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EXOTIC ANIMAL PRACTICE

Disorders of the Oral Cavity

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Ornamental fish represent the largest and most diverse group of exotic animals kept as pets. The specific oral anatomy of each family or selected species has evolved to suit the natural environment, feeding behaviors, food or prey type, and location of the food/prey in the water column. The anatomy can change over the life of the animal, from fry to adult. The oral cavity of fish is susceptible to many problems including infectious and parasitic diseases, trauma, and neoplasia. Diagnosis may involve wet mount preparations of exfoliative cytology from the lesion, histopathology, and bacterial or fungal culture.

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Joanna Hedley

A wide variety of disorders may be seen affecting the reptile and amphibian oral cavity. Owners can easily miss problems until they are at an advanced stage because of the difficulty of examining the oral cavity at home. Because many problems are secondary to an inappropriate environment or diet and may be related to systemic disease, a full history and clinical examination is always required. Treatment of oral disorders also requires a holistic approach including correction of any predisposing factors in order for long-term successful resolution of the problem.

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Brian Speer and Lauren Virginia Powers

Cranial kinesis of the avian beak is complex; particularly in birds with prokinetic beak movement, such as psittacine birds. A number of diseases can result in damage to the bony and soft tissue structures of the beak and can lead to secondary pathology, such as beak deviation, abnormal rhamphothecal growth and wear, and opportunistic infections. A solid understanding of species-specific anatomic variations is essential before attempting rhamphothecal restoration or surgical repair. Many diseases of the oral cavity can appear similar on initial clinical evaluation and therefore warrant appropriate diagnostic testing.

Anatomy, Physiology and Non-dental Disorders of the Mouth of Pet Rabbits **737**

Thomas M. Donnelly and David Vella

The first part of this review focuses on the anatomy and physiology of the rabbit mouth. Practical understanding is critical to comprehend the

dynamic pathologic changes of dental disease, which is one of the most common presenting problems in rabbits. The major theories of the etiopathogenesis of dental disease are presented. The second part focuses on non-dental oral disorders, which encompass only a small incidence of stomatognathic diseases when compared with dental disease. These diseases are primarily composed of infections (treponematosis, oral papillomatosis), neoplasia (frequently involving calcified tissue proliferation), and congenital abnormalities (mandibular prognathism, absent peg teeth, supernumerary peg teeth).

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Vittorio Capello

Diagnostic imaging techniques are of paramount importance for dentistry and oral disorders of rabbits, rodents, and other exotic companion mammals. Aside from standard radiography, stomatoscopy is a complementary tool allowing a thorough and detailed inspection of the oral cavity. Computed tomography (CT) generates multiple 2-dimensional views and 3-dimensional reconstructions providing superior diagnostic accuracy also useful for prognosis and treatment of advanced dental disease and its related complications. MRI is a diagnostic imaging technique additional to CT used primarily to enhance soft tissues, including complex odontogenic abscesses.

Intraoral Treatment of Dental Disease in Pet Rabbits **783**

Vittorio Capello

The intraoral treatment of dental disease in pet rabbits follows a complete clinical examination, intraoral inspection under general anesthesia, and diagnostic imaging. It also implies thorough knowledge of dental disease in this species. The most common intraoral procedures are extraction of incisor teeth, coronal reduction, and extraction of cheek teeth. These dental procedures require specific instruments and equipment. They should be performed in conjunction with supportive and medical treatment followed by appropriate nutrition.

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Vittorio Capello

Odontogenic facial abscesses associated with periapical infections and osteomyelitis of the jaw represent an important part of the acquired and progressive dental disease syndrome in pet rabbits. Complications such as retromasseteric and retrobulbar abscesses, extensive osteomyelitis of the mandible, and empyemas of the skull are possible sequelae. Standard and advanced diagnostic imaging should be pursued to make a detailed and proper diagnosis, and plan the most effective surgical treatment. This article reviews the surgical anatomy, the pathophysiology, and the classification of abscesses and empyemas of the mandible, the maxilla, and the skull. It also discusses surgical techniques for facial abscesses.

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Loic Legendre

Acquired dental disease represents the most common oral disorder of guinea pigs. Most patients are presented with nonspecific clinical signs and symptoms, such as weight loss, reduced food intake, difficulty chewing and/or swallowing. The physical examination must be followed by standard radiography and/or computed tomography, and thorough inspection under general anesthesia. Several complications may follow, including periodontal disease, subluxation of the temporomandibular joint, periapical infection, and abscessation. The dental treatment is aimed to restore the proper length and shape of both the incisor and cheek teeth, associated with medical and supportive treatment. Abscesses should be surgically addressed by complete excision.

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Christoph Mans and Vladimir Jekl

Dental disease is among the most common causes for chinchillas and degus to present to veterinarians. Most animals with dental disease present with weight loss, reduced food intake/anorexia, and drooling. Degus commonly present with dyspnea. Dental disease has been primarily referred to as elongation and malocclusion of the cheek teeth. Periodontal disease, caries, and tooth resorption are common diseases in chinchillas, but are missed frequently during routine intraoral examination, even performed under general anesthesia. A diagnostic evaluation, including endoscopy-guided intraoral examination and diagnostic imaging of the skull, is necessary to detect oral disorders and to perform the appropriate therapy.

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Elisabetta Mancinelli and Vittorio Capello

The order *Rodentia* comprises more than 2000 species divided into 3 groups based on anatomic and functional differences of the masseter muscle. Myomorph and sciuromorph species have elodont incisors and anelodont cheek teeth, unlike hystrichomorph species which have full anelodont dentition. Diseases of incisors and cheek teeth of rat-like and squirrel-like rodents result in a wide variety of symptoms and clinical signs. Appropriate diagnostic testing and imaging techniques are required to obtain a definitive diagnosis, formulate a prognosis, and develop a treatment plan. A thorough review of elodontoma, odontoma, and pseudo-odontoma is provided, including treatment of pseudo-odontomas in prairie dogs.

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Cathy A. Johnson-Delaney

Exotic companion carnivores such as ferrets, skunks, fennec foxes, coatimundis, raccoons, and kinkajous presented in clinical practice share similar dental anatomy, function, and diseases. The domestic ferret serves

as the representative species for this group with its anatomy, diseases, and conditions described in detail. Dog and cat guidelines for veterinary and home care seem to be relevant and applicable, including dental endodontic procedures. Annual or biannual dental examinations and prophylaxis are recommended. The most common dental and oral problems are tooth wear, plaque and calculus, teeth fractures, gingivitis and periodontitis, tooth loss, abscesses, oral ulceration, tonsillitis, and neoplasia.

Anatomy and Disorders of the Oral Cavity of Miscellaneous Exotic Companion Mammals **929**

Angela M. Lennox and Yasutsugu Miwa

Unusual mammalian species such as the hedgehog, sugar glider, and miniature pig are encountered with increasing frequency in exotic companion medicine. Disease of the oral cavity can occur in any species; although occasionally encountered in exotic mammalian species, it is rarely described in the literature. Anatomy and dentition vary significantly; diagnosis and treatment are often extrapolated from that known in other species. The best-documented disease of the oral cavity in this group of species is oral neoplasia in the hedgehog.

