RADIOLOGICAL EVALUATION OF CHINCHILLA MASTICATION ORGANS

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Received for publication November 03, 2006.

Abstract

The studies were undertaken in order to analyse radiologically bone structures of the maxilla and mandible, including the teeth in chinchillas that show pathological overgrowth of the incisor and molar teeth. The analysis included 10 sick and 10 healthy animals, whose skulls were post-mortem dissected and compared. The X-ray pictures were examined for significant elements of the bone structure: shape and saturation of incisor and molar teeth, shape, saturation, and thickness of cranial sutures, as well as the evenness of the intensity of the symptoms. The structure of the incisor teeth revealed excessive tissue mineralisation. The tooth canal was invisible, which may indicate fibrosis of the pulp. The cutting edges exhibited excessive mineralisation, which implied a lack of abrasion. The pulp growth cone was invisible. The shape of the upper incisor was altered and semicircular, this prevented contact between the edges of the opposing teeth. The surface structure of the molars was considerably saturated with invisible dental pulp, which may imply fibrosis. The roots of the teeth were distended and flask-like in shape, and considerably saturated. The visible excessive mineralisation in all the molar teeth implied a general process of osteosclerosis.

Key words: Chinchilla lanigera, dental disorders, radiology.

The chinchilla has a very short history as a farmed animal, as it was not domesticated until about a century ago. Chinchillas kept on farms rarely develop diseases, of which none has so far been recognised as a chinchilla-specific illness. Chinchillas have one deeply pigmented incisor, no canine, one premolar, and three molar teeth in each quadrant of the mouth. Dental disorders belong to those that are occasionally reported; however, treated as single cases, they have not been investigated for their causes. Published reports usually deal with excessive growth of the incisors, whilst no information has been published so far that might suggest that the premolar or molar teeth could also show growth disorders.

According to Crossley (2), chinchilla teeth grow evenly during the entire life cycle. Their excessive growth can lead to reduced body weight, sialorrhoea, swelling of the mandible and maxilla, or to at least in distinctly incorrect length of the incisor teeth. Other observable changes include altered shape of the skull, some changes in quantity and consistency of excrements, or changes in feed preferences. Many such changes can be easily detected in pet chinchillas; however, the disorders pose a more serious problem for commercial farms, where they are more likely to remain undetected.

The most commonly reported dental disorder in chinchillas is malocclusion, first symptoms of which include excessive salivation, teeth rubbing, anorexia, or reduced body weight, as described by Hayes (7). As a cure, the author primarily recommends to trim the incisors in order to correct their length or arrangement. Furthermore, the author suggests that dental diseases can either have a genetic background or result from environmental factors, e.g. a lack of hard objects to chew. Other authors (1, 9) claim that environmental factors underlying dental problems in chinchillas include accidents, diseases, and too frequent or too large litters. Symptoms of dental diseases may include blanching colour of the incisor teeth, residues of fur packed between the teeth, wet eyes, wet paws, and damaged or ruffled hair.

The incisors grow in length from 1.5 up to 3 cm per year – such increments; however, is not perceptible in healthy animals, since an excess is immediately worn down (8, 10). The growth rate of the teeth can be measured only when we track the growth of a broken tooth. With a correct occlusion, the teeth get worn down at the same distance from the gum, and are arranged in a row with the tongue placed between the incisors. The grinding surfaces of the upper and the lower teeth match. A healthy chinchilla’s incisors are dark yellow.

Accidents belong to the factors that may cause an excessive growth of the incisor teeth. This is most
likely to happen when an animal wedges its teeth in the cage mesh, which can lead to relocation of tooth buds. As a consequence, corresponding upper and lower teeth do not match correctly, which prevents grinding of the growing teeth. Other causes of excessive incisors growth include diseases that prevent feeding, inadequate nutrition, or deficiencies in minerals, mainly calcium, resulting from – for example – too intensive reproductive management of females (too frequent and too large litters).

In their natural habitat, chinchillas are able to find diversified and appropriate feed, while on cage farms the farmer must take care of their adequate nutrition. It has been recognised that feed supplementation with vitamins, calcium, and phosphorus has a positive effect on the teeth (11).

Many authors have observed visible symptoms of teeth disorders developing in chinchillas, such as salivation and lacrimation (7, 12). The condition is referred to as “slobber” (13). As a preventive measure, farmers place hard objects inside cages for the animals to gnaw and thus to wear down the teeth. Moreover, the authors present a correcting method, which consists in simply cutting the teeth (6, 7, 13). Dental deformations often result in inflammation or ulceration of the oral cavity, alveolar abscess, or periostitis – followed by considerable loss in weight. An animal with advanced changes in its teeth is unable to bite feed and dies of starvation. Recently, some chinchilla farmers have been complaining that dental defects have become a severe problem as their incidences have been constantly increasing.

The aim of this study was to analyse radiologically the bone structures of the maxilla and mandible, including the teeth, in chinchillas exhibiting pathological overgrowth of the incisor and molar teeth.

Material and Methods

The analyses were carried out on a group of selected 10 sick chinchillas (Chinchilla lanigera) between 1 and 3 years of age. All the sick chinchillas were with dental disorders. The animals were killed to prevent their death from starvation. The control group consisted of another 10 healthy chinchillas killed on farms. The head bones of the animals were dissected and the soft tissues were separated. The mastication organs of both healthy and sick chinchillas were subjected to radiological (X-ray) imaging, using a Microfocus 401 X-ray instrument with micro focusing, at the Department of Normal Anatomy, Pomeranian Medical University in Szczecin. The images were thoroughly examined and analysed.

