-drying, the tooth can be etched with a 37% phosphoric acid etching gel or liquid for 30 seconds, thoroughly rinsed with water, and air-dried. The manufacturer recommends that only uncut enamel is etched. The Panavia-cement is mixed following the manufacturer's instructions. A thin layer of the cement is applied on the internal surface of the metal crown. The metal crown is seated and the excess Panavia-cement is removed. An oxygen inhibitor is applied to the margin of the metal crown to achieve isolation from air and thus to enable the cement to set completely (177). During the setting time the crown is kept under finger pressure for approximately six to seven minutes.

178, 179: Questions



178

178 i. What is abnormal about this dog's maxillary third premolar (178), and what is the clinical significance of this condition?
ii. How does this differ from deviation?

179 i. What is this piece of equipment (179)?
ii. What is the goal of periodontal débridement?
iii. How does this unit work more effectively to accomplish new ideas in periodontal débridement?



179

173

178, 179: Answers

- 178 i. This tooth is rotated. Rotation refers to the movement of the tooth about its longitudinal axis. This is commonly seen in the upper third premolars as a result of the overcrowding occurring in maxillary brachygnathia. In cases of maloclusion where the question arises whether the mandible is too long or the maxilla too short, this may be an indication of the latter. Rotation and crowding may also result in a distortion of the gingival contour, predisposing to plaque accumulation and periodontal disease.
- ii. Deviation (or *-version*) refers to the tilting of a tooth about its transverse axis. Persistent deciduous canines may cause a lingual deviation (or *linguoversion*) of the mandibular permanent canines, and a facial deviation (or *mesioversion*) of the maxillary permanent canines.

179 i. An ultrasonic scaler (Odontoson-M™, A/S L. Goof, Copenhagen, Denmark) that has a probe-like tip that is attached to a ferromagnetic rod inside a lightweight handpiece. The handpiece is attached to tubing from a beaker that delivers water or an antimicrobial solution to the handpiece via a one-way peristaltic pump that is directed at the working tip.

ii. Periodontal débridement is becoming the new term for scaling and root planing, with the emphasis on plaque and plaque by-product elimination. The goal of periodontal débridement is to establish a healthy periodontium. This is done through supragingival débridement, subgingival débridement and treatment of the gingival sulcus or periodontal pocket to remove plaque, plaque by-products, and plaque-retentive calculus. This can be done through the use of hand instrumentation and/or power scaling and irrigation.

iii. New theories in periodontal débridement are that it is more important to remove all plaque and bacterial endotoxins from the coronal surface and subgingivally. Absolute complete calculus removal may not be the most important step in periodontal treatment as periodontal tissues have been found to heal in the presence of residual calculus as long as the plaque and bacterial by-products that cause periodontal inflammation are eliminated. Cementum removal is felt to be unnecessary and undesirable.

This unit with its probe-like working tips can be effective deep down in periodontal pockets up to 12 mm. The tips are equally active on all surfaces and will eliminate plaque and bacterial by-products when any portion of the tip contacts the surface to be treated. It is excellent for closed access to narrow pockets and furcation areas. The beaker can be filled with antimicrobial solutions that will not damage the equipment to provide additional elimination of bacteria and bacterial by-products from the anti-bacterial effect, lavage, and the cavitation activity that occurs from the ultrasonic vibration to lyse bacterial cell walls. The peristaltic pump action maintains a one-way flow of the irrigation solution so there is no back flow from the handpiece into the container or tubing. With this unit there is simultaneous removal of plaque, calculus and bacterial by-products, lavage with an antimicrobial agent, and soft tissue curettage to help return the periodontium to a healthy status.



180

180 Root canal therapy of teeth with long and narrow root canals, as seen on this radiograph (180), can be difficult, but the key to success lies in the careful cleaning and shaping of the root canal system. Explain the technical principles of this aspect of root canal therapy.

181a



181b



181 An 11-year-old pony gelding is presented with a putrid nasal discharge. Could dental disease be responsible for the changes seen on the radiograph (181a) and the endoscopic view (181b) of the nasal meati?

180, 181: Answers

180 The steps of a routine root canal therapy include: (1) Access to the pulp chamber and root canal. (2) Pulpectomy or removal of the contents of the pulp chamber and the root canal space. (3) Cleaning and shaping of the canal. (4) Obturation of the canal space. (5) Restoration of the crown.

During cleaning and shaping, a number of techniques, e.g. the ‘step-back’ or the ‘crown-down procedure’, may be used to clean the walls of the canal while giving the canal a conical shape. The tips of standard (ISO) root canal files, whether K-files or Hedström files, generally increase in size through the series by 0.05 mm from 0.05 mm through 0.6 mm, then by 0.1 mm from 0.6 mm through 1.3 mm. The file width increases from the working tip by 0.02 mm per mm of file length. Other systems are available: for example, one with width sizes increasing by a constant percent (small increases for small files, larger increases for larger files) for a more gradual flare at the apex and a more rapid flare at the coronal canal, and there is a non-ISO set of files which increases the file width by 0.04 mm per 1 mm (ProFile® 0.04 taper™ Series 29®, Tulsa Dental Products, Tulsa, OK, USA) for a more rapid flare.

The goal is to shape the canal so the apex approximates the shape of standardized gutta-percha cones. The widening of the canal toward the coronal access allows the introduction of instruments to soften and condense (vertically and laterally) the gutta-percha to make room for placement of additional cones. The shape should allow a plugger or spreader to reach within a few millimeters of the apex to allow good condensation of the filling material at the apex. In a long and narrow canal, pluggers or spreaders will not reach far enough apically to condense the gutta-percha at the apex. During the filing and shaping, flushing solutions (usually H₂O₂ or various dilutions of sodium hypochlorite) are used to flush debris and dentin filings from the canal. The tip of the endodontic flushing needle should reach within 1–2 mm of the apex, since effective flushing only occurs coronally to the needle tip. Also, the canal must be wide enough to prevent binding, since a lodged needle causes the canal to become an extension of the needle, resulting in direct tissue injection of the flushing solution into the periapical tissues.

181 Yes. The changes illustrated are specific to those which arise through the extension of an infectious process from a devitalized tooth into the nasal tissues. The radiograph (181b) shows the change which is known as turbinate ‘coral’ formation or metaplastic conchal mineralization. This is invariably the result of long-term dental suppuration involving the first or second cheek teeth (second or third premolar) with extension of infection through the thin underlying bone plate into the cartilage of the dorsal and ventral conchae. Older texts refer to a condition of horses which they describe as ‘turbinate necrosis’ and it seems likely that this is the disorder to which they were referring. It is not possible to identify which tooth is degenerate on the basis of the radiograph presented here, but a lateral oblique projection confirmed a periapical reaction around the second cheek tooth. Treatment of this disorder would necessitate extraction of the diseased tooth and turbinectomy to eliminate all of the necrotic cartilage.

182, 183: Questions

182 This is a file in the access site for a standard root canal procedure of a right maxillary canine in a four-year-old domestic shorthair cat (182).

- i. Is it appropriate, in a case like this, where the crown of the maxillary canine is fractured off at a point one-third from its cusp, to use the fracture site as the access site for standard root canal procedure?
- ii. Would you expect an easier and better access to the apex if the treatment access site were closer to the gingiva and on the mesial surface of this tooth?



182

183 The use of a surgical approach can simplify and reduce the risk of complications during dental extraction. By raising a gingival or a full-thickness mucogingival flap, access to the tooth roots is improved and it becomes possible to remove some of the supporting alveolar bone to reduce mechanical root retention, easing extraction.

- i. For which teeth might an 'envelope' flap prove helpful during extraction?
- ii. Describe a triangular mucogingival flap commonly used during extraction.

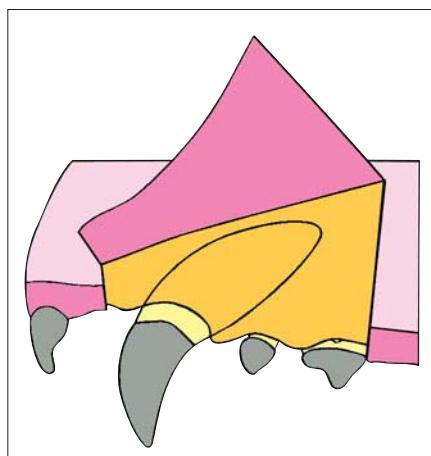
182, 183: Answers

182 i. In cats, the maxillary canine tooth is fairly straight. If the crown is fractured, access can be obtained at the fracture site. If the crown is intact, access can be made on the buccomesial aspect of the tooth, three-fourths of the distance from the gingival margin to the cusp. The more curved mandibular canine teeth of the cat should be approached in the same way as the mandibular canine teeth of dogs are approached, with access made 1–2 mm from the gingival margin on the mesial surface to the tooth.

ii. The access would be more difficult if the site was closer to the gingiva in this case, as it would have to be more oblique. An obliquely directed access would result also in removing more tooth structure than desirable and in weakening this small tooth inappropriately.

183 i. An envelope flap is made by incising through the gingival sulcus, dentogingival fibers, and interproximal gingiva of adjacent teeth, then raising the attached gingiva from the underlying alveolar bone to create a flap that does not extend beyond the mucogingival line. These flaps do not have additional releasing incisions as used in triangular and pedicle flaps. An envelope flap can be used to improve access to and visualization of the tooth root and periodontal space of most teeth, thus assisting with instrument placement (luxators and/or elevators) during extraction, or periodontal therapy (curettes). It also exposes the furcation of multirooted teeth, thereby facilitating sectioning.

ii. A triangular access flap is commonly used for the extraction of maxillary canine teeth. The releasing incision in this case will start in the diastema between the third incisor and canine, the incision being made down onto the underlying crestal alveolar bone. The incision extends around the gingival sulcus of the canine tooth, continuing interproximally to, and around, the first premolar, then the full length of the second premolar following the gingival sulcus of each tooth. A second incision is made perpendicular to the first, extending from the distal aspect of the second premolar through the gingiva and oral mucosa to just above the level of the canine tooth root apex. The gingiva and periosteum are then elevated along the length of the flap so that it can be folded back to expose the bone overlaying the canine tooth root. In some cases a second, smaller perpendicular releasing incision is required at the mesial end of the flap to further improve access (183).



183

184–186: Questions

184 With regard to 183, are pedicle flaps useful during extraction of teeth?

185 This nine-year-old Quarter horse mare was presented with progressive weight loss (185).

- i. What dental problem is visible?
- ii. Name the commonly used techniques for correcting this problem.