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Intraoral Treatment of Dental Disease in Pet Rabbits

Vittorio Capello, DVM, DECZM (Small Mammal), DABVP-Exotic Companion Mammal[a,b,*]

KEYWORDS

• Incisor teeth • Cheek teeth • Dental instruments • Extraction • Coronal reduction

KEY POINTS

- The intraoral treatment of dental disease in pet rabbits must follow a complete clinical examination, intraoral inspection under general anesthesia, and diagnostic imaging.
- Intraoral inspection and dental procedures require specific instruments and equipment suitable for rabbits.
- Extraction of incisor teeth represents the only definitive and completely effective treatment of severe malocclusion. Rabbits adapt easily to absence of incisors, and the prognosis is good.
- Coronal reduction of incisor teeth must never be performed using trimmers, clippers, or similar instruments because they frequently lead to complications such as fractures, damage of the apical germinative tissue, pulp exposure, endodontic infection, and periapical abscessation; this is a meaningless procedure in cases of severe malocclusion.
- Coronal reduction of clinical crowns of cheek teeth is aimed at restoration of the coronal length and the occlusal planes *as close as possible* to normal anatomy.

INTRODUCTION

The proper planning of dental treatment is feasible after thorough diagnosis using modalities such as intraoral examination (ideally stomatoscopy), radiography, and other advanced imaging. In many cases, treatment immediately follows diagnosis in order to avoid a second anesthetic procedure. Discussion with the owner about long-term prognosis and aftercare is imperative.

Intraoral dental procedures represent an important part of treatment of dental disease in pet rabbits. Treatment includes elimination of dental spurs, restoration of a more normal occlusal plane, extractions, and gingival suture.

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PLANNING DENTAL TREATMENT

Common Presentations

The 3 most common clinical presentations of dental disease in pet rabbits relate to overgrowth of the incisors; reduced food intake, anorexia, or dysphagia; and presence of a facial swelling.[1–3] One, 2, or all 3 of these conditions can be present at the same time. Although dental disease affecting the cheek teeth is more frequent, diseases affecting the incisors are more apparent to the owners. In the most common pattern of malocclusion, diseased incisors enhance the normal curvature of the reserve and clinical crowns. The mandibular incisors tend to elongate labially, and usually do not produce secondary lesions because they are rostral to the upper lip and nose.[1] The maxillary incisors tend to elongate and curve palatally[1,2] and possibly damage the lips and/or the palate (**Fig. 1**). Elongated incisors may fracture at different levels of the clinical crown, or even below the gingival level. In cases of advanced dental disease, growth may be slowed or arrested. Dental disease of the incisors also affects the reserve crown. Abnormal elongation and apical deformity of maxillary primary incisors may lead to partial or complete obstruction of the nasolacrimal duct. Epiphora, dacryocystitis, additional ocular lesions, or facial dermatitis are possible sequelae.[1,4–6]

Rabbits with acquired dental disease of the cheek teeth may present at different stages,[2,7] but symptoms may not be consistent with the degree of disease.[2] The earliest stage is elongation of clinical crowns. Clinical signs are usually not present at this stage, even though some symptoms, such as the rabbit being reluctant to eat hay or other hard food, may be inferred from a detailed history. This condition is caused by the elongated apex impinging on its sensory nerve supply.[7] At a further stage, elongation of the clinical crowns and the abnormal occlusal plane appear as so-called step mouth on the intraoral examination.[1,2,7] Extraoral signs may also appear, such as slight deformity of the ventral profile of the mandibular cortical bone following elongation of reserve crowns.[1,3,7,8] In advanced stages, excessive curvature of clinical crowns of mandibular cheek teeth typically occurs, but is not limited to the lingual direction. In contrast, the maxillary cheek teeth usually curve in the buccal direction, which can result in spur formation and lesions of the lingual or the buccal mucosa.

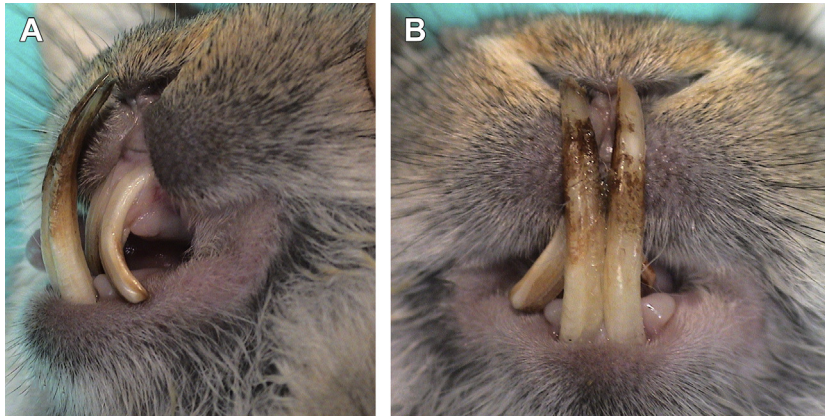

Fig. 1. Common presentation of malocclusion of incisor teeth in a pet rabbit, lateral (*A*), and rostral (*B*) views. The mandibular incisors tend to elongate labially, whereas the maxillary incisors tend to elongate and curve palatally with possible damage to the lips and/or palate. (*Courtesy of Vittorio* Capello, DVM, Milano, Italy; with permission.)

A common complication of coronal elongation of cheek teeth is fracture, especially longitudinal fracture of mandibular premolars.[1] End-stage dental disease of the cheek teeth is frequently associated with resorption of dental tissue and severe changes of cheek teeth arcades.

Instruments and Equipment

The equipment suitable for dentistry of pet rabbits can be divided into 2 groups: instruments for diagnosis and instruments for treatment.[1,2,9]

Instruments for diagnosis

Because of the deep and narrow oral cavity, special mouth gags designed to fit with the clinical crowns of incisors are essential instruments for oral examination. The rabbit and rodent table retractor/restrainer (otherwise named the tabletop mouth gag) is a special platform acting as a combined mouth gag and patient positioner.[1–3] This instrument is useful because it allows the operator to work without the need of an assistant, apart from the anesthetist. It also allows the patient to be placed in an optimal position that facilitates the intraoral examination. The patient is positioned in sternal recumbency. The table restrainer has 2 horizontal bars working as the mouth gag, where the incisor teeth are anchored (**Fig. 2**). The platform can be raised to enhance the operator's view. However, the platform should not be tilted more than 30° to minimize stress on the neck, and to avoid excessive traction on incisor teeth. Various types of gags are used under general anesthesia, but they should be used with extreme caution to prevent excessive stretching of the masticatory muscles and the ligaments of the temporomandibular joint.

