Rabbit and Rodent DENTISTRY

HANDBOOK

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Dipl ECZM-Small Mammals, Dipl ABVP-ECM

With Margherita Gracis, DVM, Dipl AVDC and EVDC

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FOREWORD

There are many books available on rabbit and rodent medicine but few include a serious look at dental disease, and with a couple of exceptions, those that do tend to be poorly illustrated. It is therefore very nice to see this book which brings together basic scientific knowledge and presents it along with graphical illustration of the range of pathology and practical treatment methods.

Owners now expect to have their animals, of whatever species, treated appropriately placing increasing pressures on their veterinarians. Luckily an increasing proportion of these owners realize that it costs money to obtain the necessary specialized equipment and skills to treat the less frequently seen species, and that they have to pay a professional fee for veterinary treatment. Long gone are the days when the limit to what an owner would pay was the cost of a new animal.

Whilst there were some dedicated "rabbit" surgical and dental instruments available at the time I qualified (27 years ago) the selection was very limited: a mouth gag, a cheek dilator and a totally inappropriate rasp for grinding overlong cheek teeth. Without the right equipment we are severely limited in the quality of work we can offer. This has changed dramatically over the last 10 years. An increasing number of dedicated instruments are being produced as the result of work done by a small number of pioneers of good "exotic" animal dentistry. At the last count there were 11 different commercial designs of rabbit and rodent incisor elevators and luxators on the market, one new design per year since the first was introduced.

Medicine advances rapidly, the amount of knowledge doubling every 5-10 years. General technological advances occur at a similar rate and with each advance the cost of equipment falls in real terms. Air driven dental units, ultrasound scanners and video-endoscopic instrumentation are now affordable by most veterinary clinics, opening up the possibility of their use in all species, not just cats and dogs. Endoscopes are particularly useful for examining inside small openings, such as the mouths of rabbits and small rodents. As can be seen from the illustrations in Chapter 6, these are very useful both for diagnostic examination and for observation during treatment.

David Crossley

PREFACE

Exotic or non-traditional pet species are increasing in popularity worldwide. As a result, veterinarians interested in the medicine and surgery of these special species are faced with challenges to provide the highest quality care.

More and more continuing education seminars and publications describe advanced exotic medicine and surgery topics such as endoscopy, orthopedics, surgery and others. Recently, the subject of rabbit and rodent dentistry has received considerable attention.

In the past, dental disease of rabbits was described simply as "slobbers," "lumps," or simply "malocclusion" with little thought to underlying etiology. Today, the many differing clinical signs, symptoms, and etiologies are well recognized and more properly grouped as a syndrome, including primary dental disease, and dental disease secondary to other underlying conditions.

In addition, dental disease is being recognized in rodent species as well, and it is clear these species with their unique anatomical and physiological differences often require a slightly different diagnostic and treatment approach.

The primary goal of the Rabbit and Rodent Dentistry Handbook is to provide the practitioner with a useful tool to aid in the diagnosis and treatment of dental disease in these various species. Veterinarians new to exotic mammal medicine will appreciate sections focusing on gross and radiographic anatomy, physiology, and visual and endoscopic examination techniques. Another chapter describes dental instrumentation and equipment. Of primary importance are chapters on the manifestations of dental disease and treatment recommendations. Many procedures are described in step-by-step detail.

The handbook utilizes a modern visual style with over 1000 full color photos and accompanying text, a style well recognized by those familiar with Exotic DVM magazine and the various excellent publications produced by Zoological Education Network.

We owe a special acknowledgement to Dr. David Crossley, our friend and mentor, who has kindly provided many charts, illustrations and photographs for this handbook. We would also like to thank Dr. Ayako Okuda, who provided additional much needed support for this project.

Vittorio Capello

VITTORIO CAPELLO

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Dr. Vittorio Capello graduated in 1989 from the School of Veterinary Medicine of the University of Milano, Italy. He has practiced exotic animal medicine exclusively since 1993, providing professional services for two veterinary clinics in Milano. Dr. Capello's focus has been the medicine and surgery of small exotic pets, in particular rabbits, rodents and ferrets.

Dr. Capello has lectured, published and taught exotic animal courses and practical laboratories throughout Italy and other parts of Europe, and is a frequent guest lecturer at the International Conference on Exotics, where he was voted most appreciated speaker two years in a row. He has written articles for Exotic DVM Magazine and the Journal of Exotic Mammal Medicine and Surgery. Other works include the Small Rodent Surgeries section in "The Exotic Guidebook" (Zoological Education Network) and an educational CD for Italian veterinarians on the medicine and surgery of the pet hamster. Dr. Capello is a member of the advisory board of Exotic DVM magazine.

MARGHERITA GRACIS

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Dr. Margherita Gracis graduated in 1993 from the Veterinary School of the University of Milano, Italy. After working in private practice for a few years, she completed a Residency in Veterinary Dentistry at the Veterinary School of the University of Pennsylvania, Philadelphia (USA). From 1998 until 2000 she worked at the same institution as a lecturer in Veterinary Dentistry. Since 2000, Dr. Gracis has been working at two referral clinics in Milano (Italy) and in Monza (Milano, Italy), dedicated to dentistry and oral surgery. She is a Diplomate of both the American (AVDC) and the European (EVDC) Veterinary Dental Colleges. Dr. Gracis is the current Past President of the European Veterinary Dental Society (EVDS) and the Italian Veterinary Dental Society (SIODOV).

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Dr. Angela Lennox graduated in 1989 from Purdue University School of Veterinary Medicine, and has practiced avian and exotic animal medicine exclusively since 1991. She is the owner of the Avian and Exotic Animal Clinic of Indianapolis. Dr. Lennox was awarded board certification in avian medicine by the American Board of Veterinary Practitioners in 2004, and is an adjunct professor at Purdue University where she teaches courses in exotic pet medicine to both veterinary and veterinary technician students. She currently serves as the President of the Association of Exotic Mammal Veterinarians. Dr. Lennox is a frequent guest lecturer at the International Conference on Exotics and the Conference of the Association of Avian Veterinarians, and has served as editor for numerous publications, including Seminars in Exotic Pet Medicine, Veterinary Clinics of North America, Exotic DVM magazine and the Journal of Exotic Mammal Medicine and Surgery. She is a member of the advisory board of Exotic DVM magazine.

CHAPTER 2

Anatomy of the Skull and Teeth

VITTORIO CAPELLO
MARGHERITA GRACIS

The distinctive anatomy of rabbits and rodents must be thoroughly appreciated in order to successfully diagnose and treat dental disease. A discussion of dental anatomy is more meaningful with an understanding of precise terms used in dentistry.

