

Dental Radiography

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Overview of diagnosis of dental disease

Diagnosis of dental disease is greatly enhanced by three modalities: thorough examination of the oral cavity, radiology and endoscopic evaluation. Examination of incisors is straightforward and can be accomplished in most rabbits during routine physical examination. Examination of cheek teeth, however, can be much more difficult, especially in dwarf breeds. A cursory examination of cheek teeth can be performed in a properly restrained patient with an otoscope, nasal speculum or other similar instrument. However, subtle lesions are frequently missed with this technique. Therefore, when dental disease is suspected based on history or cursory oral examination, thorough examination under general anesthesia is essential. Examination is greatly facilitated with instruments designed for this purpose, including a tabletop dental positioner, mouth gags, and cheek dilators. Several manufacturers now produce equipment especially for this purpose, and their value in enhancing examination of the oral cavity of rabbits and rodents cannot be over-emphasized.

Examination of the oral cavity

Thorough examination of the oral cavity should be conducted under general anesthesia. Even the deeply sedated rabbit may chew or move the mouth and tongue, hindering complete evaluation. Sedation and anesthesia protocols are well described in the rabbit. A thorough understanding of normal gross dental anatomy is essential to properly diagnose abnormalities.

The tongue is relatively large, and contains a raised dorsal area, the lingual torus (*torus lingualis*). The mucosa of the lingual torus is light pink, thick, and prominent when compared to the rest of the lingual mucosa.

Both mandibular and maxillary cheek teeth arcades are clearly visible in the normal rabbit. Mandibular cheek teeth arcades are lateral to the tongue. Small enamel points or spurs are visible on the lingual aspect of the mandibular cheek teeth, and are normal structures useful for shearing hay. These should not be misinterpreted as pathologic dental spurs.

The inferior alveolar vessels are visible below the thin oral mucosa caudal to the fifth mandibular cheek tooth. Extreme care must be taken not to damage these vessels during intraoral dental procedures.

The clinical crowns of maxillary cheek teeth are normally shorter than those of the mandibular teeth, and the last maxillary cheek tooth is significantly smaller than the other five cheek teeth.

Abnormal findings in the oral cavity of the rabbit

Abnormalities can include deviations of the cheek teeth occlusal plane, including wave mouth (undulating occlusal plane) and step mouth (stair-like differences in tooth height); sharp spurs or spikes on lingual or buccal aspects of cheek teeth, loose or fractured teeth, pus, widened interproximal spaces and damage to the tongue and adjacent soft tissues.

The earliest stage of non-traumatic acquired dental disease (ADD) of cheek teeth in rabbits is elongation of the crowns. Changes in the occlusal plane are due to excessive and irregular crown elongation, with differences in height of up to a few millimeters

between one cheek tooth and the adjacent tooth. This abnormal occlusal plane is called "wave mouth," a term borrowed from equine dentistry. Similarly, marked differences between two adjacent cheek teeth are termed "step mouth". In many cases, especially where sharp spurs have not developed, signs and symptoms may be mild or absent.

With increasing elongation, lingual curvature of clinical crowns of mandibular cheek teeth, and buccal curvature of clinical crowns of maxillary cheek teeth produces areas of individual teeth that are no longer in occlusion with opposing teeth. These continue to grow and develop into points and sharp spikes. Depending on the orientation of the spurs, these can produce severe damage to soft tissues, and eventually clinical signs including teeth grinding, reluctance to chew, changes in food preference, excessive salivation and signs related to gastrointestinal disorders. Clinical signs and symptoms related to severe ADD of cheek teeth are most severe when bilateral spurs are present. Mandibular spurs can be directed toward the buccal aspect of the tongue, creating soft tissue injuries and marked discomfort. Some are small and easily missed during oral examination of the conscious patient.

Spurs of maxillary cheek teeth typically form on the buccal aspect of the tooth, and may cause ulcerations of the mucosal surface of the cheek. Clinical signs and symptoms are usually less severe than those associated with spurs of mandibular cheek teeth.

Another common lesion is excessive coronal elongation of right mandibular CT1. In most cases, the tongue is not impaired, but discomfort is due to the pressure on the mucosal surface of the upper gingiva or the hard palate. Dwarf rabbits are prone to mandibular prognathism; therefore malocclusion of mandibular CT1 is common. Excessive elongation can result in tooth fracture.