The second instrument needed to access the oral cavity is the cheek dilator. Different sizes and shapes are available with longer blades fitting better into the rabbit mouth and being more effective in dilating the cheeks, especially in larger breeds.[1,3] After the mouth gag and cheek dilator have been applied, 2 other instruments are suitable for managing the tongue. Small and smooth-tip anatomic forceps are used to grasp and move the tongue. A flat or concave spatula is also used to deflect and protect the tongue during treatment of cheek teeth.

Fig. 2. Close-up of a rabbit positioned on the rabbit and rodent table retractor/restrainer (tabletop mouth gag) with the cheek dilator. Anesthesia is maintained using orotracheal intubation in this rabbit. Depending on the rabbit's size, the orotracheal tube may hinder the procedure. Injectable anesthetic protocols combined with face mask may be an effective alternative option. (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

Proper lighting is critical, and magnification is desirable in rabbits for intraoral inspection. Effective light spots can be connected to magnifying loupes when endoscopy is not an option. Miscellaneous diagnostic instruments include intravenous catheters of 22 to 24 gauge (without the stylet) to assess the patency of the nasolacrimal duct.

TREATMENT

The general guidelines of intraoral dental procedures consist of reduction of abnormal tooth length of clinical crowns, restoration of the occlusal plane to as near normal as possible, and extraction of diseased teeth.[2,10] Complications and secondary diseases, such as periapical infections, osteomyelitis, and odontogenic abscesses, are treated with combined dental procedures and extraoral surgery.

Medical Treatment

Medical therapy alone is not sufficient for the treatment of dental disease. However, it may be important as a temporary palliative or supportive treatment before a dental procedure under general anesthesia, and it is also an important adjunct to surgical procedures. The 3 key points of medical treatment are supportive, antimicrobial, and antiinflammatory/analgesic therapy.[1,2,10] Supportive treatment includes syringeable assist-feeding products for herbivorous species. Fluid therapy may also be necessary in some patients.[1]

The choice of the antimicrobial treatment should be based on both aerobic and anaerobic culture and sensitivity testing when possible, and considering any species-specific contraindications, such as oral administration of penicillins in rabbits.[1,2,11] Analgesia is critical to relieve pain and discomfort as well as to prevent pain-related reduced food intake and anorexia.

Intraoral Treatment

Instruments and equipment

The intraoral dental treatment requires specific instruments. Beside the equipment described earlier for inspection of the oral cavity and protection of soft tissues, other novel instruments are available for extraction and mechanical trimming.[1,2,9] Specialized elevators for rabbit incisor and cheek teeth have been designed by Dr David Crossley. Crossley luxators for rabbit incisor teeth are flat, curved to match the shape of the reserve crowns, and sharp at the concave margin. The 2 ends have different curvatures; 1 for maxillary and 1 for mandibular incisor teeth (**Fig. 3**). This instrument allows the breaking down of periodontal ligaments on the distal (lateral) and mesial (medial) aspect of the incisor teeth. Other luxators have recently been designed to address the labial (rostral) and lingual/palatal (caudal) aspect of incisors. Alternatively, properly contoured 18-gauge needles may be used on these sides.

Crossley luxators for rabbit cheek teeth are designed with 2 sharp working ends angled at about 100° to the handle, and perpendicular to each other (**Fig. 4**). This luxator is used to break the ligament on the 4 aspects of the cheek teeth: one end for the mesial and distal aspect, and the other end for the lingual/palatal and the buccal aspect. Small standard extraction forceps can be used to extract incisors; needle holders and small hemostats can be used as well, depending on the patient's size. Another instrument especially designed for rabbits is the extraction forceps for cheek teeth. The grasping tip is angled at 100° to facilitate its use in the narrow oral cavity (**Fig. 5**).

In the past, Dremel-type (20,000–30,000 rpm) hobby tools have been used for coronal reduction of cheek teeth, but several manufacturers offer precision, higher

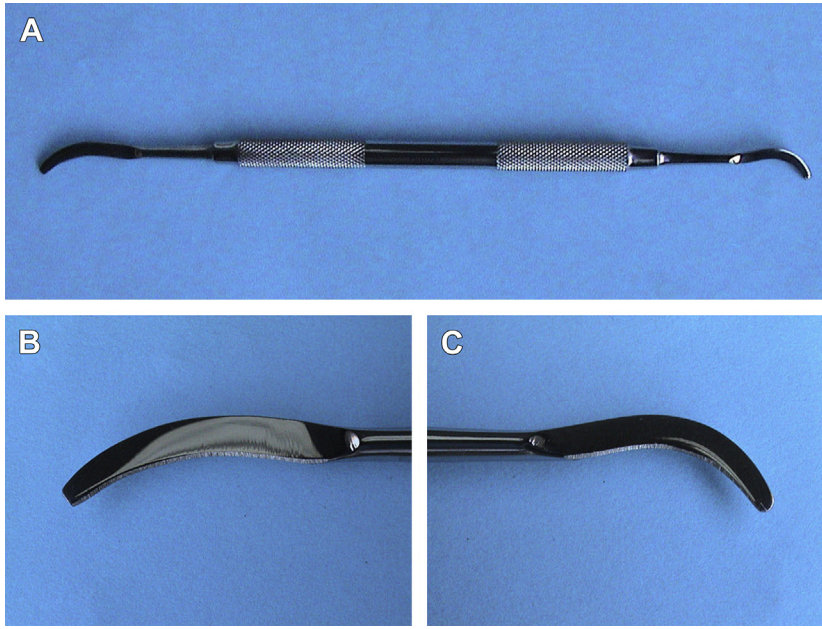

Fig. 3. Crossley luxators for incisor teeth. (*A*) The instrument. (*B*) The end for luxation of mandibular incisor teeth. (*C*) The end for luxation of mandibular incisor teeth. Note the different curvature and the sharp edge of the concave margin. (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

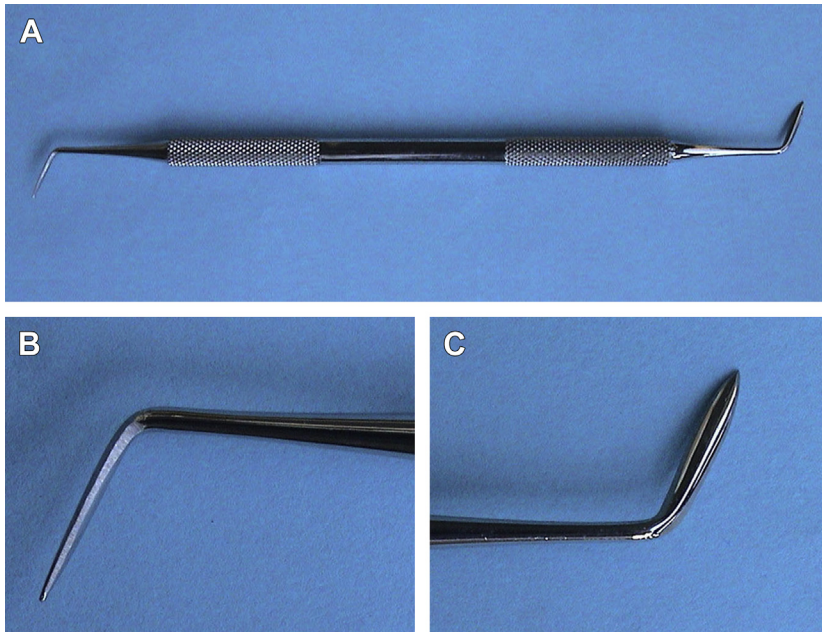

Fig. 4. Crossley luxators for cheek teeth. (*A*) The instrument. (*B*) The end for luxation of the mesial (rostral) and distal (caudal) aspects of cheek teeth. (*C*) The end for luxation of the buccal (lateral) and lingual/palatal (medial) aspects of cheek teeth. The 2 ends are angled at approximately 100° to the handle, and are perpendicular to each other. (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