Table 2.1. Dental and Periodontal Anatomic Glossary (Figures 2.1, 2.2)

Alveolar crest	The most coronal portion of the alveolar bone
Apex	The termination or end of a tooth root. This term is also used to define the termination of aradicular (see elodont) teeth. It is normally "open" (with a single large foramen) in aradicular hypsodont teeth and immature brachyodont teeth, "closed" (with an apical delta) in adult brachyodont teeth
Apical delta	A group of fine channels at the apex of a brachyodont tooth root through which the pulp blood vessels and nerves pass
Cemento-enamel junction	Where enamel and cementum meet (corresponds to the neck of brachyodont teeth)
Crown or anatomical crown	Portion of the tooth covered by enamel
Crown, clinical	Exposed portion of the tooth within the mouth, above the gingival margin
Crown, reserve	In a hypsodont tooth, the part of the crown located below the gingival margin
Furcation	In a brachyodont tooth with multiple roots, the area where roots diverge
Gingival margin	The most coronal portion of the gingiva
Gingival sulcus	The shallow space between the gingiva and the tooth, measured from the gingival margin to the gingival attachment to the tooth surface (junctional epithelium)
Lamina dura	The wall of the dental alveolus or socket, visible radiographically as a radiopaque line
Neck	The portion of the brachyodont tooth between the crown and the root
Periodontal space	The space between the tooth and the alveolar bone occupied by periodontal ligament fibers
Pulp cavity	The pulp chamber and root canal in a tooth, containing pulp tissue
Root	Portion of the brachyodont tooth covered by cementum. The reserve crown of aradicular hypsodont teeth is often improperly referred to as "root"

Table 2.6. Dentition of Lagomorphs

Diphyodont	Deciduous and permanent sets of teeth
Heterodont	Differently shaped incisor and cheek teeth
Elodont	Continuously growing and erupting teeth that do not develop anatomical roots (also called aradicular)
Hypsodont	Long crowned teeth
Duplicidentata	Double row of maxillary incisor teeth

Anatomy of the Skull and Teeth

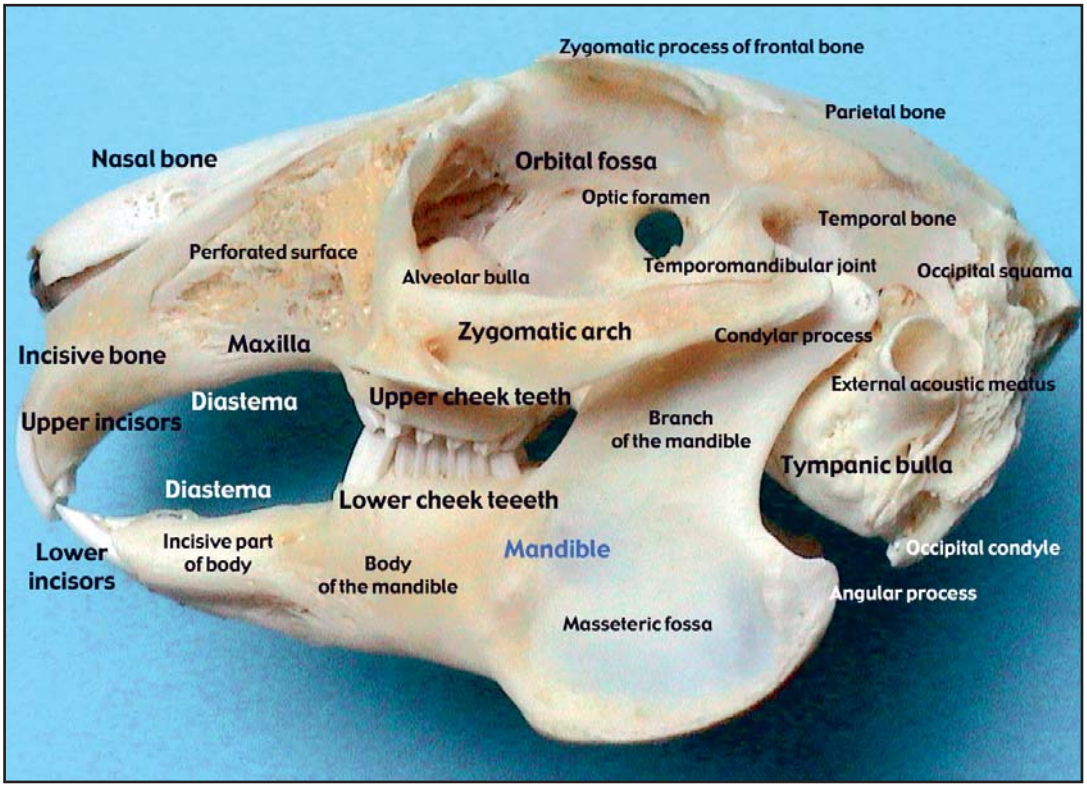


Figure 2.9. Gross anatomy of the skull of the European rabbit (*Oryctolagus cuniculus*), left lateral view. The mouth is long, with a narrow opening. Incisor and cheek teeth are separated by an edentulous gap called diastema. Lagomorphs, as well as rodents, lack canine teeth. The rabbit temporomandibular joint is dorsal to the dental occlusal plane. This skull morphology is typical of true herbivores, and is similar to larger species such as horses, cattle, sheep and goats. Also, rabbits have typical herbivorous dentition, with continuously growing incisor and cheek teeth that do not form anatomical roots. The embedded portion of the teeth, commonly referred to as the root, is in fact the so-called reserve crown (see Figure 2.2).

When the lower jaw is at rest, mandibular incisor teeth occlude between the first and second maxillary incisor teeth, and the cheek teeth are slightly separated. Cheek teeth come into direct contact only during chewing, through the movement of the mandible caudally, and shifting of the condyloid process into a step of the temporal joint surface (see Figure 3.2).

Incisor teeth of lagomorphs are anatomically and functionally similar to those of rodents, and for this reason were once classified as a suborder of rodents. However, unlike rodents with only one pair of maxillary incisor teeth, rabbits and hares usually have two pairs of teeth, namely two larger labial first incisor teeth and two smaller palatal second incisor teeth (or "peg" teeth) (Figures 2.10, 2.11). Peg teeth are cylindrical in shape, and may be absent in some individuals. The maxillary first and the mandibular incisor teeth are typically chisel-shaped. Peg teeth may protect the palate from the sharp incisal edge of the mandibular incisor teeth.