Coronal elongation is usually accompanied by an increase in the height of both the alveolar crest and the gingival margin (arrow). These changes are more apparent in maxillary, rather than mandibular cheek teeth malocclusion.

A common traumatic lesion is longitudinal fracture of the mandibular CT1, which may occur secondary to chewing inappropriately hard foods such as seeds or nuts. The most common sequela of this fracture is periapical abscess. This fracture often produces no clinical signs and symptoms; therefore the first clinical sign may be the appearance of a mass representing the developing abscess.

Stomatoscopy

Many authors have found that the detection of subtle lesions is greatly enhanced by the addition of magnification and illumination provided by oral endoscopy (stomatoscopy).

Unlike other imaging techniques, this provides direct visualization of structures.

Documentation of lesions for comparison or client education is another added benefit.

More useful equipment for exotic companion mammal endoscopy include the 2.7 mm or 1.9 mm 30 degrees rigid endoscope, light source, light cable, video camera, monitor and recording device. Diagnostic sheaths can be useful as well. Other endoscopes, for example, canine/feline otoendoscopes may be useful as well. Details for this technique are reported in detail elsewhere.

Advantages are as follows:

- Relatively simple, and non-invasive endoscopic procedure, requiring only basic skill
- Allows thorough inspection of the narrow oral cavity of herbivorous species
- Offers a magnified perspective of dental structures
- Highly reduces the risk of missing subtle lesions and achieving early diagnosis
- Facilitates coronal reduction of cheek teeth and other therapeutic procedures
- Facilitates endotracheal intubation in selected patients
- Allows the simultaneous visualization of the clinical case by multiple observers

- Allows documentation of images for tracking progress of disease and for client education.

Radiography

Dental disease frequently involves abnormalities of tooth reserve crown, which cannot be evaluated without radiography, or computed tomography (CT). It should be noted that radiographs are indicated for ALL rabbit patients with suspected dental disease, as simply reliance upon oral examination may miss important lesions leading to diagnostic and treatment errors. Radiography can be performed with plain film, mammography film, digital units, or with dedicated dental radiography units. While dental units are useful for imaging individual or groups of teeth, standard radiography is required for views of the entire skull.

The minimum database for radiographs includes a true lateral projection, right and left oblique projections, and a dorsoventral projection. Rostrocaudal projections can be valuable as well. Interpretation of poor quality radiographs is extremely difficult. "Poor quality" can refer to errors in technique (over and under exposure, patient movement and blurring) or errors in positioning, for example failure to obtain a true lateral. Increasing degrees of obliquity result in changes that can be over-interpreted as lesions. Excellent technique and positioning are critical to prevent missing subtle lesions, or incorrect interpretation.

While experienced practitioners may become skilled at acquiring dental radiographs in the conscious patient, most find sedation or general anesthesia an important prerequisite for acquisition of high quality radiographs.

The true lateral projection (near perfect superimposition of the tympanic bullae, ventral mandibular profiles and other landmarks) is useful to evaluate overall tooth length, occlusion of incisor teeth and the occlusal plane of cheek teeth. Deviations from true lateral make interpretation of these structures difficult and encourage diagnostic errors. Right and left oblique radiographs allow evaluation of individual incisor teeth, the mandibular cortices, and apexes of individual maxillary and mandibular arcades, all of which is prevented when these structures are completely superimposed on the true lateral view. For initial screening, degree of rotation ideally should be limited to 15-20 degrees. Additional views with increasing obliquity may be obtained as desired, for example to attempt to completely isolate specific structures. It should be noted that due to the shape of the rabbit skull, it is easy to obtain a view that is oblique in one area of the skull, but lateral in another, for example, oblique mandibular cortices with the incisors completely superimposed. Ideal oblique positioning produces an image demonstrating equal obliquity throughout.

Ventrodorsal or dorsoventral views are more difficult to interpret, but may help detect other abnormalities, such as abnormalities of the bony profile of the mandible and maxilla. The dorsoventral view is easier to obtain in the rabbit; an exception is when there are marked deformities of the ventral mandible/

Diagnostic quality rostrocaudal views are challenging to obtain, and in general less useful in the rabbit. These may help demonstrate the occlusal plane and degree of curvature of the cheek teeth.