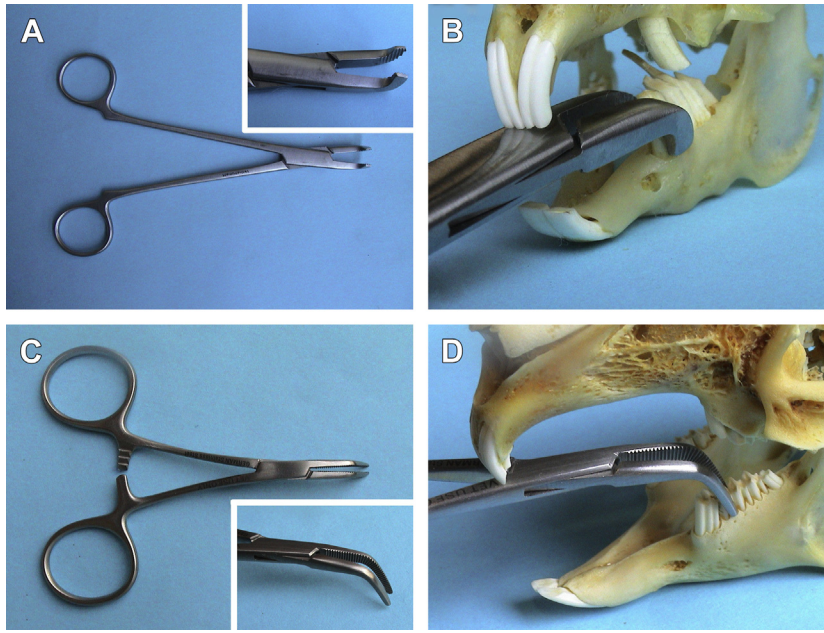

Fig. 5. Extraction forceps for cheek teeth. Standard extraction forceps for cheek teeth (*A*) and related size in relationship to a skull of a 1.5-kg dwarf rabbit (*B*). Smaller extraction forceps (*C*) and related size in relationship to a skull of a 1.5-kg dwarf rabbit (*D*). (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

speed handpieces. A dental unit is adequate and recommended for dental treatment of pet rabbits. A straight dental handpiece is needed because the standard angled dental handpiece used for dog and cat dentistry cannot access the mouth of rabbits, and its use is limited to coronal reduction of incisor teeth.

Many different types, shapes, and sizes of burrs are available. Sheats protecting the metal bur can be mounted on straight handpieces. Old diamond rasps and cutters for rabbit cheek teeth are still available on the market, but their use must be discouraged because forces applied by these instruments can fracture cheek teeth and may cause severe damage to adjacent soft tissues.

Treatment of Incisor Teeth

Extraction

Extraction of the incisor teeth is the only definitive and completely effective treatment of severe malocclusion, both with and without associated acquired dental disease.[1,2,10,12,13] Maloccluded incisor teeth are not functional, and rabbits adapt easily to the absence of incisors. They are able to eat normally using their lips and tongue for food prehension. Also, repeated coronal reductions are not recommended because of frequent anesthesia, complications such as pulp overgrowth and exposure,[14] or abnormal reserve crowns affecting the function of nasolacrimal ducts. Financial reasons may also be a concern.

In most cases, extraction of the entire set of 6 incisor teeth is necessary, even if, in selected cases in which a single mandibular incisor tooth is fractured or infected, extraction of that single mandibular incisor tooth may be indicated. For those patients, the maxillary incisor on the same quadrant may be able to keep a normal occlusal plane because of lateral chewing movements.

Diagnostic radiographs are taken before extraction of incisor teeth, in particular to assess the reserve crowns.[2,15] The use of mouth gags is possible after extraction of incisor teeth, but it is a bit more difficult, and mouth opening may be suboptimal. For this reason, intraoral dental procedures on cheek teeth should be performed before extraction of the incisor teeth.

Extraction of mandibular incisors before maxillary incisors is not a specific guideline, but it is the author's preference and the recommendation is to begin by extracting the mandibular incisor teeth (**Fig. 6**).

The anesthetized patient is placed in dorsal recumbency. The gingiva is scrubbed with 0.1% chlorhexidine solution. For optional adjunct local anesthesia, local block of the mental nerve is performed.[16,17] The gingival attachment is incised circumferentially around the 4 aspects of the clinical crown with the tip of a number 11 scalpel blade. The longer edge of the Crossley luxator is inserted in the periodontal space on the mesial side of the tooth, until resistance is felt. The luxator is held in position for a few seconds to stretch and damage the periodontal ligament. The tip of the