185

186 When repairing mandibular and maxillary fractures in the dog and cat, how can an adequate airway for anesthesia, good surgical exposure, and the opportunity to check the occlusion intraoperatively be achieved?

184–186: Answers

184 The flap shown in 183 showing access to the canine tooth root, is a pedicle flap with sides of uneven length. Pedicle flaps can be created to accommodate almost any tooth or group of teeth by making releasing incisions at either end of an envelope flap, then extending the gingival and periosteal elevation, usually creating a mucogingival flap. The periosteum on the under surface of full-thickness mucogingival flaps is inelastic. By incising through the periosteum without damaging the under-surface of the mucosa, it is possible to produce a much more mobile tissue flap which can be advanced over tissue defects such as oronasal fistulas. The most important aspect of flap closure is first, to avoid any tension on the closure, and second, to avoid having unsupported suture lines. Whenever possible the suture line should be over healthy bone or soft tissue, not over a void.

185 i. A long right maxillary second premolar hook is present that has penetrated the gingiva and is rubbing on the mandible. The left maxillary second premolar has a similar hook. The mandibular third molars should always be examined for the presence of hooks or ramps, especially when the mesial portion of the maxillary second premolars are not in occlusion, as the distal portion of the mandibular third molars may not be in occlusion, also resulting in hook or ramp formation. This horse was only nine years old but had four places where tall/long parts of teeth were traumatizing the gingiva and rubbing on bone.

ii. There are many techniques for removing tall/long hooks. Molar cutters, Dremel™-type instruments with burrs, chisels, and floats may be used to reduce the tall areas.

186 Passing the endotracheal tube through a pharyngotomy incision satisfies all requirements (186). The importance of checking the occlusion during surgical repair of mandibular and maxillary fractures cannot be overemphasized. The presence of an oral endotracheal tube makes this impossible. However, intubation with a cuffed endotracheal tube to prevent aspiration is highly recommended during any oral surgery. Care should be taken to use a wire-reinforced endotracheal tube, to prevent collapse of the tube when bent. An additional advantage of a pharyngotomy is that the same opening may be used postoperatively for a gastroesophageal tube for nutritional support. Contrary to tracheotomy, pharyngotomy is a safe and easy procedure.



186

187–189: Questions

187 This patient is a working dog that requires the use of its canine teeth, with as much coronal height as possible (187). What technique would be indicated?

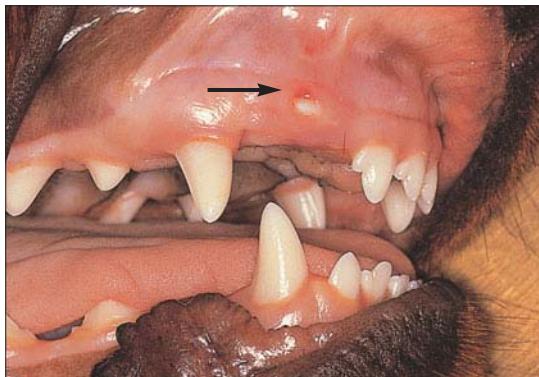


187

188 In a rabbit presenting with malocclusion, the appropriate treatment plan can only be formulated once a thorough investigation has been undertaken (see 140 and 210). It is inappropriate to treat an obvious incisor malocclusion without checking the rest of the dentition. Even in cases with known traumatic causation (e.g. fracture of an incisor tooth) there can be unrelated jaw length or cheek tooth abnormalities.

- What is the appropriate treatment for a supragingival fracture of an incisor tooth in an otherwise healthy rabbit?
- What is the most appropriate method of incisor crown-length reduction in rabbits?

189 This six-month-old dog has changed his deciduous dentition in time and the permanent dentition is in place. Only the tip of the crown of the maxillary third incisor is visible through the gingiva (189, arrow). What is your diagnosis, and what is the recommended treatment?



189

181

187–189: Answers

187 Due to the depth of the fracture and the size of the remaining crown, a crown-lengthening procedure must be performed. After performing conventional endodontic treatment, an incision along the sulcus is made from the borders of adjacent teeth. Releasing incisions are made at adjacent teeth. The gingiva is reflected away from the bone and tooth with a periosteal elevator, exposing the bone. Coronal alveolar bone is removed to increase the coronal length. A conventional crown preparation is performed. Impressions are taken. Additional surface area may be gained by ordering a custom post. At this point, the gingiva is sutured to its new apically relocated position. An alternative to crown-lengthening would be orthodontic extrusion of the tooth. The disadvantage to this approach would be the length of time it takes to extrude the tooth.

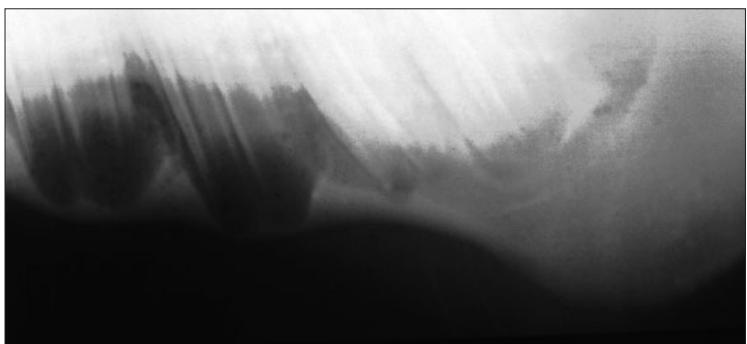
188 i. If the periapical tissues are not seriously damaged, a fractured tooth will usually regrow and return to occlusion providing the opposing tooth/teeth are not allowed to overgrow in the meantime. The fractured surface of the damaged tooth should be smoothed to prevent soft tissue irritation. If pulp exposure has occurred, the tooth should be cleaned and disinfected before performing a partial pulpectomy and pulp capping (dressing) procedure under aseptic conditions. The most practical material for both pulp capping and sealing the pulp chamber is a setting calcium hydroxide cement. This will generally survive long enough to allow healing of the pulp, it is non-toxic, and it will wear away once the tooth returns to function. It is necessary to perform crown height reduction of the opposing teeth at frequent intervals until the damaged tooth returns to function.
ii. Use of a cutting bur in a high-speed dental handpiece. Rabbits which are accustomed to handling will frequently accept tooth shortening by this method without any restraint other than having their lips held to the side. It is a good idea to place a wooden tongue depressor across behind the teeth while they are trimmed to prevent accidental damage to the animal's tongue. The use of forceps, nail clippers, or wire cutters for the trimming of teeth is both painful to the patient and traumatic to the periodontal tissues. These instruments tend to shatter the tooth, risking longitudinal fracture and pulp exposure. The forces released as the teeth are cut with such implements causes both periodontal and periapical trauma, risking permanent damage.

189 The third incisor is retained and embedded. Radiographs are indicated to visualize the position and morphology of this tooth. Extraction is the treatment of choice for two reasons. First, embedded teeth are prone to develop dentigerous cysts in time (see 48). Secondly, most of the crown is located under the gingiva. The gingiva does not attach to the enamel surface, except at the epithelial attachment at the most apical part of the crown. The result is a deep gingival pocket, which will trap bacteria, food, and debris. Extraction should be performed as soon as possible. Orthodontic treatment of this condition is impractical and not in the interest of the patient. This displaced tooth has to be extruded and possibly moved and tipped. Although this is possible and is standard treatment in human orthodontics, the treatment would require a very difficult series of different appliances and a long treatment period.

190, 191: Questions



190a



190b

190 Shown here are a radiograph and a photograph of a young horse with 'three-year-old bumps' (190a, b). What are these swellings?

191 This is a luting cement (191). Would this be the best choice for cementing a restoration to vital dentin within 1–2 mm of the pulp? Discuss components of non-composite luting agents and their relative ability to irritate the pulp.



191

190, 191: Answers

190 Eruption cysts. They arise in young horses when the ventral mandibular cortex becomes distorted by the expansion of the underlying dental sacs before eruption of the permanent dentition. These sacs contain the primordial tissues from which the permanent premolar teeth will differentiate. In Thoroughbreds, eruption cysts are far more common in the mandible than in the maxilla. Ponies are usually involved when the cysts arise in the maxilla. In general terms, eruption cysts are self-limiting and of cosmetic importance only. The precise mechanisms of dental eruption are not known but the process should be correctly aligned with the eruption pathway clear of obstructions. Some believe that eruption cysts are the result of impaction, but it is difficult to explain how the eruption pathway of all three premolar teeth can become obstructed at the same time, as it is common for three swellings to be present in the same horse. Impaction is most likely to arise when a permanent neighboring tooth lies across the path of the eruption, or when the space between the teeth on either side is too narrow. The fourth premolar, being the last permanent tooth to erupt, is the most vulnerable. The result of impaction is that the crown cannot advance into the mouth and therefore the root structures build up aborally. True impaction is more common in the mandible and causes a large, discrete ventral swelling.

191 No. This is a glass-ionomer, and would be a poor choice of material for using on dentin which is <1 mm in thickness over vital pulp. The liquid component of glass-ionomer luting agents is polyacrylic acid along with a number of other acids. Until the glass-ionomer completely sets, unreacted acid can be quite irritating to a poorly protected pulp.

Zinc phosphate cement has the longest track record of currently used luting agents. The powder is mostly zinc oxide powder with a small amount of magnesium oxide. The liquid is phosphoric acid and water. Small amounts of buffering salts are added to control the reaction, during which the acid reacts with some of the zinc oxide to form zinc phosphate. The acid in this material makes it irritating to the pulp in a similar manner to the polyacrylic acid in the glass-ionomer. Zinc silicophosphate cement adds silicate glass to the zinc oxide powder, and also uses a phosphoric acid-containing liquid. This acid can irritate an unprotected pulp.

Zinc oxide–eugenol (ZOE) cement is much less irritating to the pulp. The eugenol helps deaden any sensation of discomfort, which makes it often described as being ‘soothing to the pulp’. A major disadvantage for luting permanent restorations is its solubility in oral fluids. Even the improved ZOE cements, which contain added polymers and inorganic compounds to the powder, and ortho-ethoxybenzoic acid (EBA) to the liquid, are still less stable than other cements.

Carboxylate cements (also called polycarboxylate, polyacrylate) also use zinc oxide for the powder, but use polyacrylic acid for the liquid. Although the pH of the liquid is only 1.7, it neutralizes quickly during setting (compared with glass-ionomer’s slow setting reaction) and is therefore considered relatively non-irritating to the pulp.