When evaluating dental radiographs, first critically discern radiographic quality. In particular, is technique adequate? Is the lateral a near true lateral? Are the oblique views no more than 15-20% degree of obliquity for all portions of the skull? If no, consider acquiring additional views.

Abnormalities

Any deviation from normal radiographic anatomy should be considered a potential lesion. On the lateral view, common abnormalities include the loss of the normal “zig-zag” occlusal plane, and may include wave mouth and step mouth. Missing teeth may be noted. In some cases, two distinct occlusal planes may be observed, which may occur in certain patterns of uneven elongation.

Overall elongation may be suspected by the presence of ventral mandibular deformation by the apexes of the mandibular CT, and maxillary reserve crowns, which appear more dorsal than expected. Another potentially useful tool for the detection of cheek tooth elongation is to evaluate the radiopaque lines produced by the maxillary and the mandibular diastema (space between incisors and cheek teeth). These lines should not be parallel, but slightly oblique and converge some distance in front of the incisor teeth. It should be noted that these radiographic landmarks are not useful in brachycephalic or dwarf rabbit breeds.

It should be noted that radiographs are also important to gauge post-treatment success. Ideally, radiographs are obtained prior to, and after all dental procedures. However, the author concedes that for many rabbit patients with chronic acquired dental disease undergoing frequent (every few months) dental treatments with disease that appears consistent from treatment to treatment, pre-procedural radiographs are often omitted.

Computed tomography (CT)

Computed tomography of the skull is a critical diagnostic imaging tool for rabbits with acquired dental disease and related complications, e.g. osteomyelitis of the mandible and the maxilla. The obvious advantage of CT is the production of images “slices” that are not superimposed by multiple structures. Newer data manipulation software also allows production of other specialized images (shaded surface display, volume rendering) greatly facilitating diagnosis. Smaller patients present difficulties due to production of a small image, which is by nature lower-resolution.

Deep sedation or anesthesia is essential for proper positioning, and to reduce breathing artifact. This is especially important in smaller mammals with higher respiratory rate. The patient is commonly positioned in ventral recumbency, with the head elevated slightly and kept horizontal. The endotracheal tube will not create a superimposition as in conventional radiographs; however, the connection with the anesthetic circuit might hamper perfect symmetric positioning. Facemasks can produce artifact and are not recommended. Avoid the use of tape or other positioning devices with the exception of foam blocks.

Prior to scanning, a scout view is collected in both dorsoventral and lateral projection. Scout projections are standard x-ray images that are used to ensure accurate positioning of the patient for CT scanning. The dorsoventral projection is useful for evaluating bilateral symmetry and the lateral projection is useful for the selection of the angle of the scan plane. A provisional transverse scan through the tympanic bullae can also be made to check for proper position of the head if desired. The thickness of the slices is selected (1 mm or less), as well as the extent of the scan.

Interpretation of CT Data

Traditional axial CT images are challenging to interpret, and require skill and practice. Radiologists agree that axial views and supplemental sagittal, coronal and oblique views are the most critical and sensitive for diagnosis. However, supplemental information comes from 3D renderings, converting CT data of selected body parts into an image very similar to an image of an anatomical specimen, well within the range of

interpretation of a trained clinician.

Dedicated imaging software programs allow various reconstruction techniques, including volume rendering (VR) techniques, and shaded surface displays (SSD). Shaded surface displays present a contoured surface map of the entire image volume. The volume can be rotated on the monitor to allow the observer to visualize any surface. Shaded surface displays have limited usefulness because deep structures are masked, but they are helpful for evaluating abnormalities of the bones of the skull, for example osteomyelitis and skull fractures.

Software for reading DICOM images is readily available. A quick search of the internet revealed a number of products with varying operating system requirements and pricing for purchase. OsiriX is the most popular and user-friendly online freeware currently available to Macintosh users.



Table top dental mouth gag for hands free positioning of the rabbit for oral examination.



A properly positioned lateral radiograph of a rabbit with acquired dental disease.

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