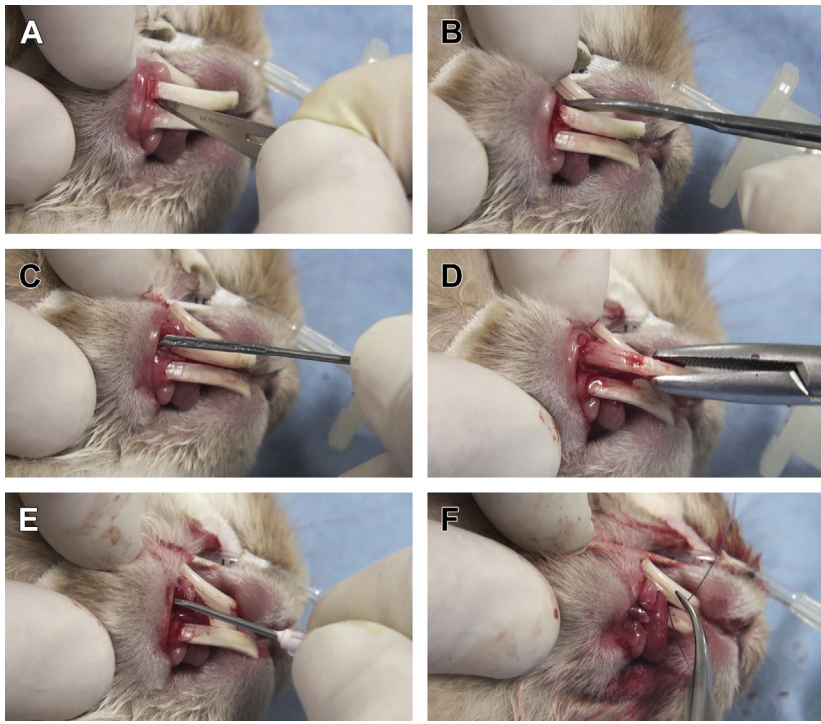

Fig. 6. Extraction of mandibular incisor teeth. (*A*) The gingival attachment is incised circumferentially around the 4 aspects of the clinical crown with the tip of a number 11 scalpel blade. (*B*) The mandibular edge of the Crossley luxator is inserted in the periodontal space on the distal side of the tooth. (*C*) A flattened and curved contoured 18-gauge needle is used to break down the periodontal ligament on the labial aspect. (*D*) The tooth is grasped with the extraction forceps (a needle holder in this case) as close to the gingival margin as possible. It is extracted using steady, slowly increasing force, following the curvature of the root and with slight torsional movements. (*E*) After extraction, damage of the geminal tissue is performed by inserting a needle into the alveolus to curette the alveolar walls, which helps to prevent possible tooth regrowth. (*F*) Suture of the gingiva using 4-0 absorbable suture material (poliglecaprone, Monocryl). (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

luxator is gradually moved toward the apex of the tooth. The free hand is used to stabilize the mandible. The same procedure is then performed on the distal aspect of the tooth. With the same technique, either a dedicated luxator for the lingual and labial sides of the tooth or a contoured, 18-gauge hypodermic needle is used to break down the periodontal ligament on those aspects. The tooth should be loose and very mobile at this point. The tooth is grasped with the extraction forceps as close to the gingival margin as possible. It is extracted using steady, slowly increasing force, following the curvature of the root and with slight torsional movements. When the tooth is loosened and ready to be extracted, the tooth is repeatedly inserted back in the socket before extraction to damage the germinal tissues at the bottom of the alveolus. If the periodontal ligament has been completely and correctly severed and the tooth is not severely deformed, it can be extracted without the use of significant force. Bleeding is usually minimal and can easily be controlled with sterile cotton swabs. After extraction, the tooth is examined to ensure that the entire tooth and its pulp tissues have been removed. In addition to repeated insertion of the tooth before extraction, further damage of the geminal tissue is performed by inserting a needle into the alveolus to curette the alveolar walls after extraction, which helps to prevent possible tooth regrowth. The alveolar cavity is thoroughly flushed with saline solution to remove any debris. If periapical infection is present, dilute 2% povidone iodine or 0.1% chlorhexidine solution is used for flushing. The alveolus is closed by suturing the gingiva with simple interrupted sutures or a purse-string suture pattern using 3-0 or smaller absorbable suture material. However, when infection is present the alveolus is left open, allowing the gingiva to heal by second intention.

Before extraction of the maxillary incisor teeth (**Fig. 7**), the gingiva is scrubbed with 0.1% chlorhexidine solution. For optional adjunct local anesthesia, local block of the rostral infraorbital nerve is performed.[16,17] The upper harelip is lifted with the free hand, which is used to hold and stabilize the patient's head. Either a dedicated luxator for the labial and palatal sides of the tooth or a contoured, 18-gauge hypodermic needle is used to sever the periodontal ligament on the labial and palatal sides of the maxillary incisor teeth, similar to the procedure described for mandibular incisors. When working on the palatal aspect, special attention should be paid to prevent damage to the small secondary incisor teeth. The periodontal ligament is severed on the mesial and distal aspects of the primary incisor teeth using the Crossley luxator. The periodontal ligament is particularly strong on the mesial aspect, and the tooth will be significantly loose after the ligament is cut. When the tooth is loosened, the clinical crown is grasped with suitable extraction forceps or a pair of needle holders. To avoid dental and bony fractures, the tooth is pulled gently, following the natural curvature of the reserve crown, and applying a slight distal (lateral) rotation during extraction. After extraction, the tooth is examined to ensure that the entire tooth and its pulp tissues have been removed. The procedure is repeated on the primary incisor tooth of the contralateral quadrant, and bleeding is controlled with sterile cotton swabs. A thin, 22-gauge, contoured hypodermic needle is used to loosen the secondary incisor teeth. When the small peg tooth is completely luxated, it is extracted with small extraction forceps or thin hemostats, taking care to avoid crushing the tooth. After extractions, the alveoli are curetted with a needle to remove any remaining pulp tissues, and rinsed with saline or 0.1% chlorhexidine solution. The gingiva is closed with simple interrupted sutures or a purse-string suture pattern with 3-0 or 4-0 absorbable suture material to promote gingival healing. However, the extraction site is not sutured when infection is present. When using a purse-string pattern, the suture material is fixed at a minimum of 6 points through the gingiva before tightening it.

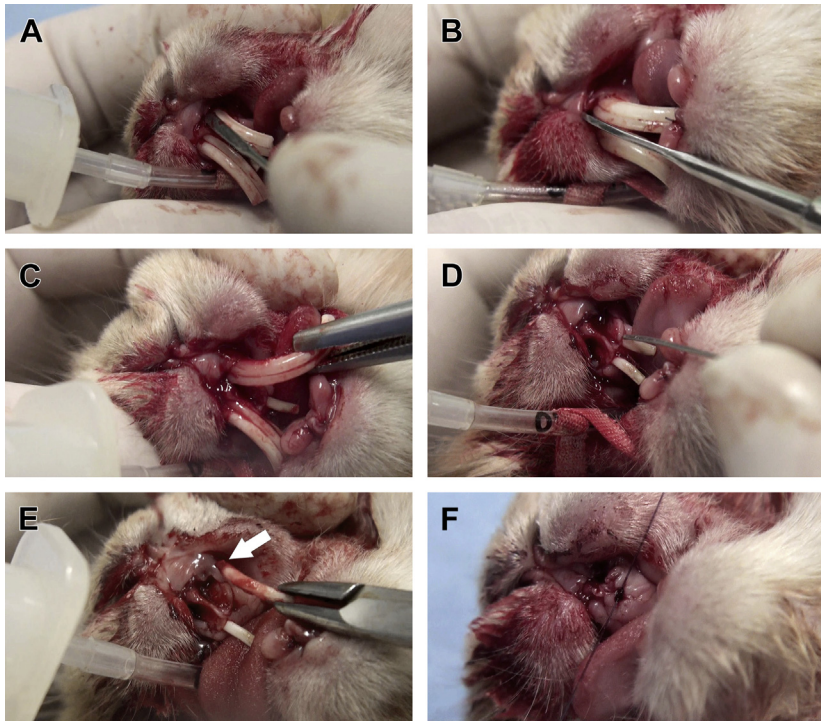

Fig. 7. Extraction of maxillary incisor teeth. (*A*) A flattened and curved contoured 18-gauge needle is used to break down the periodontal ligament on the labial aspect of the primary incisor tooth. (*B*) The maxillary edge of the Crossley luxator is inserted in the periodontal space on the mesial aspect of the tooth. (*C*) When the tooth is loosened, the clinical crown is grasped with suitable extraction forceps (a large hemostat, in this case). The tooth is pulled gently, following the natural curvature of the reserve crown, and applying a slight distal (lateral) rotation during extraction. (*D*) A flattened and curved contoured 21-gauge needle is used to perform luxation of the rostral aspect of the secondary (peg) incisor tooth. (*E*) The peg tooth is extracted using a small needle holder. Note the red germinative tissue at the apex (*arrow*), showing complete extraction. (*F*) Purse-string suture of the gingiva using 4-0 absorbable suture material (poliglecaprone, Monocryl). (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

At the end of the dental procedure, a postoperative lateral radiographic view is taken to confirm complete extraction of all 6 incisor teeth.