In summary, with the exception of glass-ionomer, these agents all use zinc oxide in the powder phase. With the exception of zinc oxide–eugenol, they all use either phosphoric acid or polyacrylic acid in the liquid phase.

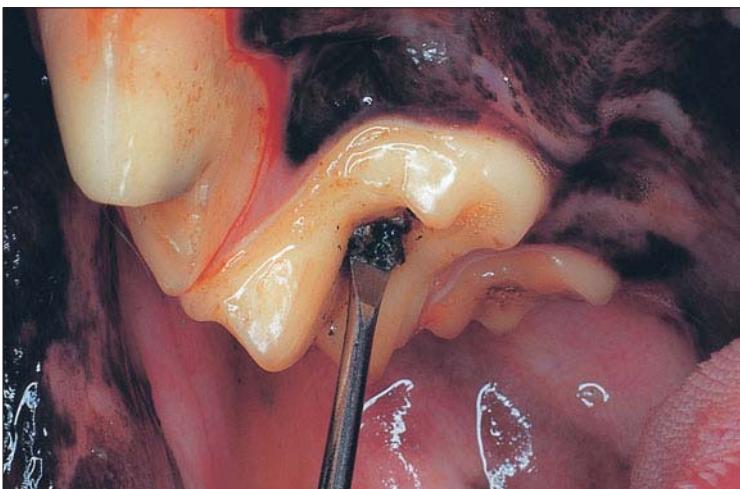
192, 193: Questions



192

192 Chew toys are beneficial in maintaining periodontal health (192).

- i. What benefits can be expected from chew toys?
- ii. Describe the proposed mechanisms of action.
- iii. How effective is the regular chewing of toys in maintaining periodontal health?



193

193 This brown lesion on the occlusal surface of this dog's maxillary first molar tooth is leathery and can largely be curetted from the tooth (193). How would you treat this lesion? Which restorative material would be the material of choice, and why?

192, 193: Answers

- 192 i. Depending on the type of toy, regular chewing may reduce the accumulation of dental deposits (plaque and calculus) on the tooth surfaces. A reduced plaque burden may reduce gingivitis.
- ii. Chewing devices exert their effect by maximizing the self-cleansing associated with function and by the physiologic stimulation of salivation.
- iii. In the absence of other oral hygiene measures there will still be a substantial accumulation of dental deposits and consequent gingivitis. While it is known that without plaque there is no disease, we do not know what amount of plaque is compatible with maintenance of periodontal health. We do not at our present level of knowledge understand what triggers the progression from gingivitis to periodontitis. The regular use of chew toys should be viewed as an adjunctive to other more effective means of plaque removal, preferably frequent and meticulous tooth brushing.

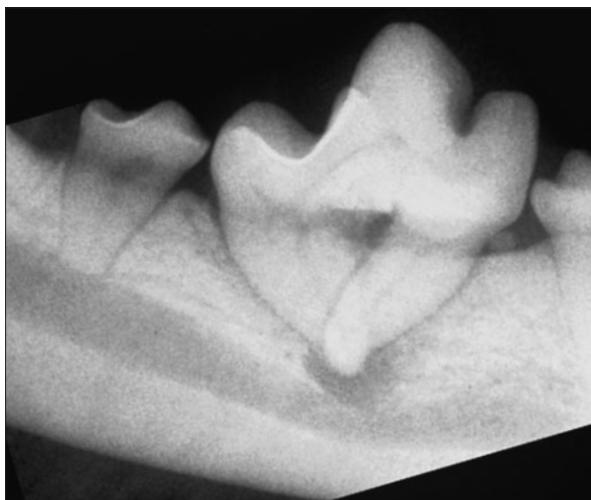
193 Treatment of dental caries involves removal of the diseased tooth material, creating an appropriate preparation for the restorative material, and then restoring the lost dental structure. For G.V. Black-Class I lesions (occlusal surface of molars or premolars), amalgam still provides excellent properties for restoration. The occlusal table surfaces of these teeth sustain huge compressive forces and no other restorative material matches the strength of amalgam under compressive loads. Typical compressive strength of amalgam (seven days after placement) ranges from 350–500 MPa (50,000–70,000 p.s.i.). Also, amalgam is easy to use and is less technique-sensitive than many other materials. It does require removal of slightly more tooth structure to create an undercut for mechanical retention. This retentive undercut may be small, made with a small round or pear-shaped bur. A round or pear-shaped bur undercut avoids a sharp line-angle between the cavity wall and cavity floor, which would introduce a stress point and a space which is difficult to fill. There is a trend towards bonding amalgam restorations to decrease marginal leakage and sensitivity (98). If a bonding agent is not used, the cavity preparation should be lined with a cavity varnish. The amalgam is triturated to mix the mercury with the other metals (i.e. silver, tin, copper, and possibly zinc or palladium). The amalgam is immediately placed into the defect and condensed. Condensation removes voids and bonds the amalgam into a homogenous mass with minimal porosity and residual mercury. Removing excess mercury strengthens the final amalgam by helping to reduce the γ_2 -phase (the tin-mercury component which is the weakest). Amalgams with zinc must be protected from moisture contamination by saliva or contaminated instruments. Any water present will react with the zinc, liberating hydrogen gas. Entrapped gas can cause a delayed expansion beginning one week after insertion. This is one reason that zinc-containing amalgams should not be used for retrograde filling following apicoectomy. Once the amalgam is placed, it is carved to the desired shape and the surface and margins are smoothed by burnishing with a ball burnisher. Final polishing should be delayed at least 24 hours.

194, 195: Questions



194a

194 What is the importance of the position of the gingival incision and the thickness of a periodontal flap (194a)?



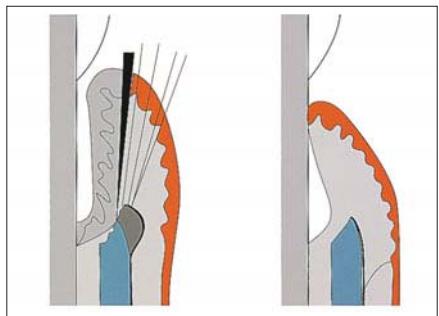
195a

195 This radiograph (195a) illustrates the need for pre-extraction radiographs.

- i. Give three examples of changes associated with a tooth where a pre-extraction radiograph is valuable.
- ii. What other valuable information can be gained from a pre-extraction radiograph of very mobile teeth?

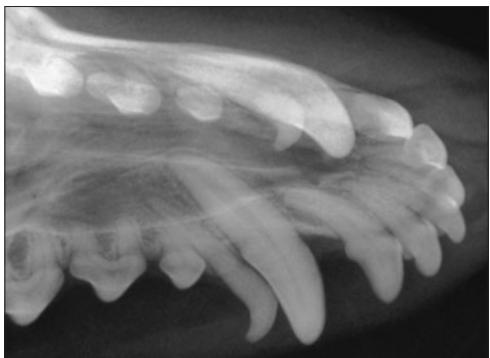
194, 195: Answers

194 Flaps begin with a gingival incision that follows a scalloped design. The widest part of the incision is at the mid-point of the tooth, whereas the narrowest part is pointed interdentally. The further apically one wants the flap to fall, the further one makes the incision from the tooth (194b). Incisions which are used to elevate flaps may be intracrevicular, crestal, or subcrestal depending on their proximity to the tooth. Intracrevicular incisions preserve the most soft tissue and are useful in open curettage, bone grafting, and guided-tissue regeneration surgery. With bone grafting and guided-tissue regeneration surgery, one usually attempts to preserve most of the gingiva because it is required for coverage of the site for better healing. Crestal and subcrestal incisions allow the flap to fall to greater degrees of apical positioning and are useful in pocket elimination surgery. Flaps for apical positioning are made with an inverse bevel to thin the gingival margin. Pocket elimination and osseous resection for architectural revision usually remove more gingiva by making wider and more apical incisions which end subcrestally. Flaps are classified by thickness (full and partial) depending on whether epithelial covering and periosteum are included. Most surgeons prefer full-thickness flaps as split-thickness flaps interfere with the blood supply and are technically challenging. Full-thickness flaps have the advantage of better vitality because vascularity is less compromised.



194b

195 i. This tooth has an abnormal root structure which will make extraction difficult. The tooth with a normal-appearing crown may have evidence of pathologic root resorption. In cases of persistent deciduous teeth (195b), it is important to know whether and to what extent physiologic root resorption has taken place. A fractured crown of a mandibular tooth may show evidence of periapical pathology in close proximity with the cortical bone which may result in a 'pathologic' fracture when attempting to extract this tooth. Other conditions that would influence the extraction technique include: supernumerary roots, fused roots, root dilaceration, and root fracture.
ii. Tooth mobility leading to extraction of the tooth may be secondary to neoplastic processes or metabolic bone diseases such as hyperparathyroidism. Extensive osteolysis of bone and fractures of the mandible or maxilla may also result in mobility of teeth.



195b

196, 197: Questions



196

196 Calculus (196) is mineralized plaque.

- i. How does it form?
- ii. What is its composition?
- iii. Is calculus pathogenic?

197 An 18-month-old Labrador Retriever has fractured an incisor tooth playing with another dog (197). What treatment would you recommend for this patient?



197

189

196, 197: Answers

- 196 i.** Dental plaque serves as an organic matrix for subsequent mineralization. Precipitation of mineral salts usually begins within two weeks after plaque formation. The mineral source for calculus is saliva for supragingival plaque and gingival fluid for subgingival plaque. Crystals form initially in the intercellular matrix and on bacterial surfaces and finally within the bacteria for some specific species. Calculus is formed in layers often separated by a thin cuticle that becomes embedded in it as calcification progresses. Food debris and hair are often found incorporated in calculus in dogs. The structure is heterogenous with a variable thickness and density. The surface is irregular and rough.
- ii.** In humans, supragingival calculus consists of 70–90% inorganic material, mainly calcium phosphate; other salts are calcium carbonate and magnesium phosphate. The crystals formed vary according to the age and location of calculus, brushite being more common in supragingival calculus and magnesium whitlockite in the subgingival calculus. The organic component consists of protein–polysaccharide complexes, desquamated epithelial cells, leukocytes, and various types of bacteria. Subgingival calculus has less brushite and more whitlockite as well as a higher ratio of calcium to phosphate. There are few studies on calculus composition in the dog and the results vary: one author found predominantly calcium phosphate, as in humans, whereas another study found calcium carbonate to be the principal salt.
- iii.** Calculus itself is no longer considered a pathogenic agent. Roughness *per se* does not cause gingivitis and calculus without bacteria may permit an epithelial attachment to form. Calculus acts as a retentive area of plaque.