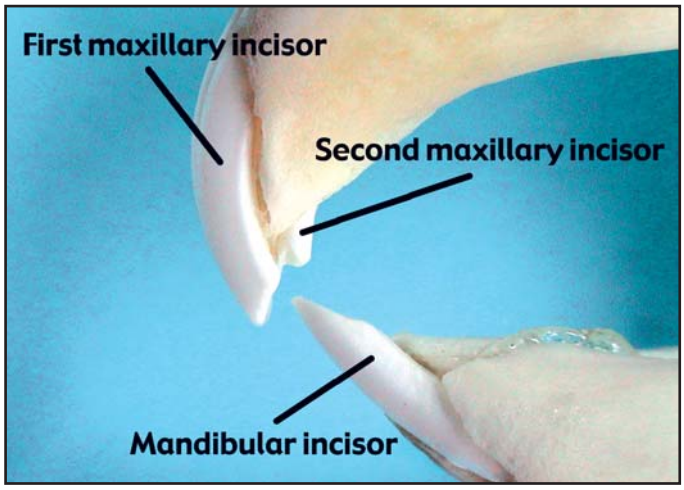


Figure 2.10. Close up of incisor teeth, gross specimen, lateral view.

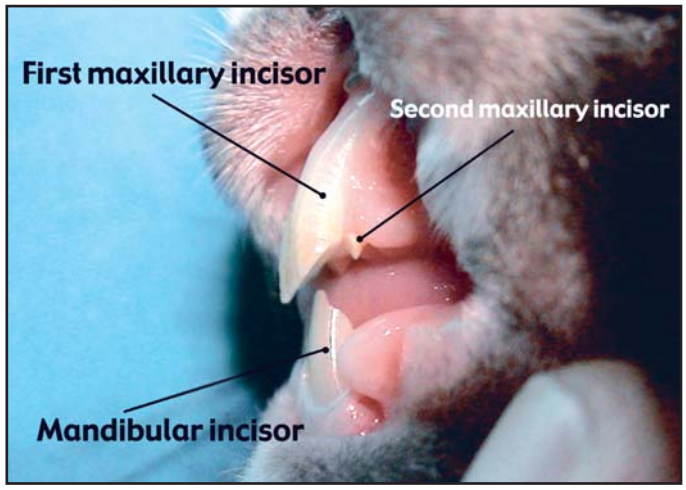


Figure 2.11. Close up of incisor teeth on live animal, lateral view.

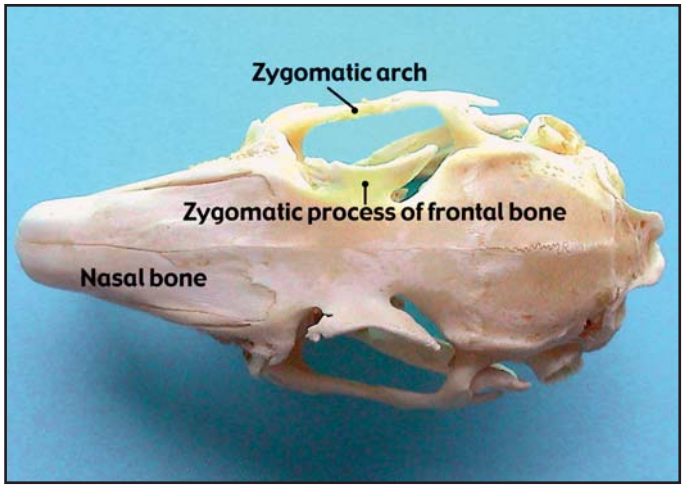


Figure 2.12. Dorsal view of the skull.

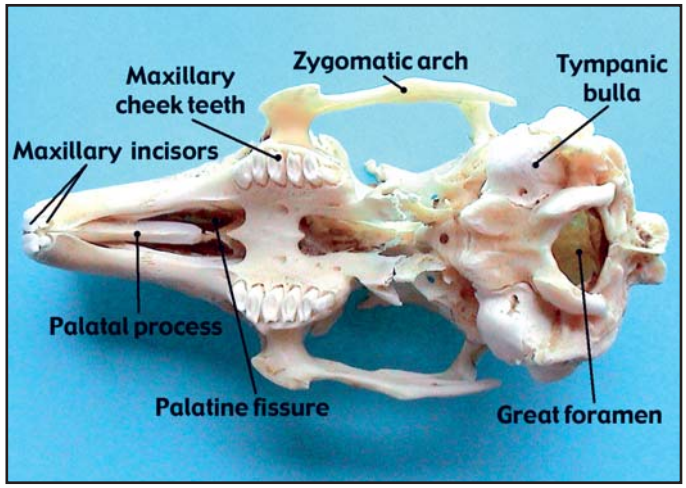


Figure 2.13. Ventral view of the skull, mandible removed.

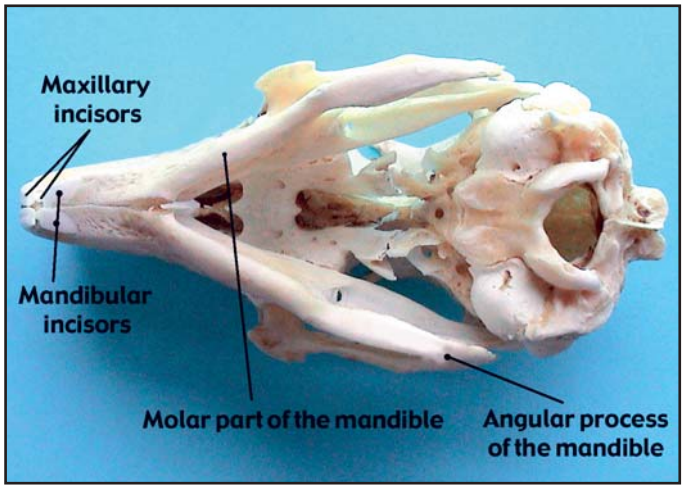


Figure 2.14. Ventral view of the skull, with the mandible in place.

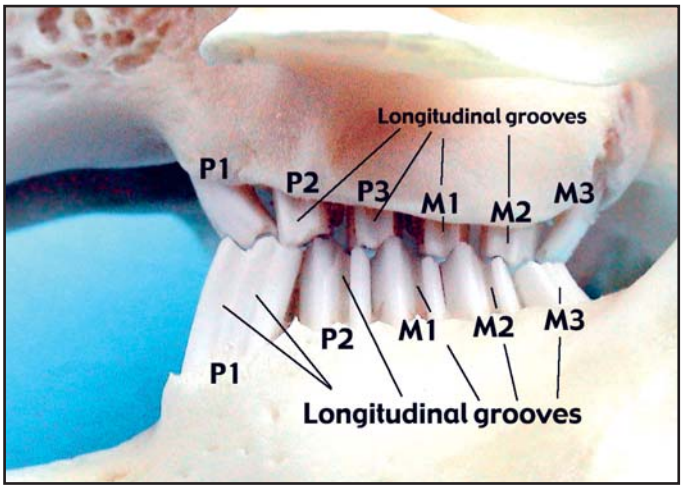


Figure 2.15. Cheek teeth. Rabbits have three premolar and three molar teeth on each maxillary quadrant, and two premolar and three molar teeth on each mandibular quadrant. Premolar and molar teeth are visually indistinguishable, and are therefore simply called "cheek teeth." Longitudinal grooves are present on the buccal surface of the cheek teeth. Transverse enamel ridges on the occlusal surface interlock with the opposite teeth during chewing, providing an efficient rough surface for grinding and crushing of fibrous food material.