Incomplete removal of teeth or failure to destroy pulp tissues can result in partial or complete regrowth.[1,15] In the first case, a bud of reserve crown may regrow, not followed by eruption of a clinical crown. This latter case is rare,[18] and can be addressed should it occur.

Possible complications are represented by fracture of the incisive bone and retention of fragments in the case of preexisting tooth ankylosis, and dehiscence of the gingival suture. Extraction of the retained reserve crown may require an extraoral approach.[15] Dehiscence typically heals by second intention and does not require specific treatment.[1]

Coronal reduction

Coronal reduction is limited to selected cases in which malocclusion is minimal, has been diagnosed early, and proper occlusion of both incisor and cheek teeth can be restored.[1,2,10]

Trimmers, clippers, or similar instruments must not be used because they do not allow the restoration of a normal incisal edge, and frequently lead to complications such as fractures, damage of the apical germinative tissue, pulp exposure, endodontic infection, and periapical abscessation.[1]

Reduction of coronal length and reshaping of the occlusal plane must be performed on anesthetized patients with a fissure-cut bur on a high-speed angled dental handpiece, or with a diamond disc on a low-speed straight handpiece. In case of pulp exposure, partial pulpectomy and pulp capping have been described.[1,14]

Treatment of Cheek Teeth

Coronal reduction

Coronal reduction of clinical crowns of cheek teeth is intended to restore the coronal length and the occlusal planes as close as possible to normal anatomy.[2,7,19] It should be performed with a low-speed straight handpiece and longer grinding-type burs that can be safely introduced into the small oral cavity of the rabbit. Small rasps and molar cutters should not be used.[1]

Standard orotracheal intubation may be routinely performed during anesthesia for intraoral procedures. However, depending on the rabbit's size, effective application of mouth gag and cheek dilators, and the difficulty of the procedure, the orotracheal tube may significantly hamper the movements and the procedure. Although intubation is a mainstay of anesthesia, intraoral procedures should never be suboptimal because of the endotracheal tube. Injectable anesthetic protocols combined with face mask, and nasal or nasotracheal intubation, may be effective alternative options.

Depending on severity of acquired dental disease, coronal reduction may be more or less effective. With regard to prognosis for treatment of malocclusion, several considerations should be kept in mind and discussed with the owner[19]:

1. Coronal reduction is a palliative treatment by default, because acquired dental disease is progressive.[20] Apart from very early stages at which minimal correction would help normal chewing preventing further changes, coronal reduction does not stop or address the underlying bone and/or dental disease.
2. The goal of proper coronal reduction is burring of spurs, restoration of the proper length of clinical crowns, and restoration of an even occlusal plane. Even is mostly synonymous with flat, and does not correspond with anatomically normal. Clinicians are aware that it is impossible to restore the normal zigzag occlusal plane, and slightly bent in a dorsoventral and rostrocaudal direction.
3. Coronal reduction does not address abnormal elongation of reserve crowns. Despite this obvious limitation, it does help to relieve pain. Elongation of apices of cheek teeth leads to pressure, deformity, and even perforation of the periapical cortical bone, which may be painful. When clinical crowns are elongated, coronal reduction helps to reduce apical pressure during chewing movements.
4. Coronal reduction does not address abnormal curvature of reserve and clinical crowns. Depending on the severity of this trait of dental disease, formation of new spurs occurs more or less frequently. The owners should be informed that repeated intraoral treatments may be necessary for the patient's life. However, the slowing or cessation of eruption caused by advancing dental disease and repeated treatments usually occurs.

Despite this being a palliative procedure compared with the normal anatomy of cheek teeth, coronal reduction is usually very effective, and it dramatically improves the patient's clinical condition.

With regard to the dental procedure, several points and tips should be considered:

1. The simple burring of spurs does not represent a proper and complete dental treatment. This procedure relieves some pain and allows healing of mucosal wounds, but the discomfort elicited by the excessive elongation of clinical crowns and the abnormal occlusal plane is not improved. This omission leads to partial remission of symptoms, and to frequent relapse.
2. Coronal reduction must never be performed beyond restoration of normal length in order to reduce time until the next dental treatment; for example, burring all cheek teeth to the gingival level. Excessive coronal reduction results in improper occlusion with risk of increased discomfort and/or exposure of the pulp. Also, excessive coronal reduction may result in exposure of the pulp cavity,[20] eliciting pain and predisposing to endodontic disease.
3. However, abnormal elongation of clinical crowns of mandibular cheek teeth is accompanied by stretching or hyperplasia of the gingiva in some patients. This stretching or hyperplasia may allow the clinical crowns (the portion of the tooth beyond the gingival margin) of cheek teeth (in particular the mandibular) to appear normal at intraoral inspection, whereas the reserve crown is elongated, both the portion inside the alveolus and the short portion buried under the gingival margin but not within the socket. In order to detect this misleading abnormality, clinicians must carefully compare the visual findings at intraoral inspection with the radiographic findings in the lateral projection of the skull (**Fig. 8**). Because the radiograph does not show any evidence of gingival tissue, the whole length of the cheek teeth (from the occlusal plane through the apex) can be properly evaluated. In this case, the clinical crown will have to be burred shorter than the gingival margin. The clinical crown will appear shorter than normal, but the whole length of the tooth will be correct.
4. Some patients have severe step mouth (uneven length of adjacent cheek teeth), in which a clinical crown might be longer than normal, and others might be shorter than normal. The abnormally short clinical crowns should not be used as a landmark for restoration of an even occlusal plane. Doing so can result in excessive reduction of length. If 1 or more cheek teeth are shorter than normal, the final result will still be a form of step mouth, because the elongated (or the normal) clinical crowns will be longer than those that are abnormally short.
5. Special attention must be paid to coronal reduction of elongated mandibular CT4 and CT5, because the lower alveolar vein lies just under the mucosa of the pharyngeal commissure, in close proximity. Accidental injury of this vein may cause significant intraoral hemorrhage.