- 197** Extraction. This tooth has a vertical root fracture which extends all the way to the apex. Obturation would be impossible at this point, and treatment to stimulate healing and fusion would be problematic and would carry a poor prognosis. Small vertical root fractures can be difficult to diagnose; in one study, only 30% of vertical root fractures were evident on radiographs. They may be caused by trauma, as in this case, or by excessive force used during lateral condensation of root filling materials during endodontic treatment. These result in failure of the endodontic treatment. An endodontic–periodontal lesion will develop. Left untreated, a large halo of bone loss develops around the affected root. This can be misinterpreted as a periodontal or extended periapical abscess. On endodontically treated teeth, a thin ribbon of gutta-percha or other radiolucent filling material may be seen extruding from the otherwise conical material in the treated root canal. Transillumination of the root while looking down the canal with magnification may help identify a small vertical root fracture. If a root fractures iatrogenically during lateral condensation, the operator may hear or feel a slight ‘pop’, followed by the canal accepting additional obturating material with less resistance. Long-term retention of this root would not be likely, and the endodontic procedure will eventually fail. In a multirooted tooth, the affected root can be amputated if the remaining roots are periodontally healthy and provide sufficient support for the tooth. The only other alternative, even with small, unapparent vertical root fractures, is to extract the tooth.

198–200: Questions



198a

198 Identify this instrument (198a), and compare its design with that of periodontal curettes.

199 Tooth brushing is the single most effective means of removing plaque (199).

- i. What frequency of tooth brushing is required to maintain clinically healthy gingiva?
- ii. What frequency of tooth brushing is required to restore inflamed gingiva to clinically healthy gingiva?



199

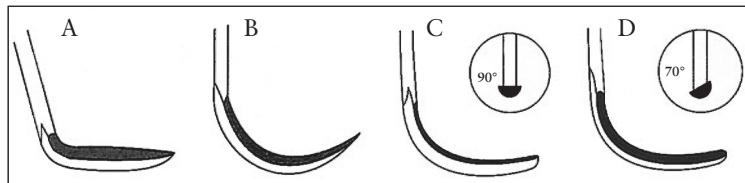


200

200 A mandibular canine in an extraoral position when the mouth is closed, is a relatively common orthodontic problem in pure-bred cats (200). What other malocclusion often occurs in conjunction with this condition?

198–200: Answers

198b



198 A Towner-Jacquette scaler, which is a double-ended instrument combining a curved and a straight sickle scaler. There are two basic types of sickle scalers: the *straight* sickle scaler (198b (A)) and the *curved* sickle scaler (198b (B)). The straight sickle scaler has two cutting edges on a straight blade that ends in a sharp point; this instrument is also known as a Jacquette scaler. The curved sickle scaler has two cutting edges on a curved blade. The back of a straight sickle scaler is slightly flattened, in contrast to a curved sickle scaler, which has a pointed back. Sickle scalers are designed for the removal of supragingival calculus. These instruments are used with a blade angulation of 45–90° and with a pull stroke. They are primarily used for the removal of gross supragingival calculus, e.g. before using the ultrasonic scaler, and for removal of calculus from developmental fissures, e.g. the maxillary fourth premolar in the dog.

Periodontal curettes have a rounded toe and back. They can be used for supragingival calculus removal near the gingival margin, but are primarily used for subgingival scaling, root planing, and curettage of diseased pocket epithelium. There are two basic types: the *universal* curette (198b (C)) and the *Gracey* curette (198b (D)). The face of the universal curette is perpendicular to the terminal shank and has two cutting edges. Universal curettes can be used on both mesial and distal tooth surfaces. The face of the blade of Gracey curettes has an angulation of 70° and has only one active cutting edge. Gracey curettes are area-specific, i.e. they are designed for specific teeth and surfaces. A wide variety of universal and Gracey curettes are available, with variations in the shape and length of the shank and blade.

199 i. One study has shown that brushing every other day is sufficient to maintain clinically healthy gingiva in the dog. Another study failed to duplicate these results. In the first study, trained dental technicians performed the tooth brushing, while in the second study the tooth brushing was performed by animal health technicians. It seems likely that the technique and effectiveness of the animal health technicians is more on a par with that of a motivated dog owner. Consequently, it is suggested that the recommendation to dog owners should be brushing more frequently than three times a week.

ii. Several studies have demonstrated that daily tooth brushing will restore clinically healthy gingiva in individuals with gingivitis. Most dogs and cats that have not received any form of oral hygiene will have gingivitis. Consequently, the recommendation should be daily tooth brushing if the animal will allow it.

200 The development of brachycephalic feline breeds has resulted in a wry malocclusion and craniofacial asymmetry often associated with one mandibular canine in an extraoral position when the mouth is closed.

201–203: Questions

201 With regard to wry malocclusion and craniofacial asymmetry in brachycephalic feline breeds (200):

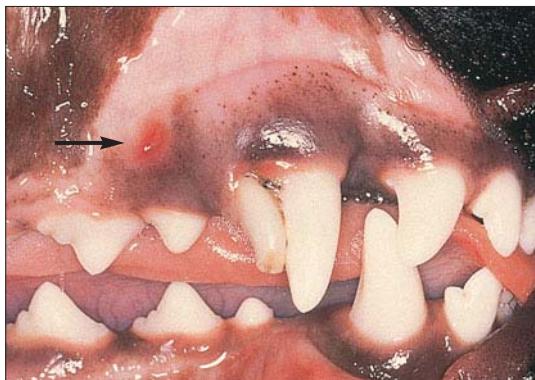
- i. What are the treatment options and expected results?
- ii. What are the dental show standards for cats?

202 What are the radiologic findings associated with this 15-mm diameter, exophytic tumor on the gingival margin of the mandibular first incisors in a dog (202)? In general, how does one systematically evaluate radiographs of suspected oral tumors?



202

203 In this seven-month-old dog, the deciduous canine tooth is still in place and not mobile (203). It is fractured and a sinus tract is visible overlying the root tip. What is the treatment of choice, and why?



203

201–203: Answers

201 i. Restoration of the dentition to a normal occlusion is extremely difficult. This condition is usually not amenable to orthodontic correction. If orthodontic correction is attempted, fixed dental attachments (i.e. hooks, buttons) are placed on the deviated canine and on one or more anchor teeth. The maxillary fourth premolar and the mandibular first molar are often used as anchor teeth. Elastic traction (i.e. power chain, rubber bands) creates constant force on the canine. Leaving this untreated can result in continued soft tissue trauma to the upper lip, masticatory impairment, and periodontal complications. Crown amputation, partial coronal pulpectomy (pulpotomy), and home care is another option to relieve upper lip trauma and improve masticatory function.

ii. Feline show standards are rather loose. They usually state that no teeth are to be visible when the mouth is closed. This simple standard does not address the occlusion nor the disqualification for correction. The AVMA ethical guidelines are discussed in **112**.

202 The radiologic descriptors of oral tumors systematically focus on the appearance of the lesion, surrounding bone, and teeth. In evaluating the lesion, one should note the size, border, density, and number of the lesion(s). In this particular example, there is a single, 15-mm diameter, peripheral, soft tissue density with ill-defined margins on the bony interface. There is no evidence of mineralization in the tumor. The surrounding bone can show evidence of expansion, perforation, erosion, and remodeling. Ill-defined margins and destruction of the bone cortex are suggestive of a malignancy, while expansion of the cortex is more indicative of a benign lesion (see **22**). With a benign lesion, a layer of smooth reactive bone may be found on the outside. Bone resorption can be focal (or geographical), moth-eaten, or permeative. In this example, there is evidence of a predominantly moth-eaten pattern of bone resorption between the roots of the first incisors and deeper down the left mandible. The rostral mental foramen on that side is markedly enlarged. Teeth involved in an oral tumor can either be in their original position, displaced, or partially resorbed. Displaced teeth, as in this example, are more commonly found in relatively benign tumors, while aggressive, malignant tumors tend to leave the teeth ‘floating’ in their original position.

This radiograph (**202**) was taken of a peripheral or canine acanthomatous ameloblastoma, previously known as an acanthomatous epulis. The radiologic findings associated with odontogenic and non-odontogenic tumors are generally non-specific. However, radiographs form an important part of the clinical staging in determining the extent of the tumor and in establishing whether bone involvement is present. Apparently normal radiographs do not rule out bone infiltration, as about 40% of the bone must be resorbed before this becomes visible using conventional radiography.

203 Extraction should be performed immediately. Resorption of deciduous teeth is dependent on the presence of living cells (odontoclasts). In this case, these cells were destroyed due to the pulp necrosis resulting from the complicated fracture and associated periapical pathology (sinus tract). Any resorative activity ceased, causing the deciduous canine to stay in place. If the fractured deciduous tooth remains in place for a long period of time, the infection can easily spread further and cause a local osteomyelitis with the danger of affecting the permanent canine.

204, 205: Questions

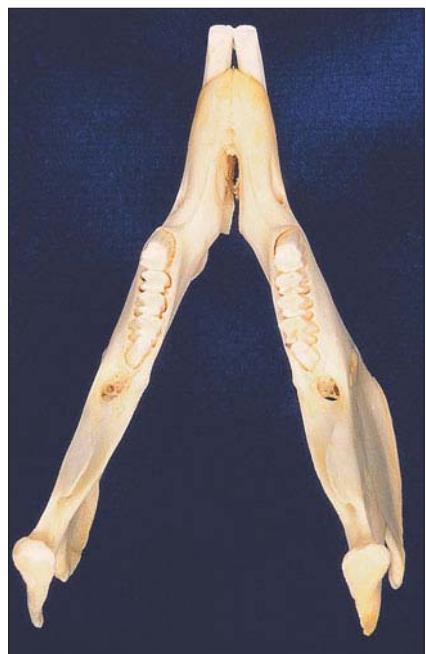
204 Conventional endodontic therapy concentrates on the cleaning, shaping, and sealing of the root canal system.

- i. Why is shaping important?
- ii. What instruments are generally used to shape the apical stop?
- iii. How do 60 mm veterinary-length root canal instruments differ from ISO-instruments?

205a



205b



205 i. What is the dental formula and characteristic dental features of the domestic rabbit (205a, b)?

- ii. How does the dentition of lagomorphs differ from that of rodents?