As maxillary and mandibular cheek teeth differ in number, each mandibular tooth occludes with two maxillary teeth. The first and the sixth maxillary cheek teeth only occlude with the first and the fifth mandibular cheek teeth, respectively.

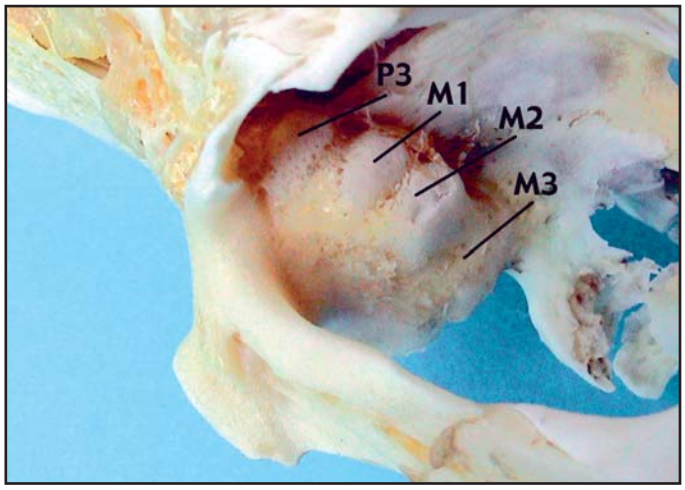


Figure 2.16. Dorsal view of the skull, focusing on the left orbital fossa. The apex of four overgrown cheek teeth can be seen protruding through the bony plate in the pterygopalatine fossa.

Table 2.7. Dental Formula

2I	0C	3P	3M	= 28
1I	0C	2P	3M	

The permanent dental formula of lagomorphs includes six incisor and 22 cheek teeth. Lagomorphs are diphyodont, with two sets of teeth. The deciduous teeth are lost just before or shortly after birth.