In general, when early diagnosis and treatment are performed before severe changes of the cheek teeth have occurred, coronal reduction combined with proper nutrition is often effective in preventing ongoing dental disease.[20]

The dental procedure consists of the application of a rotating bur to the dental occlusal surface. The tooth is moistened with saline before coronal reduction to reduce the amount of tooth dust and prevent thermal injury to dental pulp.[1,2,10,19–21]

Proper coronal reduction of cheek teeth can be verified with a post-treatment radiograph in lateral projection, which is compared with the same projection taken before the intraoral dental treatment.

Extraction

Indications for extraction of cheek teeth are significantly different from indications for extraction of incisor teeth.[19] Although incisor teeth can be extracted with a good anatomic and functional prognosis, cheek teeth play a primary role for normal crushing

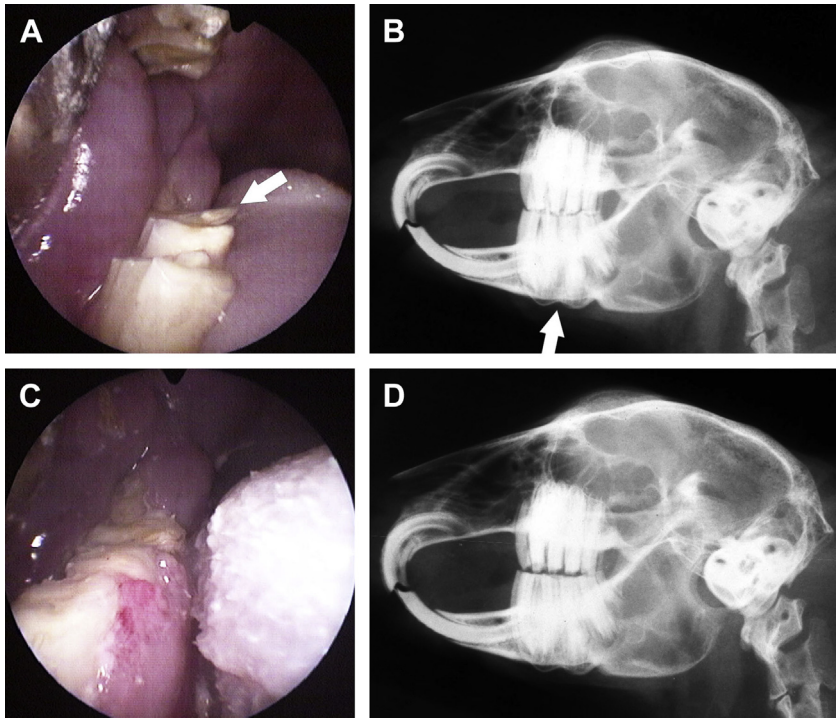

Fig. 8. Coronal reduction of cheek teeth, as seen from stomatoscopic and radiographic viewpoints. (*A*) Elongation and malocclusion of clinical crowns of the right mandibular cheek teeth arcade. Clinical crowns of CT1, CT3, and CT4 are bent lingually. Step mouth is present, as well as a lingual spike on CT4 (*arrow*). Dental disease of mandibular cheek teeth arcades was bilateral, associated with mild elongation and malocclusion of the clinical crowns of maxillary cheek teeth arcades. (*B*) Radiography in the same patient, laterolateral view. Overall elongation of reserve crowns of cheek teeth is present, with deformity of the ventral cortical bone of the mandible (*arrow*). The occlusal plane of cheek teeth is abnormal, and the normal zigzag radiotransparent line is lost. (*C*) Right mandibular cheek teeth arcade in the same patient, after coronal reduction. The occlusal plane is now even. Note the apparently short clinical crowns, caused by stretching or hyperplasia of the gingiva. (*D*) Control radiograph postoperatively following coronal reduction. Even though it is impossible to restore the normal occlusal plane, a small gap is present between the cheek teeth arcades, and the occlusal plane is more regular. Also, the control radiograph shows that coronal reduction was adequate, considering the gingival elongation masking part of the clinical crown of the cheek teeth. (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

of food, and the goal of therapy should be retention of as many cheek teeth as practically possible.[15,19] Dental indications for carnivorous mammals typically include the extraction of a tooth that is significantly damaged and this may not apply to rabbit dentistry. Because of the peculiar palisade pattern of rabbit cheek teeth, extraction of even a single tooth may cause instability of adjacent teeth.

Indications for extraction of cheek teeth include:

- When a cheek tooth is loose
- When a tooth is associated with periapical infection (typically it is also loose)
- When a cheek tooth is fractured; sometimes complete extraction of the reserve crown is not b possible, as in the case of some longitudinal fractures

- For selected teeth (ie, maxillary premolars) to reduce the need for frequent and repeated coronal reduction
- In selected cases, special extractions might be required, as in the case of diseased maxillary molars to create access to the alveolar bulla for treatment of empyema or a retrobulbar abscess

The 2 sharp working ends of the Crossley luxator for cheek teeth are used to sever the periodontal ligaments on all 4 aspects of the cheek teeth[1,2,10,19,21] (**Fig. 9**). Luxation and extraction are easier depending on the degree to which a diseased tooth is loose. Because of the small size, the short clinical crown, and the long reserve crown of cheek teeth, small extraction forceps with tips angled at about 100° to the handle are critical to perform a proper extraction.

When a cheek tooth is extracted, it is not necessary to extract the opposing tooth because:

- With the exception of the maxillary CT1 and CT6, the occlusal plane of every cheek tooth matches with 2 portions of the occlusal plane of opposing teeth, in a domino fashion
- Overgrowth of opposing teeth can be controlled with repeated coronal reductions