The X-ray images were used to comparative analysis of the following essential elements of the bone structure: shape and saturation of incisor teeth, shape and saturation of molar teeth, shape, saturation, and thickness of cranial sutures and intensity evenness of the symptoms.

Results

The skulls of the healthy animals revealed the following:
1. The incisors with distinct tooth canals, visible pulp and growth centres. The edge without excessive mineralisation showing explicit grinding effects. No signs of mineralisation in the tooth canal, the growth cone visibly concave.
2. The molar teeth with a well shaped surface structure and visible cavities, without signs of mineralisation. The roots exhibiting correct course with clearly visible pulp (Fig. 5). The periodontal membrane without signs of overload.
3. The shape of the cranium without any signs of pathological changes, sutures even, regular saturation, lacrimal duct visible within the orbital area (Figs 2 and 3).

The skulls of the sick animals revealed the following:
1. The incisor teeth – image over saturation indicating excessive mineralisation of the tissues. Invisible tooth canals implying processes of tooth pulp fibrosis. The incisor edge showing excessive mineralisation, no signs of abrasion. Pulp growth cone invisible. Altered shape of the upper incisor teeth (semicircular shape) disabling the contact between the edges of the opposing teeth (Fig. 6).
2. The molar teeth – the surface considerably saturated invisible pulp that may be a proof of a fibrosis processes. Roots distended, flask-shaped, and heavily saturated. Evidently excessive mineralisation on each molar implying that the process is general rather than local (Fig. 6).
3. The craniuns with thickened bone edges, the areas adjacent to the sutures showing excessive mineralisation, invisible lacrimal duct in the orbital area (Figs 1 and 4).

Discussion

Roentgen’s discovery of penetrating radiation in 1895 caused a real revolution in diagnostics. An X-ray picture is a projection of three-dimensional anatomic objects on the plane of a detector. X-rays passing through the body are unequally absorbed by the anatomical structures, depending on the specific density of the chemical elements that build them. Due to unequal radiotransparency, an X-ray picture of cranium anatomical elements resembles their cross-section, where more mineralised tissues produce whiter areas compared to structures of lower mineralisation. An X-ray shows the inorganic part of the bone structures; this not only reveals changes in the bones themselves, but also allows drawing more general conclusions about processes running in the entire system. Any deviations from standard X-ray absorption or changes in the formation of the bone tissue imply that pathological processes may take place. Such changes can be classified as “dense bone”, or osteosclerosis.
Fig. 1. X-ray of a chinchilla cranium with pathological changes.

Fig. 2. X-ray of a normal chinchilla cranium.

Fig. 3. Horizontal cross-section of a healthy chinchilla cranium as X-ray image.

Fig. 4. Horizontal cross-section of chinchilla cranium with pathological changes as X-ray image.

Fig. 5. X-ray of incisor and molar teeth without pathological changes.

Fig. 6. X-ray of incisor and molar teeth with mineralisation changes and distended alveolar processes in the area of molar teeth.
X-ray pictures of the sick chinchillas’ skulls have revealed intensified processes of bone saturation compared with the control, which implies pathological processes. As these pathological processes affected the entire structures, they seem to have been symptoms of system-wide processes rather than local ones. The literature reporting on tooth growth centre damages does not provide any information on possible symptoms in other bone structures of the skull (3 - 5).

We have not found any description of similar changes in chinchillas in any professional publications. Biological balance in healthy, mature osseous tissue results from two simultaneous but opposing processes of formation and destruction of both the organic and inorganic part of the bone structure. The following is required in order to maintain functional balance:

- providing the organism with appropriate quantities of nutrients, such as proteins, minerals, and vitamins A, C, and D
- balanced functioning of endocrine glands, such as pituitary, thyroid, parathyroid, adrenal glands, gonads, and pancreas
- appropriate functional stimulation

Osteosclerosis can be a result of enhanced osteoblastic function or hindered bone resorption. The causes of dense bone can be local or general in character, and it can occur in response to certain local stimuli or as a result of the organism processes. Local centres of osteosclerosis in the maxilla and mandible can occur as a response to chronic inflammation. Compensational bone formation expressed as dense bone also occurs in the case of excessive strain. Compensation centres are always connected with the lamina dura of the dental alveolus. General osteosclerosis is observed very rarely, when occurring as a result of either genetic disorders, e.g. acromegaly or poisoning with fluorine, lead or phosphorus.

Due to the fact that, the observed pathological changes are found in a growing number of populations, and also because affected animals suffer severely, it is crucial to find the causes and eliminate the disorder. Therefore, further studies will be undertaken including biochemical, histological, and, possibly, genetic analyses.

At this stage of the research, we are unable to declare unambiguously what the underlying cause of the disorder is. The studies we have completed are pioneering in this area, hence defining the changes as general in scope may contribute a new quality to the continuation of these studies. Available literature that deals with disorders of this kind erroneously blames mineral-vitamin deficiencies for the causes of pathological overgrowth of the teeth. The studies have unambiguously demonstrated that the causes should be sought in general saturation disorders of the osseous structures.

References