204, 205: Answers

204 i. In order to gain access to the apical portion of the root canal it is necessary to shape the access cavity and the coronal portion of the root canal to accommodate the diameter of instrumentation required for apical preparation. It must also be possible to place the appropriate size master gutta-percha point through the access route. The apical extent of the root canal is shaped so that it conforms closely with shape of the standard gutta-percha points (cones) which are traditionally used, along with a root canal sealing paste, to seal the apical extent of the root canal. An apical ‘stop’ is produced in teeth with an apical foramen so that a suitable gutta-percha point can be seated firmly without extruding through the tooth apex.

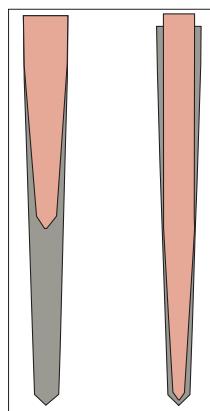
ii. The apical extent of the root canal is shaped using hand instruments such as K-files, Hedström files, or K-reamers. ISO-standard files and reamers have a diameter of $(1/100 \times \text{ISO-number})$ mm at their tip, increasing in diameter by 0.32 mm along the 16 mm working end. Standardized paper and gutta-percha points are produced with the same taper.

iii. Veterinary-length (60 mm) root canal files and reamers have a working end which is about twice as long as the ISO-size equivalent file with a reduced taper. In order to prepare the apical root canal for placement of standard sized gutta-percha points it is necessary to use a ‘step-back technique’ when using 60 mm files. This involves preparing the apex to the master file size required, then continuing preparation with sequentially larger size files which are worked to within 1 or 2 mm of the depth reached by the previously used file. During this procedure it is important to flush the canal thoroughly and keep recapitulating to full working depth using the master file so that dentinal filings are not packed into the apical portion of the canal. The diagram (204) illustrates the poor fit of an ISO-standard gutta-percha point in a root canal prepared with a long taper file.

205 i. The dental formula of lagomorphs is: $I\frac{2}{1}:C\frac{0}{0}:P\frac{3}{2}:M\frac{3}{3} = 28$

Rabbits have a heterodont, diphycodont dentition with all teeth being elodont (aradicular hypsodont): elodont teeth grow throughout life and never develop anatomic roots. Although diphycodont, the deciduous teeth are not functional and are exfoliated shortly before or after birth. The incisors are separated from the premolars and molars by a broad diastema, without canines. There is a pair of small maxillary incisors, the ‘peg teeth’, behind the large first incisors. All incisor teeth have a complete jacket of enamel.

ii. The main taxonomic difference is the presence of the maxillary second incisors in lagomorphs, while rodents have only a single pair. Another difference is that lagomorphs are diphycodont while rodents are considered monophycodont. Rabbits have unpigmented enamel while most rodents have yellow-orange incisor enamel. Rabbits have a full elodont dentition while in most rodents only the incisors are continuously growing. The relative widths of the mandible and maxilla, and the range of movement of the temporomandibular joint, also form important differences.



204

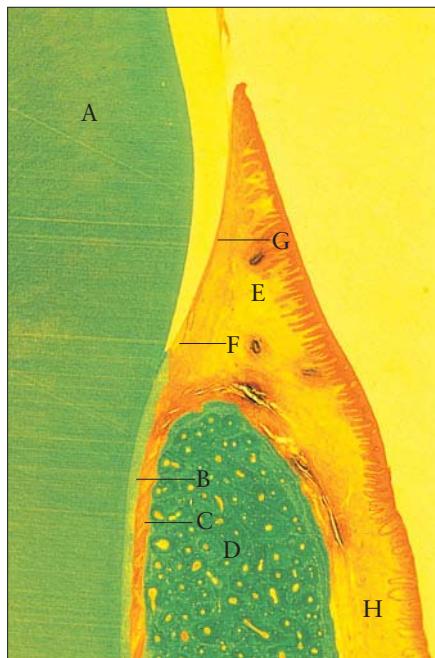
206, 207: Questions

206 i. What are the components of the periodontium?

ii. List the periodontal structures depicted by the arrows marked A–H in 206.

iii. What are the ultrastructural characteristics of the junctional epithelium?

206



207a



207 This horse is being ridden as a hunter-jumper (207a). What corrective dental procedures should be performed?

206, 207: Answers

- 206 i. Gingiva, periodontal ligament, cementum, and alveolar bone.
- ii. (A) Dentin. (B) Cementum. (C) Periodontal ligament. (D) Alveolar bone. (E) Gingival connective tissue. (F) Junctional epithelium. (G) Sulcular epithelium. (H) Attached gingiva.
- iii. Cells of the junctional epithelium (JE) migrate in the direction of their long axis towards the bottom of the sulcus where they are shed. The cells approaching the sulcus contain lysosomes and can phagocytose microorganisms. At the bottom of the sulcus, all JE cells exfoliate and neutrophils can also be seen migrating through the JE. The replacement rate of the JE is about five days, which is twice as high as that of the oral gingival epithelium. Subsequently, the desquamation rate is also higher. In contrast to other stratified squamous epithelium of the oral cavity, the JE is only composed of two layers, the active basal layer and an inactive suprabasal layer. The cells all have basically the same structure; they do not undergo a differentiation process like the cells of a keratinized, stratified squamous epithelium. The attachment between the JE and the tooth surface is called the epithelial attachment. This attachment is provided by hemidesmosomes between the tooth surface (covered by acellular afibrillar cementum or by the dental cuticle) and the internal basal lamina developing on the surface of the JE cells in contact with this non-epithelial substrate.

207 The sharp enamel points (207b) should be floated off and the mesial aspect of the second premolars beveled back, rounded, and smoothed. This is frequently referred to as forming a 'bit seat'. The maxillary premolars are beveled back in the shape of a thumb in profile. There is some disagreement as to the degree of beveling back that should be done on the mandibular second premolars. In general, if the horse is working with its nose out (head horizontal), only a small amount of beveling is done. If the horse works with its nose down (head vertical), more beveling back is done. It has been suggested that the bit being used dictates final shape. If a snaffle bit is used, the tooth should be rounded one-third its length, starting at the level of the gingiva on the mesial aspect. Start the rounding half-way up on the second premolar and extend distally if a curb bit is used. All the mesial surfaces should be rounded and smoothed no matter how much beveling is done. Most of the 'bit seats' are shaped by hand, but power tools are being used more frequently.



207b

208, 209: Questions

208 i. This is the nozzle of a piece of equipment used during routine periodontal treatment (208). What is it, and how does it work?

ii. What are the advantages of this technique?

iii. How should it be used, and what precautions should be taken?



208

209 A large swelling of the left mandible was evident in this five-year-old riding horse (209a). Oral examination revealed a defect between the second and fourth premolars. Also shown here is a 30° lateral-oblique radiograph (209b).

i. What is the radiologic diagnosis?

ii. How may the condition be treated?



209a



209b

208, 209: Answers

208 i. An air-polishing unit used for polishing. It uses medical-grade sodium bicarbonate crystals and water in a jet of compressed air to ‘sandblast’ the surface smooth. A well-known example of this equipment is the Prophy-Jet® (Dentsply Ltd.).

ii. Air-polishing has many advantages, especially for veterinary use. It is a very effective means of polishing. Air-polishing involves no physical contact with the tooth and thermal injury is of no concern, contrary to cup-and-pumice polishing. Air-polishing is ideally suited for polishing teeth separated by wide diastemata and with a considerable variation in shape and size. Areas that are very difficult or even impossible to reach with the rubber cup can easily be polished using the air-polisher. It is also believed that air-polishing may be complementary to periodontal débridement in removing subgingival plaque and toxins.

iii. The nozzle through which the slurry is propelled should be held 3–5 mm from the tooth and centered on the middle third of the tooth. The manufacturer’s recommendation for conically shaped teeth is to direct the spray at a 60° angle towards the gingiva; however, care should be taken not to direct the spray directly into the sulcus. Non-keratinized mucosal surfaces (e.g. the sublingual mucosa) behind the teeth to be polished should be shielded, either by the operator’s finger or by gauze. Prolonged use on dentin, cementum, and restorative materials (e.g. composite materials) should be avoided. There is some concern in human dentistry that absorption of the sodium bicarbonate may result in electrolyte disturbances. Air-polishing generates an aerosol of microorganisms and powder over a wide area around the patient. Personal protection (mask, eye-wear) is, therefore, very important and work surfaces require thorough cleaning and disinfection after the procedure.

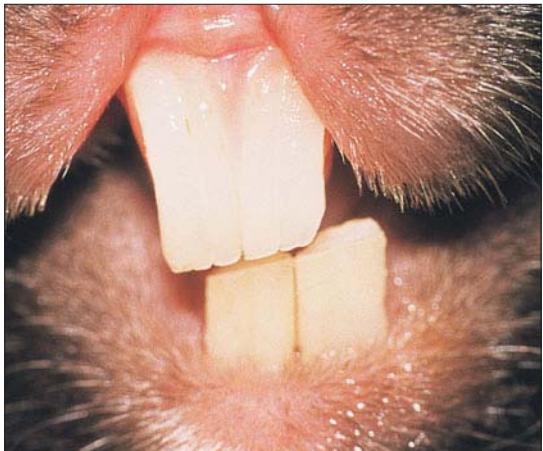
209 i. The radiograph (209b) shows a bizarre pattern of radiodense tissues in the location of the third premolar, suggestive of an odontoma. An odontoma is an example of an inductive odontogenic tumor: during tumor formation, an inductive effect between the epithelial and mesenchymal tissues takes place, similar to that occurring during odontogenesis, and the various dental tissues are formed. If tooth-like particles are identifiable, the term *compound odontoma* is used. In this case, where the aggregation of dental tissues is disorganized, this tumor is known as a *complex odontoma*. Although odontogenic tumors are rare in horses, the possibility of an odontogenic tumor should be considered whenever an animal develops a localized swelling of either jaw, and particular suspicion should be raised when the patient is young, coinciding with the time of greatest activity of the primordial dental tissues. Although the radiologic signs of odontoma are pathognomonic, a biopsy is indicated in most cases.

ii. An odontoma may be amenable to surgical removal. Removing the tumor by intra-capsular excision (piecemeal withdrawal of the tumor) following a bone flap approach may be sufficient, but postoperative radiographs are advisable to establish that all dental tissue has been removed. Some odontomas are not amenable to surgical removal by virtue of their size.