Deep Muscles, Arteries, Veins and Nerves

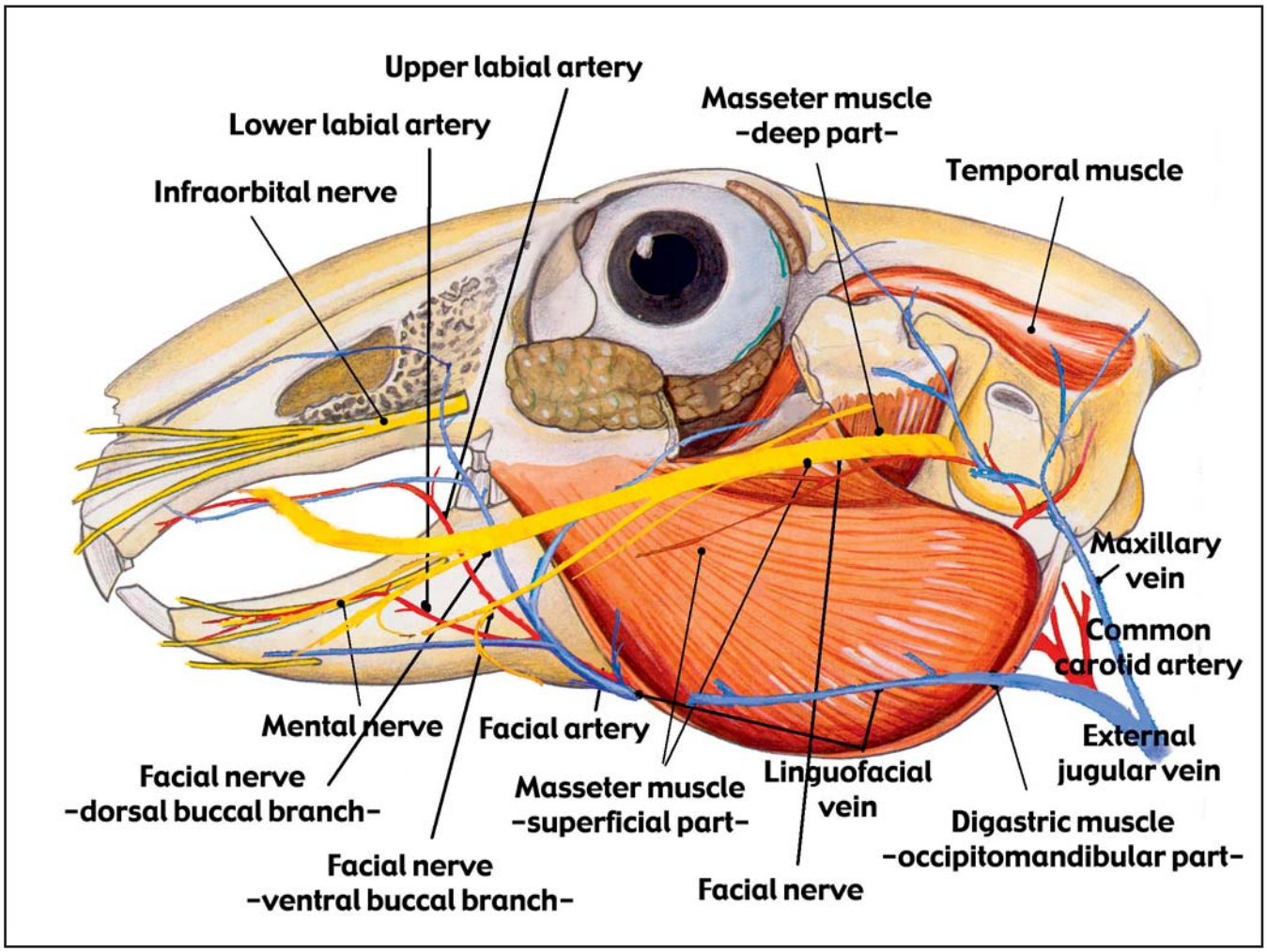
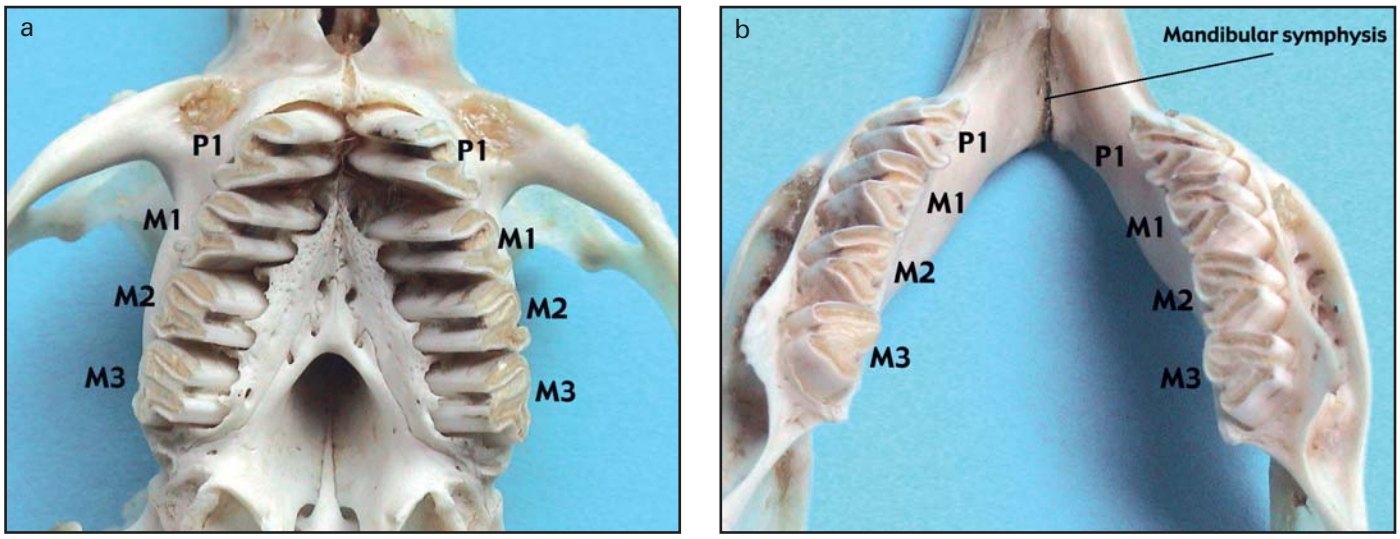
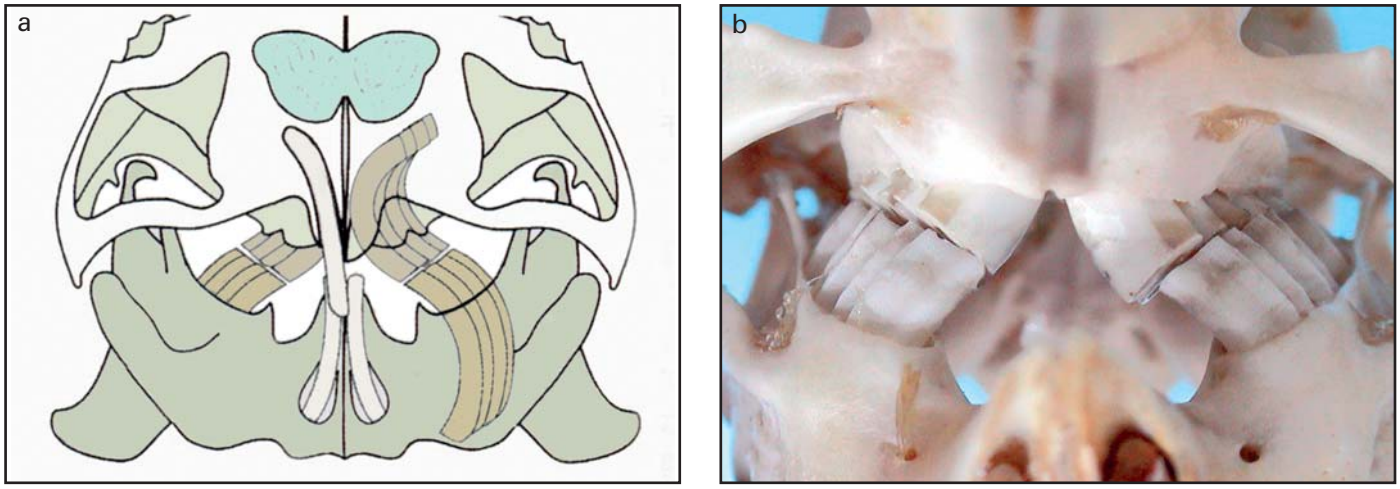


Figure 2.28. Diagram of the deep muscles, arteries, veins and nerves of the head of the rabbit, lateral view.

Reprinted from A Colour Atlas of Anatomy of Small Laboratory Animals, Vol. I, Popesko P, Rajtovà V, Horàk J, pp 32, 35, 39, 40, 1992, with permission from Elsevier.



Figures 2.40a,b. Cheek teeth. Guinea pigs and other porcupine-like rodents have one premolar and three molar teeth on the left and right maxilla and mandible. Premolar and molar teeth have no anatomical or physiological differences, and are therefore simply called "cheek teeth." Therefore, guinea pigs have four mandibular and four maxillary cheek teeth on each side, for a total of 16 cheek teeth. Deep longitudinal grooves are present on the buccal surface of the cheek teeth (Figure 2.43). Each mandibular cheek tooth occludes with one single opposing maxillary tooth. Mandibular and maxillary teeth of each arcade are aligned to form a straight line angled obliquely in a disto-mesial, bucco-palatal direction. In particular, right and left maxillary arcades converge rostrally to the point that the first cheek teeth closely meet.



Figures 2.41a,b. a) Diagram of cheek teeth of guinea pigs, skyline view. b) Close-up of a rostral view of the cheek teeth, incisors removed. The oblique occlusal plane is clearly visible. Guinea pigs are anisognathic, with the mandible much wider than the maxilla. The maxillary dental arcades are therefore closer to each other than the mandibular arcades. The cheek teeth of guinea pigs normally come in full occlusion when the jaw is at rest. The mandibular teeth are curved with a pronounced buccal convexity, and the maxillary teeth with a prominent palatal convexity. This results in a 30 degree oblique occlusal plane that slopes from buccal to lingual, dorsal to ventral.

Illustration modified from Crossley DA: Clinical aspects of rodent dental anatomy, J Vet Dent 1995, 12: 131-135 with permission.