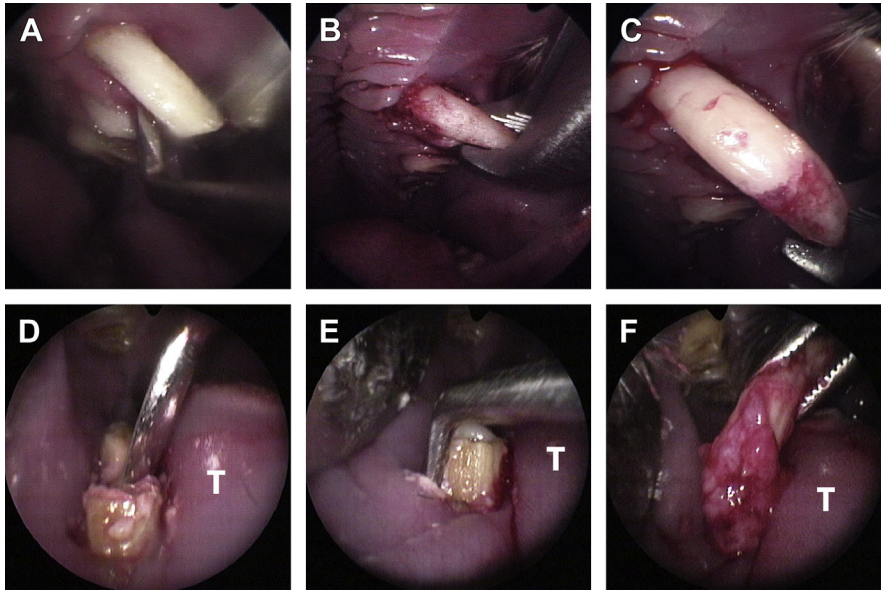

Fig. 9. Extraction of cheek teeth. Extraction of the left maxillary CT1 (*A–C*) and the right mandibular CT1 (*D–F*). (*A*) The perpendicular end of the Crossley luxator for cheek teeth is inserted on the distal aspect of the diseased tooth. (*B*) After luxation on the 4 aspects and when the tooth is loosened, the clinical crown is grasped with the extraction forceps (standard size, in this case) and (*C*) extracted following the abnormal curvature of the diseased reserve crown. (*D*) The perpendicular end is inserted on the distal aspect of the diseased tooth, affected by periapical infection. (*E*) The other end of the Crossley luxator works the buccal aspect of the tooth. Pus is visible on the distal aspect, after luxation of that side. (*F*) The clinical crown is grasped with the extraction forceps (small size, in this case) and extracted. The elongated and deformed reserve crown and apex are clearly visible. T, tongue. (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

- Acquired dental disease may eventually result in slowing or arrested elongation of opposing teeth
- Contact between the dental occlusal plane and gingiva may provide sufficient and effective wearing

Combined intraoral and extraoral extraction

For information on surgical treatment of periapical infections, debridement of odontogenic abscesses and osteomyelitis, and related extraoral extraction of cheek teeth (or their fragments), please see Vittorio Capello: Surgical Treatment of Facial Abscesses and Facial Surgery in Pet Rabbits, in this issue.

When the reserve crown of cheek teeth is fractured (even with multiple fragments), or when ankylosis of the reserve crown is present, complete extraction from the intraoral approach is not possible. In these cases, complete extraction of the remainder of the reserve crown may require a combined intraoral/extraoral approach. Extraction of the clinical crown and part of the reserve crown is performed intraorally; extraction of the remaining reserve crown is performed through the extraoral approach.[1,2,15]

Suture of the gingiva

Suture of the gingiva may or may not be performed after extraction of cheek teeth[19] (**Fig. 10**). Because of small patient size and the narrow opening of the oral cavity, it

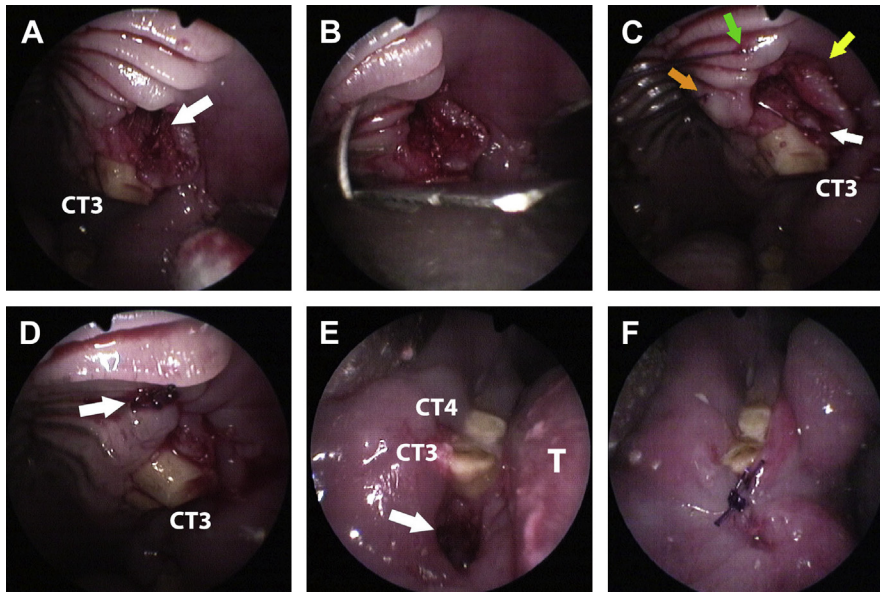

Fig. 10. Suture of the gingiva after extraction of maxillary (*A–D*) and mandibular (*E*, *F*) cheek teeth. (*A*) Large defect after extraction of both left maxillary premolar teeth (*arrow*). (*B*) The curved needle of a 5-0 absorbable suture material (poliglecaprone, Monocryl) is inserted through the palatal mucosa to create a horizontal mattress suture between the palatal mucosa and the gingiva. (*C*) The suture passes through the palatal mucosa (*green arrow*), laterally through the gingiva (*yellow arrow*), again through the gingiva on the same buccal side (*white arrow*), and back again through the palatal mucosa (*orange arrow*). (*D*) The suture is tightened (*arrow*), closing the defect. (*E*) Large defect after extraction of both right mandibular premolar teeth (*arrow*) (*F*) Suture of the gingiva in a mattress fashion using a 5-0 absorbable suture material (poliglecaprone, Monocryl). (*Courtesy of* Vittorio Capello, DVM, Milano, Italy; with permission.)

is a challenging procedure that requires proper lighting, magnification, and instruments. A small and long needle holder, and fine-tipped scissors are particularly useful. Special suture material with a curved needle is available from dental suppliers, otherwise an ordinary curved needle can be bent appropriately to allow suture of margins inside the small space.

As a general guideline, gingival suture should be performed anytime it is feasible and the defect is large, and when periapical infection is not present. In case of infection, the gingiva is allowed to heal by second intention. Gingival suture after extraction of 1 or 2 proximal mandibular cheek teeth may be performed in cases of combined extraoral access for debridement of osteomyelitis and marsupialization. If feasible, suture of the gingiva is designed to prevent drainage of food debris through the osteomyelitic site, or the formation of an oral/extraoral permanent fistula.

Suture is deliberately not performed after extraction of several maxillary molar teeth when the goal is to maintain patency with the alveolar bulla.

Complications

Complications during intraoral procedures are rare. Flat or curved spatulas are designed to reflect the tongue and soft tissues, and to protect them during coronal reduction. Hemorrhage from the lower alveolar vein should be prevented when the most distal (caudal) cheek teeth are manipulated.[19] In some patients affected by advanced dental disease of maxillary cheek teeth with severe elongation and deformity of reserve crowns, luxation might accidentally damage the descending palatine artery or the maxillary artery. Hemorrhage of these important vessels may be challenging to control and requires the use of gelatin sponge hemostatic material and/or pressure.

SUMMARY

The intraoral treatment of dental disease in pet rabbits follows a complete clinical examination, intraoral inspection under general anesthesia, and diagnostic imaging. The most common intraoral procedures are extraction of incisor teeth, coronal reduction, and extraction of cheek teeth. These dental procedures require specific instruments and equipment.

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