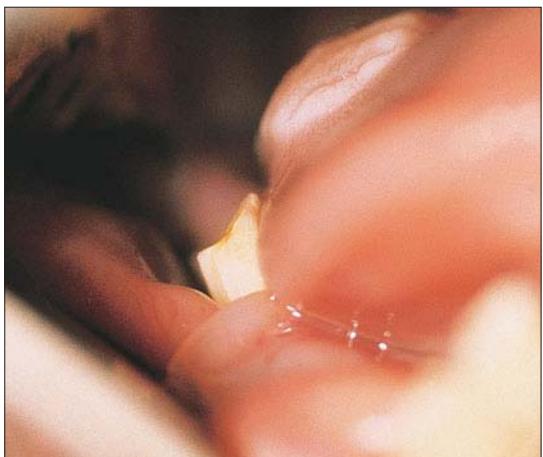
210, 211: Questions

210 This rabbit was approximately one year old. It had been fed on a concentrate ration (pellets and grain) without access to fresh herbage or hay since weaning.

- i. What abnormality/abnormalities can be seen on these photographs (210a, b)?
- ii. What is/are the likely cause(s)?
- iii. How significant is this in a six-month-old rabbit compared with the same problem in an eight-year old rabbit?



210a



210b

211 What are the possible immediate and long-term complications of dental repulsion in the horse?

210, 211: Answers

210 i. Oblique wear of the incisor teeth (**210b**). The mandible is also displaced to the left. As the abnormal wear pattern is slanting in the same direction it is likely that the mandibular position is significant, particularly as the rabbit was conscious when the photograph was taken. Rabbits have a normal wide range of lateral mandibular movement, so this positioning could have been caused by the method of restraint.

ii. The abnormal wear pattern suggests a functional problem associated with lateral chewing movements. This could be due to skeletal, neurologic, muscular, or temporomandibular joint problems, or intraoral pathology. Abnormal wear of the cheek teeth can lead to physical restriction in the range of jaw movement. Conscious alteration of chewing pattern is probably the most common cause of subtle abnormalities such as this.

In this particular case, the diet was easily chewed, little grinding being required before the food was swallowed. When fed such a diet there is a tendency for rabbits to make reduced lateral chewing movements, resulting in insufficient wear to the lingual surfaces of the mandibular and buccal surfaces of the maxillary cheek teeth. In the case illustrated here the rabbit had developed sharp spikes only on the lingual surface of the mandibular cheek teeth on the right-hand side of its mouth. Occlusal equilibration to return the teeth to their normal contour, followed by introduction of a more abrasive (normal) diet of hay and fresh grass, which required considerable chewing effort, prevented recurrence over a five-year follow-up period.

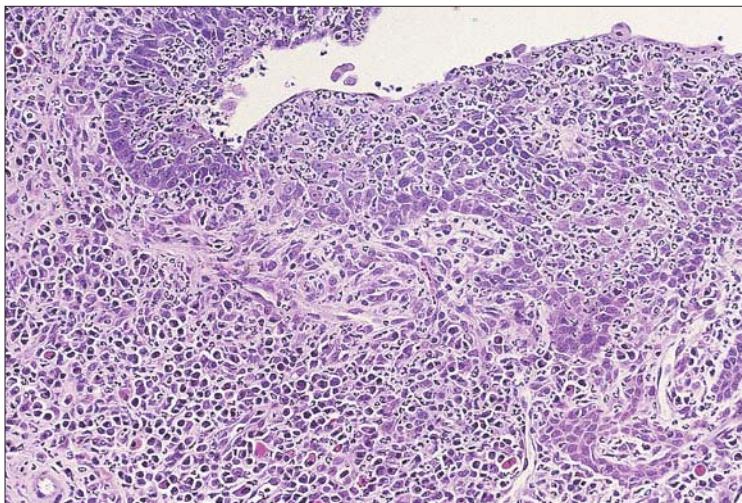
iii. The significance of dental problems in animals with continuously growing teeth generally declines with age. If a minor abnormality has taken eight years to develop it is not likely to progress rapidly, making successful long-term control much more likely. In a young animal such problems are frequently an indication that ongoing control measures will be required.

211 The extraction of an equine molar or premolar tooth is a formidable undertaking with many potential complications in the intraoperative and postoperative periods, not to mention the long-term sequelae for the animal's oral conformation.

The complications which can occur at the time of repulsion or shortly thereafter include: (1) Traumatic fracture of the mandible. (2) Iatrogenic damage to neighboring teeth. (3) Inadvertent disruption of adjacent structures: nasolacrimal duct; parotid salivary duct; branches of the linguofacial artery and vein; palatine artery; ventral and dorsal buccal branches of the facial nerve; infraorbital nerve. (4) Failure to remove the entire tooth – dental sequestration. (5) Sequestration of bone fragments from the lining of the alveolus. (6) Loss of the alveolar plug with contamination of the alveolus by ingesta. (7) Oronasal fistula formation.

In the months and years which follow dental extractions the teeth on either side will tend to drift across the vacant space to narrow the defect in the arcade. The occluding tooth in the opposite jaw will continue to erupt without attritional wear and, as the space vacated by the extracted tooth narrows, the resultant overgrowth will become more pointed. Clearly, there are major long-term implications for the oral conformation of the patient and regular rasping, i.e. at three-month intervals, is indicated to prevent secondary complications.

212, 213: Questions



212

- 212 i. Chronic gingivostomatitis in the cat is also known as lymphocytic–plasmacytic gingivostomatitis. What does the term lymphocytic–plasmacytic refer to (212)?
ii. Is it of clinical value to biopsy these lesions?



213

- 213 This is a two-year-old cat with a history of chronic sneezing (213).
i. What is the midline palatal structure, and what is the cleft?
ii. What are possible treatment options?

212, 213: Answers

212 i. Some pathologists emphasize the types of inflammatory cells that accumulate in oral mucosal lesions. This has created the impression among clinicians that lymphocytic-plasmacytic gingivostomatitis is a specific disease entity in the cat.

Acute lesions are mainly associated with polymorphonuclear neutrophilic infiltrates, whereas increasing numbers and proportions of lymphocytes and plasma cells indicate chronicity. The presence of eosinophils is suggestive of either parasitic or allergic (type-1 hypersensitivity) reactions. Secondary microbial infection is common in oral lesions and results in a mixed inflammatory response. Acute inflammation will have a predominance of neutrophils, whereas chronic inflammation will be characterized by the presence of macrophages, lymphocytes, and plasma cells.

ii. Although the histopathologic findings may be suggestive of a specific disease process, like an eosinophilic granuloma, the inflammatory responses of oral tissues are often non-specific. Any condition that breeches the oral defense mechanisms may allow normal oral flora to invade the deeper tissues and to elicit inflammation. To complicate matters, the lesion may actually result from the host's attempt to contain immunologically or eliminate foci of microbial persistence, e.g. chronic, ulcerating, hyperplastic faucitis associated with chronic oral carriage of feline calicivirus. A biopsy of the latter lesion would demonstrate a severe and diffuse plasmacytic-lymphocytic infiltrate in deeper tissues and a more ulcerative and suppurative process superficially. With ulcerative lesions in the oral cavity of the cat there is always the possibility of neoplasia which warrants taking a biopsy.

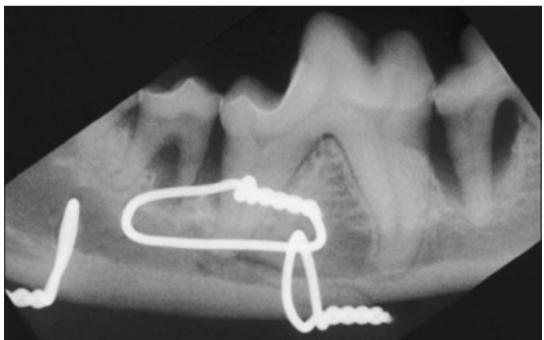
213 i. The round structure on the midline is the incisive papilla; buccal (lateral) are the orifices of the incisive ducts. The incisive ducts communicate with the paired vomeronasal organs and then caudodorsally through the palatine fissures with the nasal cavity. The vomeronasal organs consist of olfactory membrane located at the rostral base of the nasal septum. Lip curling and the 'Flehmen response' as a result of sniffing is thought to be a response to open the incisive papilla to allow more molecules to enter and be exposed to the tissue lining the vomeronasal organ. Impulses from the stimulation of this olfactory membrane eventually travel to areas of the hypothalamus associated with sexual and feeding behavior, and possible social interactions. Clients will often ask about the incisive papilla, thinking that this is a tumor in formation. In this case, there are clefts resulting from abnormally wide openings of the incisive ducts. These clefts allow food and other debris to be trapped.

ii. Treatment options include increased home hygiene, surgery and an obturator. Increased home hygiene could include the use of instruments to remove the foreign material, or water irrigation either via a curved-tip syringe or water pic. This would require dedication on the part of the client. Surgical options include the use of a sliding flap, pedicle flap, or inverting palatal flap. The risk of this procedure is that the surgery could make the condition worse. The third alternative is to manufacture an obturator with a rubber-based material. The obturator can be placed in the clefts to prevent the introduction of food when the patient is eating; it can be removed for cleaning.

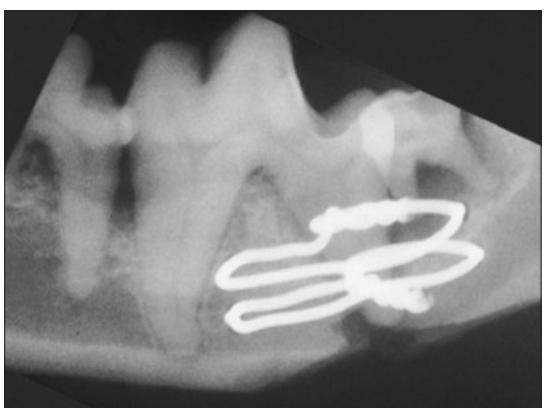
214, 215: Questions

214 These are two intraoral radiographs depicting the use of intraosseous wiring for the repair of a bilateral mandibular fracture in a dog (214a, b).

- i. What is the most important principle in the management of jaw fractures? List several additional principles that should be utilized in the management of these fractures.
- ii. What is the proper technique for tightening wires during the fixation of jaw fractures?