CHAPTER 5

Radiology of the Skull and Teeth

VITTORIO CAPELLO
MARGHERITA GRACIS

EQUIPMENT AND INSTRUMENTS

Radiographic examination of the skull and teeth is an essential diagnostic tool in cases of suspected dental disease in lagomorphs and rodents. Multiple views are necessary for a full evaluation; the diagnosis should not be based on any single radiographic image. The radiographic series should always include a lateral skull view, two lateral oblique skull views, and a ventrodorsal or dorsoventral skull view. A rostral skull view and one or more intraoral dental views may also be useful. Deep sedation or general anesthesia is usually necessary for perfect positioning. For some anesthetic procedures, larger rabbits and rodents are intubated. However, for the purposes of skull radiography, an endotracheal tube may interfere with the image.

Figure 5.1. Good quality skull radiographs can be obtained with the use of standard radiographic equipment and screen films.

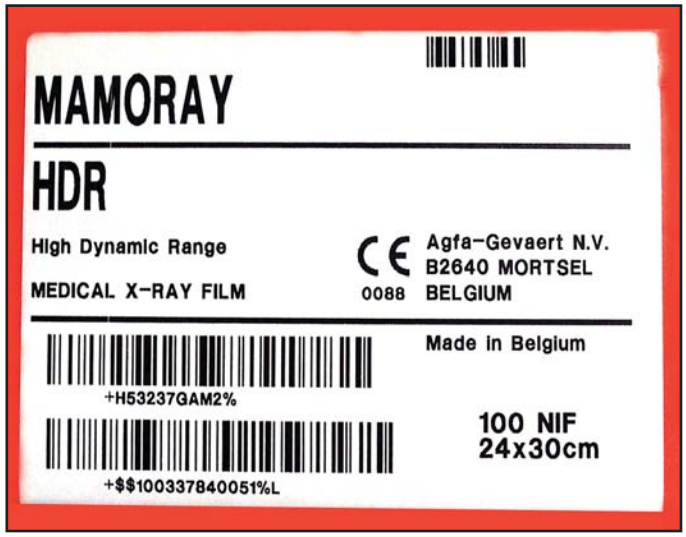
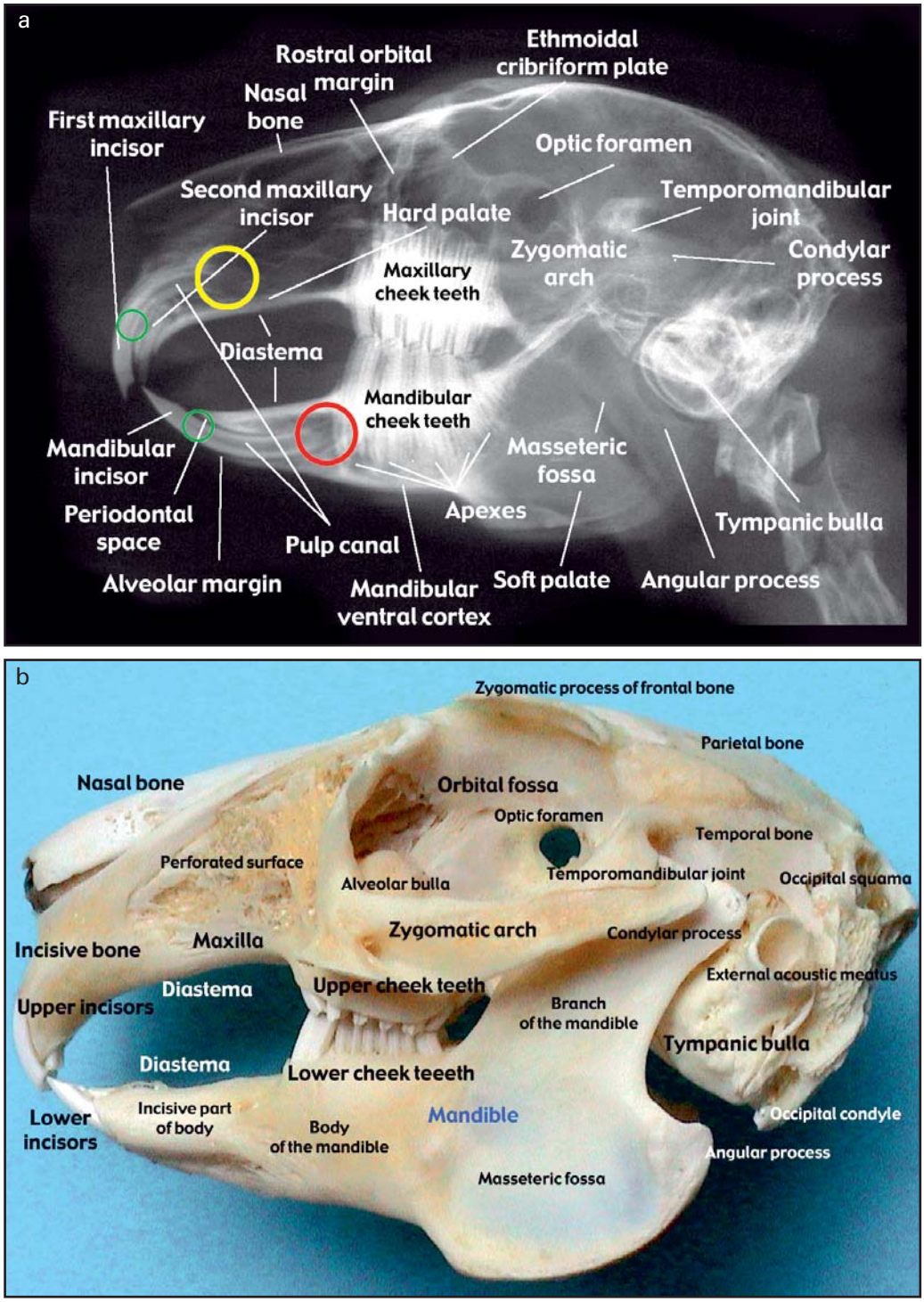


Figure 5.2. High-resolution mammography x-ray films are particularly advantageous.

Skull Radiographs: Lateral View, Radiographic Anatomy



Figures 5.14a,b. The apex of the mandibular incisor teeth (a, red circle) normally extends to the level of the ipsilateral first cheek tooth. Maxillary incisor teeth are more curved than mandibular incisors, and their apex is normally located half the length of the diastema, at some distance from the corresponding radiopaque hard palate (a, yellow circle). The tip of the radiolucent pulp system of normal incisor teeth usually extends to the level of the alveolar ridge, or just above it (green circles). The maxillary second incisor teeth (peg teeth) are short and small, with a slight curvature. The buccal alveolar margins of both maxillary first and mandibular incisor teeth are more apical than the palatal and lingual margins. Note the regular, smooth palisade formed by the cheek teeth. The mandibular cheek teeth apexes are at some distance from the ventral cortex of the mandible.