214a



214b

215 Why are extraction forceps less suitable for use in dogs and cats than in humans (215)?



215

214, 215: Answers

214 i. Restoration of occlusion and anatomic reduction of the fracture. The interdigitation of the teeth is precise and the tolerance for error is narrow. Proper dental occlusion results from anatomic reduction of fracture fragments. However, proper occlusion may be difficult to achieve when there has been bone loss or loss of teeth, or when the fracture is highly comminuted. In these cases it is important to rely on occlusion of the remaining teeth as a guide and accept less-than-perfect bone reduction if necessary. In cases in which there has been bone loss or loss of teeth, an alternative technique for jaw fracture repair other than intraosseous wiring is recommended. Additional guidelines for the application of intraosseous wiring in the treatment of jaw fractures include the following: (1) A ventral surgical approach is recommended. (2) Tension band principles should be utilized. (3) Soft alveolar bone, reactive bone, or infected bone should be avoided during wire placement. (4) Wires should be placed somewhere between perpendicular to the fracture line and parallel to the long axis of the mandibular body, and if two wires are used, they should be placed at an angle to each other. (5) All orthopedic wires should be fastened securely. (6) Additional support should be utilized if necessary. (7) At least two wires should be placed across any single fracture line. (8) Excessive soft tissue dissection and the incorporation of soft tissue beneath wires should be avoided.

In the case illustrated, complications can be expected because: (1) There are teeth present in the fracture lines. (2) The wires placed in the left mandible are parallel, allowing a swivel action. (3) Multiple fractures are present, exceeding the limits of what can reasonably be expected of intraosseous wiring.

ii. Wires should be preplaced before tightening. While the wire is being tightened, tension should be applied to the wire to ensure that a tight fit of the wire is achieved. Proper wire tightening allows the wire to twist around itself rather than one wire twisting around the other. Following wire placement, occlusive alignment should be re-evaluated.

215 Human teeth are relatively robust structures, normally varying only a little in size between patients. Unless they are grossly decayed, human teeth can withstand application of the considerable forces used during forceps extraction. It is necessary for extraction forceps to closely fit the teeth they are applied to so there are different designs for each size, shape, and position of tooth in the human mouth. Carnivore teeth are relatively thinner, with proportionately longer roots, so are prone to fracture when lateral or crushing forces are applied to them. The teeth also vary considerably in size and form, making it impractical to have an adequate set of forceps for all situations. If forceps are used during extraction of carnivore teeth, the tooth should first be loosened as much as possible using other methods. The instrument jaws are applied as far apically as possible and must fit the tooth well. Pressure is then applied and held repeatedly in an apical then coronal direction, intruding and extruding the tooth into the alveolus to tear periodontal fibers. With single-rooted (reasonably straight) tooth segments, gentle rotational forces can also be applied and held in alternate directions, again tearing periodontal fibers. Use of excessive force is likely to result in tooth or jaw fracture.

216, 217: Questions

216 Pictured are three different types of power scaling tips (216).

- i. What are the different power sources for these instruments?
- ii. How does the tip action vary between these instruments, and what is their operating frequency?
- iii. What are the major similarities and differences of these power scalers?



216



217

217 This photograph illustrates the traditional method used to extract the cheek teeth of horses by repulsion (217).

- i. What are the surgical principles of this procedure?
- ii. What are the indications for the extraction of cheek teeth in horses?

207

216, 217: Answers

- 216 i. The scalers on the left and right are classified as ultrasonic scalers and are powered by electricity. The one on the left is a magnetostrictive unit. The electricity creates a magnetic field in a ferromagnetic rod or metal stack. This magnetic field creates vibrations which are transmitted to the working tip. The scaler on the right is classified as a piezoelectric unit. Electrical current is passed through a crystal in the handpiece that changes shape, thus creating the vibrations in the handpiece tip. The center scaler is a sonic scaler which is powered by compressed air and is attached to a dental handpiece. Vibrations at the scaler tip are created when air passes through a hole in a shaft inside the handpiece, spinning a ring which encircles the scaler.
- ii. The sonic scaler tip moves in an elliptical fashion, much like a figure-of-eight pattern. They operate at 2,000–6,000 Hz. The edges of the diamond-shaped tip are the most active and the power is concentrated in the last 3–5 mm of the tip. The ultrasonic tip on the left is equally active on all sides of the working end and moves in a rotary fashion. Pot-stack ultrasonic scaler tips have a more elliptical action or may have surfaces that are more active than others, namely the upper and under surfaces of the tip greater than the lateral surfaces. Ultrasonic scalers operate at frequencies of 20,000–40,000 Hz. Piezoelectric scalers have two active surfaces, usually the 3 o'clock and 9 o'clock sides. The tip motion is linear in a back-and-forth action. Piezoelectric scalers operate at 25,000–45,000 Hz. Knowledge of tip action and active sides of the instrument is important to allow for more efficient scaling and proper use of the instrument.
- iii. All these instruments are used for gross supragingival calculus removal from teeth. They all use a water spray for lavage and/or cooling and will create an aerosol. Different tip sizes and configurations are available for all of them for heavy calculus removal and fine calculus removal. The ultrasonic units will develop heat in the instrument tip, while the sonic scaler produces little heat. The ultrasonic magnetostrictive units with long and very thin tips with directed water spray are designed for subgingival use to perform periodontal débridement.

- 217 The technique necessitates an apical approach to the diseased tooth which is then driven out into the mouth with a hammer and punch. In order for extraction procedures to be successful it is essential to accurately identify which tooth, if any, is diseased and then to remove the *right tooth*, the *whole tooth* and to damage *nothing but the tooth*. The objectives of the aftercare, which can be prolonged, are to eliminate secondary infection from the adjacent tissues and to prevent contamination of the alveolus during the healing stages.
- ii. Indications include idiopathic apical abscessation, pathologic and iatrogenic fracture, impaction, maleruption with secondary periodontitis, and malformations including developmental tumors. For the maxillary arcade the indications are similar but with the addition of periapical abscessation secondary to infundibular necrosis. Evidence that a tooth requires extraction is obtained from the external signs, detailed oral examination, and radiography. Unless the evidence is convincing it is irresponsible to proceed with the extraction surgery.

218, 219: Questions



218a

218 In designing a crown for this fractured tooth (218a):

- Where should the margins be placed?
- What type of margins could be used, and what are the advantages and disadvantages of each?
- What precautions must be taken?

219 i. What is the cause of the artifact seen on this radiograph (219)?

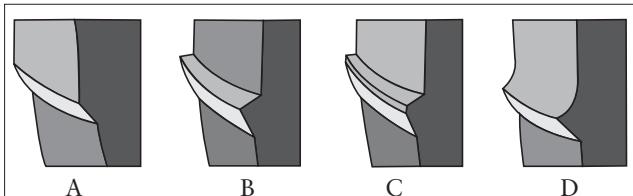
- What other processing errors can occur that can make a dental film difficult, if not impossible, to evaluate?



219

218, 219: Answers

218b



218 i. Ideally, crown margins are best placed supragingivally. Restoration margins cannot be perfectly adapted to the tooth, and as a result there will always be microscopic defects in finished crown-tooth margins. When the margin is placed subgingivally, there is a greater chance of creating an area that allows plaque retention. If the crown margin must be placed subgingivally, the chances of doing harm are decreased by creating a well-adapted margin.

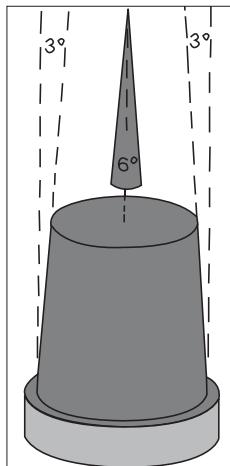
ii. There are three general types of margins: (1) A feathered (or knife-edge) margin is where the margin is created by gently sloping the margin coronally (218b (A)). Often, the actual end point of the margin is not obvious and must be indicated to the laboratory. This margin has the advantages of minimal tooth loss and ease of preparation. (2) A shoulder margin (218b (B)) is where a definite ledge is created in the prepared tooth. The disadvantage of this margin is the increased amount of tooth loss. It is required for a porcelain crown. A variation of this technique is to add a bevel to the shoulder (218b (C)). This is indicated for preparations with extremely short walls and can also be used for porcelain-fused-to-metal crowns. (3) A chamfer (218b (D)) is a hybrid between the feathered margin at one extreme and a shoulder margin at the other. The tooth is cut so that tooth is removed coronally, and at the same time the margin tapers to a shoulder at the margin. This is generally regarded as the finish line of choice for metal crowns.

iii. Whatever margin is used, caution should be used not to cut away too much tooth, but at the same time allow room for the crown in the occlusion with other teeth. In addition, the crown form should be created so that there are no overhangs and an optimal 6° taper (an inclination of 3° on each surface) exists to allow the prosthetic crown to fit properly and have optimal retention (218c).

219 i. A light leak probably occurred during processing.

ii. A film that is too dark is related to too much exposure time, too long in the developer, or too warm a developing solution. A film that is too light is related to a developing solution that is old or too cold, not enough developing time, or not enough exposure time. A foggy film or ‘washed-out’ background is related to old developer, which also causes loss of detail. Brown spots on the film result from fixer that is too old, film not fixed long enough, or film not rinsed well (fixer oxidizes). A film will not develop properly if paper is left attached to the film.

218c

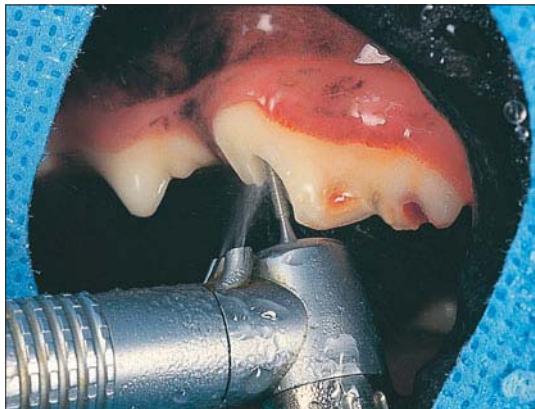


220, 221: Questions

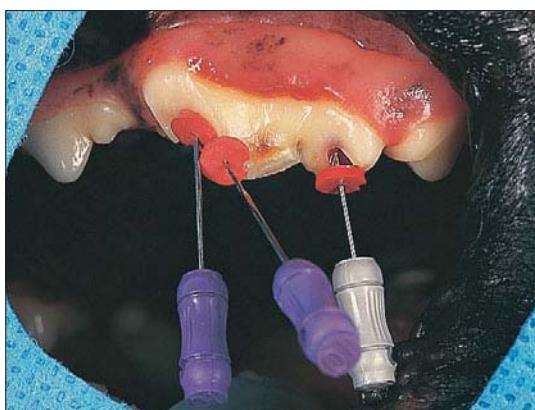
220 The most important aspect of atraumatic extraction technique is the severing of the periodontal ligament, which is most frequently performed using dental luxators and elevators.

- i. What are the main differences between dental elevators and luxators?
- ii. Why are elevators and luxators produced in different sizes and tip curvatures?