DENTAL DISEASES OF CHEEK TEETH

Many different patterns of abnormalities from mild to severe may be recognized in cases of acquired dental disease of cheek teeth (ADD). The severity of the pathologic changes can be staged. Both radiography and endoscopy are important for staging of ADD, and endoscopy in particular allows a more detailed examination of the oral cavity. Thorough evaluation and diagnosis are particularly important, as the patient's clinical signs may be mild or may be absent.

Early diagnosis is the key to early treatment and resolution of lesions involving soft tissues of the gingiva, tongue and oral mucosa (see Chapter 12), which can be a source of constant pain in the pet rabbit. Prompt treatment will also prevent the progression of dental disease.

Stages of Cheek Teeth Malocclusion and Acquired Dental Disease

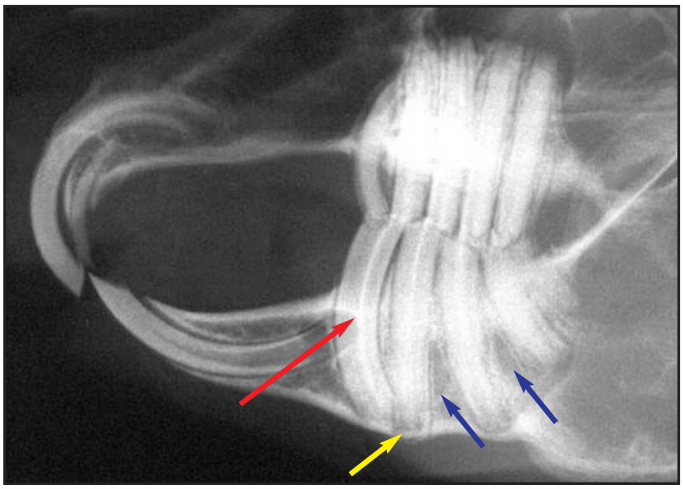


Figure 8.35. The earliest stage of acquired dental disease (ADD) of cheek teeth in rabbits is elongation of the crowns. Because both the reserve crown and the clinical crown begin to take up more space, abnormalities related to increased pressure begin to occur. The zig-zag pattern of the cheek teeth occlusal plane is still normal (see Figure 5.13), but the radiolucent line is less visible when the mandible is at rest, even in a proper lateral projection. Pressure on the reserve crowns begins to increase when the animal chews. Since there is not another tooth cranial to the first premolars, they begin to curve, with increasing mesial convexity (red arrow).

In some early cases, slight deformation of the ventral mandibular cortical bone due to the increased pressure may be visible (yellow arrow). Due to the abnormal convexity, interproximal space of mandibular cheek teeth begins to widen (blue arrows). Malocclusion of incisor teeth is usually not present at this stage.

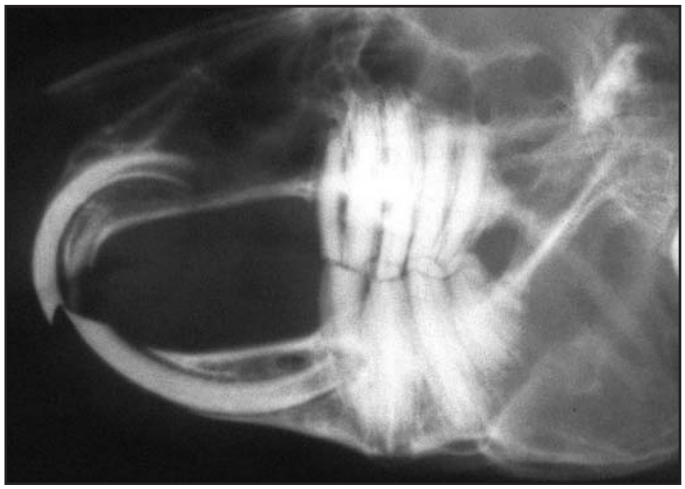


Figure 8.36. ADD of cheek teeth, later stage. Abnormal changes to the occlusal plane due to excessive and irregular crown elongation are clearly visible, with height differences between adjacent molars of up to a few millimeters. An irregular zig-zag radiolucent line or the superimposition of two different zig-zag lines are present. This abnormal occlusal plane is called "wave mouth." Mandibular cheek teeth root deformities are also visible. Malocclusion of incisor teeth is not still present.

CHAPTER 12

Dental Procedures

VITTORIO CAPELLO
MARGHERITA GRACIS

REDUCTION OF INCISOR HEIGHT IN RABBITS

Elongated incisor teeth may require reduction to allow normal food prehension and in many cases, to help restore the normal occlusion of the cheek teeth. However, aradicular hypsodont teeth often grow very quickly, at an average rate of 2 mm per week for maxillary incisor teeth and 2.4 mm per week for mandibular incisor teeth. Therefore, this procedure may need to be repeated frequently. Incisor reduction is indicated when malocclusion is mild and can be readily corrected. Extraction may be more appropriate in case of severe malocclusion.

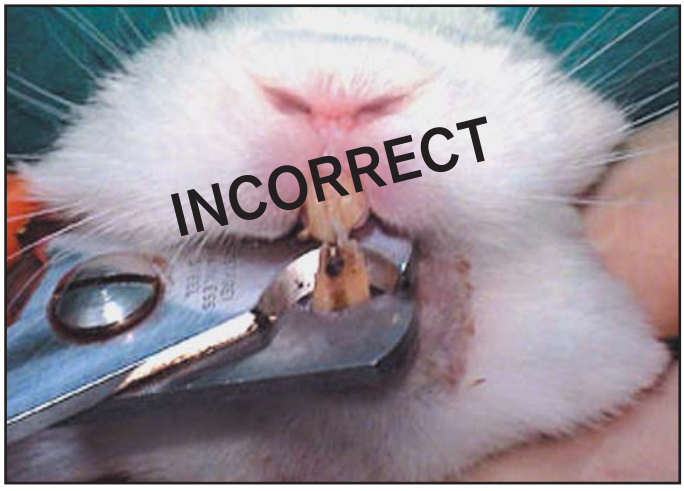


Figure 12.1. Simple amputation of overgrown incisor teeth with nail clippers or other similar instruments must be discouraged, as this technique is associated with patient discomfort and a high rate of potentially severe complications, including vertical fractures. Fractures and the application of these types of forces to the teeth can lead to damage of the apical germinal tissues. Clipping does not allow the restoration of a normal incisal edge, and creates rough surfaces that can produce secondary injuries to the tongue and lips.