221 These pictures show the transcoronal access to the roots of the maxillary fourth premolar in a six-year-old Afghan Hound (221a, b). Describe why this approach is so often used by veterinary dentists.



221a

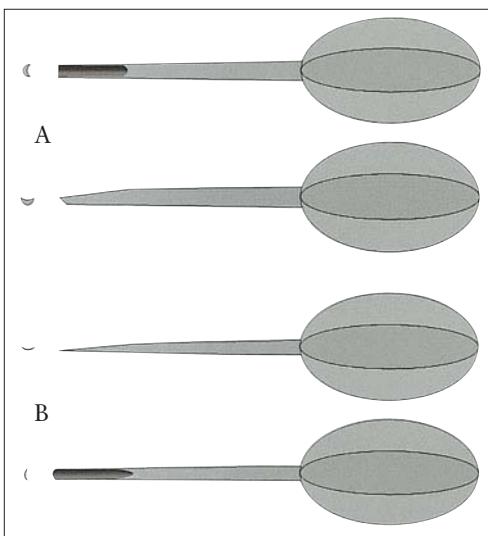


221b

220, 221: Answers

220 i. Dental elevators are fashioned with a cutting edge in chisel form while luxators are more knife-like. Elevators are made from hardened metal and are robust instruments which can withstand heavy handling. They are sharpened in the form of a chisel and often also go under that name. Luxators are produced from softer metal which can be readily sharpened. The thin, highly-tapered tip of a luxator (220 (B)) penetrates the narrow periodontal space far more readily than the 'chunky' tip of an elevator (220 (A)). When used appropriately, mechanical advantage reduces the effort required to do the work of extraction. Luxators have a thin, tapered blade which can be used as an efficient gradient wedge.

ii. The width and curvature of the instrument tips need to conform to the roots of the teeth on which they are used, so a wide variety of sizes are required. For veterinary use the most common sizes are 2, 3, 4, and 5 mm, the larger three sizes being standard sizes used by human dentists. Various manufacturers interpret the designs differently, so by shopping around it is possible obtain a set of 30–40 instruments to suit all small animal dental needs.



220

221 The technique removes relatively little tooth substance so that maximum strength is preserved. The technique also provides straight-line access and good exposure to all three roots of the maxillary carnassial tooth, and can be performed in dogs of all sizes and breeds. The palatal root canal of the maxillary fourth premolar is particularly difficult to thoroughly débride and shape for four reasons. First, this canal is often very small and, especially in older dogs, can be partially calcified. Second, the canal's exit from the pulp chamber is not in the same relative location in every tooth. Third, the palatal root varies in its relative orientation to the other roots. Sometimes it runs fairly parallel to the mesiobuccal root and sometimes it diverges from the mesiobuccal root. These last two factors make it difficult to locate the entrance to the canal from near the central cusp or from a site near the buccal groove. The fourth problem is encountered when trying to access the canal directly through the cusp of the palatal root. The cusp is small, and in many large dogs it is awkward or impossible to place the head of a standard high-speed handpiece close enough to drill a hole in the palatal cusp directly over the pulp chamber of this root. The transcoronal approach, which usually requires two new access sites, provides straight-line access to the apex of all three root canals being treated so that each canal can be adequately prepared.

222, 223: Questions

222 With regard to the transcoronal access in 221:

- i. Is making additional access sites preferable to accessing all three root canals via the fracture exposure site that is revealed when a large buccal slab fracture or central cusp fracture has exposed the pulp?
- ii. Is it important to preserve the palatal root when performing standard root canal therapy?

223a



223b



223 This is a congenital cleft hard palate with an associated midline soft palatal defect in a four-month-old Shetland Collie presented because of chronic, bilateral nasal discharge (223a, b). Several guidelines have been recommended in the surgical management of congenital cleft hard and soft palatal defects. What are these guidelines and what surgical technique can be utilized in the successful management of congenital cleft hard and soft palatal defects?

222, 223: Answers

222 i. Although it is often possible to access all three root canals through the fracture exposure site, complications are more prevalent due to increased pulp chamber perforations (over-instrumentation) of both the mesiobuccal and the palatal roots, metal fatigue leading to separated files if files are prebent, stripping the canal with the file's concave side and leaving contamination on the convex side of the prepared root canal, and the resultant ledging and filling voids (incomplete fills).

ii. Yes. When palatal root canal complications occur, usually as a result of either over-instrumentation or inability to access the canal, clinicians may advocate amputating the palatal root to avoid subsequent periapical or periodontal disease. The palatal root, however, provides an important buttress effect against the powerful shearing forces exerted on the maxillary fourth premolar and should be treated and preserved if at all possible. In a retrospective study, 20% of the maxillary fourth premolars that had palatal roots amputated experienced crown fracture within 12 months of the procedure. Postoperatively, most dogs will continue to abuse this tooth by chewing on bones and other hard objects. With the transcoronal approach, fewer complications arise than with other techniques, and maximal strength and structure can be maintained in this large and important tooth.

223 The following guidelines have been recommended in the surgical management of palatal defects: (1) The covering flaps should be larger than the defect they will cover. (2) The vascular supply to the flap should be preserved. (3) Suture lines should be arranged whenever possible to lie over connective tissue rather than over the defect. (4) Tissues should be handled gently and relatively large bites of tissue should be taken to minimize tension and minimize interference with the blood supply at the edges of the wound. (5) The use of electrocoagulation for hemorrhage control should be avoided. (6) Tissues should be sutured to appose edges that do not have an intact epithelial surface. (7) A two-layer closure should be utilized whenever possible.

The surgical techniques that utilize the guidelines listed above are the overlapping flap technique for the repair of hard palatal defects and the two-layer closure of the soft palatal congenital defect. The overlapping flap technique is preferred by most surgeons because there is less tension on the suture line, the suture line is not located directly over the defect, and the area of opposing connective tissue is larger which results in a stronger scar. The overlapping flap technique is performed by creating two mucoperiosteal flaps. One flap is hinged at the end of the palatal defect and is turned beneath the other flap. Horizontal mattress sutures of synthetic absorbable suture material are utilized to maintain the connective tissue surfaces of both flaps in apposition. The midline soft palatal defect is corrected by making an incision along the medial margin of the soft palate on each side and bluntly separating the palatal tissue to form a dorsal and ventral flap on each side with a scissor. The two dorsal flaps are sutured in a simple interrupted pattern while the two ventral flaps are sutured.

224, 225: Questions

224 Dental enamel is the hardest tissue in the body.

- i. How does it differ from other body tissues?
- ii. What are its principal components (also compared with dentin and cementum)?

225 This dog has had a traumatic injury to its maxillary canine tooth (225).

- i. What are the differences between an avulsed tooth, a luxated tooth, and a subluxated tooth?
- ii. What would be an appropriate treatment plan to salvage this tooth?
- iii. When is endodontic therapy appropriate for these teeth?



225

224, 225: Answers

224 i. Enamel is acellular.

ii. Enamel is principally composed of closely packed crystals of carbonated calcium hydroxyapatite $[Ca_{10-x}Na_x(PO_4)_{6-y}(CO_3)_2(OH)_{2-u}F_u]$, aligned as rods or prisms with traces of the protein matrix laid down during enamel formation enveloping each crystal. The composition of enamel, compared with dentin and cementum, is as follows:

	<i>Enamel</i> Weight (%)	<i>Volume (%)</i>	<i>Dentin and cementum</i> Weight (%)	<i>Volume (%)</i>
Carbonated hydroxyapatite	96	85	70	47
Protein and lipid	1	3	20	33
Water	3	12	10	20

The protein matrix of immature enamel mainly consists of amelogenins, which account for 90% of all enamel proteins. As the enamel matures, amelogenins are broken down by proteinases and the main remaining non-amelogenin proteins include the enamelins. When the teeth of man, primates, and carnivores (where enamel forms the protective covering to the crown) erupt, the enamel is incompletely mineralized. Throughout life there is a constant mineral exchange between the moist oral environment (saliva is normally supersaturated with calcium salts) and enamel, thus allowing the incorporation of fluoride and other ions into the mineral structure. In the presence of fluoride, more fluoroapatite $[Ca_{10}(PO_4)_6F_2]$ is formed, which is less soluble and more acid-resistant than hydroxyapatite. Changes in the oral environment, such as the release of acids during bacterial metabolism within plaque or the application of phosphoric acid 'etchants', can lead to demineralization of enamel. If only the surface layer is affected, remineralization can occur, but since the cells (ameloblasts) which produce enamel have degenerated by the time the tooth erupts into the mouth, enamel cannot repair itself or regenerate when it is otherwise damaged or lost.

225 i. An avulsed (or exarticulated) tooth is one that has become completely separated from the alveolar socket. These teeth must be reimplanted, ideally within 30 minutes, as damage to the periodontal ligament attachment occurs from desiccation. The prognosis is guarded and some tooth resorption is likely.

A luxated tooth is one that has lateral, intrusive or extrusive displacement. The tooth shown in 225 has significant lateral displacement disrupting the buccal alveolar wall. There will be significant mobility and these teeth will not remain stable when replaced in their socket. They have a better prognosis than a completely avulsed tooth.

A subluxated tooth is one that has become mobile from a traumatic injury but has not become displaced. It may not need to be stabilized to allow repair of the periodontal ligament.

ii. A treatment plan for a laterally luxated tooth is to obtain an intraoral radiograph to evaluate the hard tissues, and gently débride the palatal alveolar area and root surface. The periodontal ligament fibers should be left intact if they appear healthy. The tooth is replaced into the alveolus and stabilized. Several options are available to stabilize this tooth depending upon the degree of mobility and presence of anchor teeth. A figure-of-

eight wire around the two maxillary canines stabilized with acrylic or composite resin material is a simple method to stabilize a canine tooth that has instability laterally and a healthy counterpart. An acrylic or composite resin splint can be placed between several adjacent teeth in the same arch to obtain good stability also. The splint may be left in place for four to six weeks. Endodontic treatment is performed as described below and the tooth is followed radiographically to determine continued treatment success.

iii. Endodontic treatment is generally required in avulsed and luxated teeth due to the disruption of the blood supply to the tooth and subsequent pulp death. Various times have been recommended for endodontic treatment. Initial root canal therapy should be done 2–3 weeks after initial treatment to remove pulp tissue, clean the canal, and fill the canal with calcium hydroxide. A permanent obturation with sealer and gutta-percha can be completed at the time of splint removal or up to a year later. Avulsed teeth that are treated endodontically at the time of reimplantation may have a worse prognosis.

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