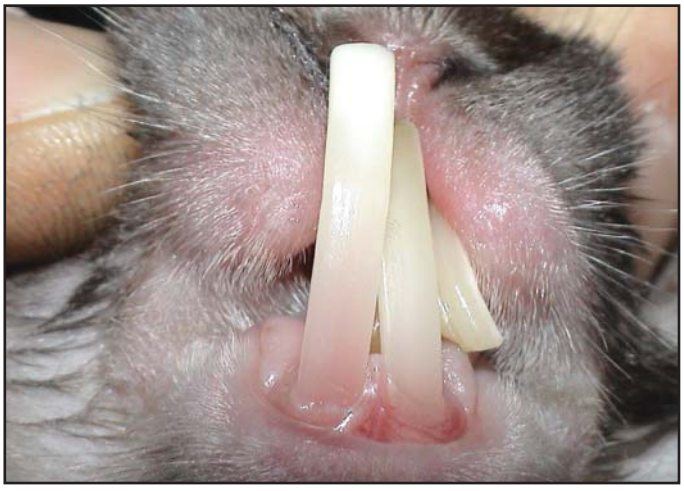


Figure 12.2. The pulp system of elongated incisor teeth often extends beyond the gingival margin and may be seen as a pink discoloration of the clinical crown.

EXTRACTION OF ARADICULAR HYPSODONT TEETH

Feeding behavior is not negatively impacted by the extraction of incisor teeth. Lagomorphs and rodents without incisors use their lips and tongue for food prehension.

Indications for extraction of incisor teeth include congenital or acquired severe malocclusion, dental fractures, and endodontic and periapical disease.

The following technique is useful for extraction of incisor teeth in lagomorphs and rodents. Anatomical differences should be understood and can be appreciated radiographically before attempting extraction. Some rodents, like hamsters, rats and prairie dogs, have very large maxillary teeth and extremely long mandibular incisor teeth when compared to rabbits.

EXTRACTION OF MANDIBULAR INCISOR TEETH

Figure 12.79. The patient is anesthetized and placed in dorsal or preferably lateral recumbency. The gingiva is scrubbed with dilute 2% povidone iodine or 0.05-0.1% chlorhexidine solution.

Figure 12.80. The tip of a #11 or #15 scalpel blade is inserted into the gingival sulcus to incise the gingival attachment circumferentially around the entire tooth.

Figure 12.81. Luxators are then used to progressively loosen and sever the periodontal ligament fibers, freeing the tooth from the alveolus. A luxator is inserted into the periodontal space on the mesial side of the tooth and rotated slightly along the tooth long axis until a resistance is felt. It is then held in position for a few seconds to stretch and disrupt the periodontal ligament fibers. Care should be taken when working on this aspect of the tooth to avoid mandibular symphyseal separation, which is much less likely than in smaller rodents, but a possible complication. Applying leverage should be carefully avoided as transverse forces predispose to tooth fracture. The free hand should be used to hold and stabilize the mandible at all times. The tip of the luxator should be gradually moved toward the apex of the tooth. The same procedure is performed on the distal aspect of the tooth. Care must be taken to insert the instrument between the alveolar walls and the tooth, rather than alveolar walls and surrounding soft tissue, to avoid damage to nearby vessels and nerves.

MARSUPIALIZATION

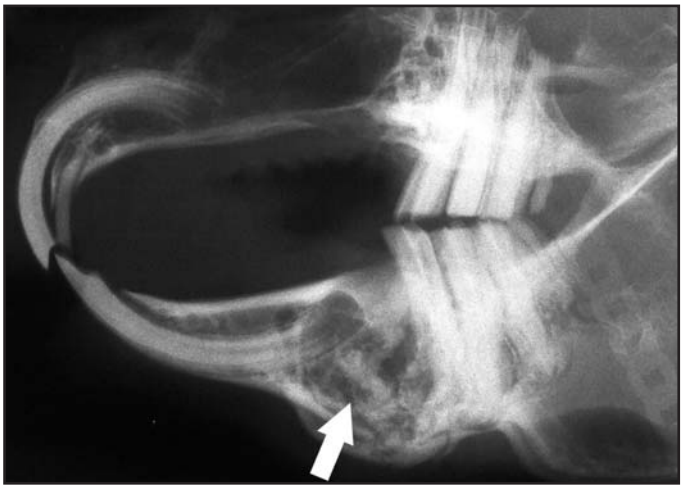


Figure 13.1. Abnormalities seen on this lateral radiograph are consistent with mandibular osteomyelitis. A fragment of mandibular CT1 (arrow) is visible in the circular radiolucent lesion that likely represents purulent material. Right and left maxillary premolar teeth had been previously extracted.

Figure 13.2. The rabbit is anesthetized and placed in lateral or dorsal recumbency, depending on the site of infection. The area is shaved and aseptically prepared.

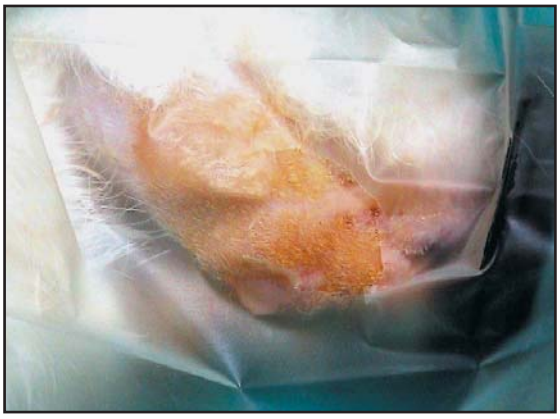


Figure 13.3. An adhesive transparent drape is placed on the surgical field, facilitating view of the orientation of the head.

Figure 13.4. A 1-2 cm skin incision is made over the firm mass, taking care not to enter the underlying abscess.

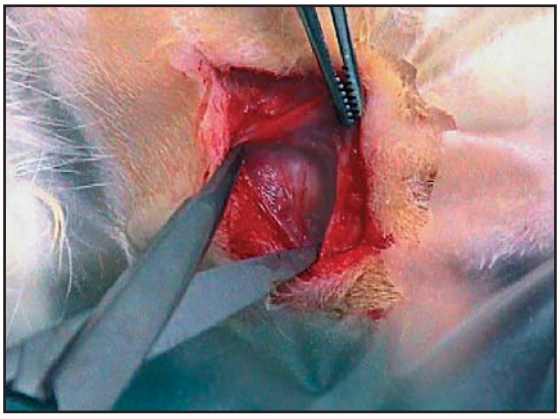


Figure 13.5. Subcutaneous tissue and muscle layers are gently dissected to free as much of the abscess capsule as possible, taking care not to disrupt connection to the cortical bone.

Figure 13.6. The Lone Star retractor is used to facilitate access to the surgical site.

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