Equine odontoclastic tooth resorption and hypercementosis

Equine odontoclastic tooth resorption and hypercementosis is a relatively recently described condition of the incisors. It is characterised by roughening of the sub-gingival crown and enlargement of the apical part of the tooth. Clinical signs include pain, mastication issues and bitting problems. Theories regarding the aetiology include mechanical strain to the periodontal ligament and bacterial infection. The underlying basis is likely multifactorial and there is research ongoing to establish a cause. By addressing gaps in knowledge, the ultimate goal is to develop regenerative treatments and early intervention protocols, alleviating the pain and distress associated with the condition. Radiography is a useful imaging technique to diagnose the condition, as is microcomputed tomography which is more sensitive. Currently, there is no disease-modifying treatment and the only option available is removal of affected teeth. In some cases, this can involve surgical extraction of all incisors and is something patients are able to manage well.

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Most domestic animals have brachydont teeth, which are short crowned and fully erupted by maturity (*Figure 1a*). Because the equine diet is predominately tough forage, their dentition is adapted to account for this (Muylle, 2011). Thus, equine teeth are described as hypsodont, meaning they have long crowns which continuously erupt as the surface of the tooth is ground away during mastication (Dixon and du Toit, 2011). The occlusal surface is continuously changing, so the appearance may be used to estimate a horse's age (*Figure 1b*) (Muylle, 2011). Equine oral health can correlate with behavioural changes and in cases of equine odontoclastic tooth resorption and hypercementosis, these can include avoidance of human contact around the mouth, excess salivation and mouthing of a water bucket (Pearson et al, 2013). Research into the incisor and canine teeth of horses is less extensive compared to that of the premolars and molars (Casey, 2013); however, in 2008, a previously unknown disease of the incisors and canines was clinically recognised for the first time (Staszyk et al, 2008). Staszyk et al (2008) termed the disease equine odontoclastic tooth resorption and hypercementosis as a result of the apparent loss of mineral content and build up of cementum along the reserve crown (Staszyk et al, 2008; Earley and Rawlinson, 2013). Equine odontoclastic tooth resorption and hypercementosis is a relatively common, progressive disease of equine teeth, with 62.0–72.2% of horses around 20 years old displaying moderate to severe radiographical changes consistent with the disease (Rehrl et al, 2018; Tretow et al, 2023). Equine odontoclastic tooth resorption and hypercementosis is most commonly present in the incisors and canines of horses older than 15 years (Staszyk et al, 2008). However, occasionally premolars and molars can be affected (Moore et al, 2016) and less severe forms have been found in horses from 10 years old (Rehrl et al, 2018; Tretow et al, 2023). A study looking at microcomputed tomography images in incisor and canine teeth of 115 horses found that 55.7% of the study population had at least one incisor affected, compared to 43.3% that showed the disease on canine teeth (Bearth et al, 2023). It also found that canines were less likely to undergo hypercementosis compared to incisors, but resorption of the crown, widening of the periodontal

space at the root and lamina dura lysis were more likely (Bearth et al, 2023). These findings suggest that canines are affected slightly less frequently and in a slightly different way but further research is needed to confirm this. While its aetiology is unknown, it has been suggested that there is a male predilection (Smedley et al, 2015) and further epidemiological studies are required to determine whether there are other predispositions. Furthermore, it appears that warmbloods and thoroughbreds are more commonly diagnosed (Sykora et al, 2014; Smedley et al, 2015; Lorello et al, 2016; Earley et al, 2017), although others state there are no apparent breed associations (James, 2022; Tretow et al, 2023).

Aetiology

A number of theories exist underpinning the aetiology of equine odontoclastic tooth resorption and hypercementosis. Mechanical strain on the periodontal ligament may be involved (Staszyk et al, 2008; Hole and Staszyk, 2018). The theory supporting this suggests that micronecrosis and cytokine release may lead to the activation of clastic cells (Hole and Staszyk, 2018) and may also allow a suitable environment for microorganisms to proliferate (Hole and Staszyk, 2018). Red complex Gram-negative bacteria have been isolated from cases of equine odontoclastic tooth resorption and hypercementosis including *Treponema* spp., *Tannerella* spp. and *Porphyromonas gingivalis* (Sykora et al, 2014). The incidence of periodontitis increases in older horses (Crabill and Schumacher, 1998), and as horses age, the reserve crown becomes shorter and the angle between the upper and lower incisor teeth decreases (Muylle, 2011). A study comparing a young and old equine 3D model of the rostral maxilla and mandible identified larger areas with higher stress from older horses (Schrock et al, 2013). Areas which underwent the highest amount of stress were around the alveolar crest and just occlusal to the root tip (Schrock et al, 2013).

The majority of resorptive lesions commence at the apical portion of the tooth at the lingual aspect and spread in a mesial and distal direction (Earley and Rawlinson, 2013; Schrock et al, 2013; Henry et al, 2017; Rahmani et al, 2019). Similarly, hypercementosis is most commonly found at the apical aspect of the tooth, spreading to the crown (Arnbjerg, 2014; Henry et al, 2017). Further research is required to establish where both of these conditions primarily occur.

A number of biochemical markers have been assessed in horses with odontoclastic tooth resorption and hypercementosis, with the most significant alteration being a reduction in blood albumin concentrations (Earley et al, 2017). This may be explained by chronic inflammation related to the disease or reduced feed intake as a result of dental disease (Earley et al, 2017). However, this study lacked age-matched controls and more research is required (Earley et al, 2017). Hypercementosis could be a more reparative process, as it only occurs with resorption, whereas resorption can occur alone (Henry et al, 2017). Additional control-based research is needed with sufficient power to improve our understanding of the potential underlying causes (James, 2022).

Clinical diagnosis

The disease is characterised by odontoclastic tooth resorption and unregulated cementum deposition of the reserve crown

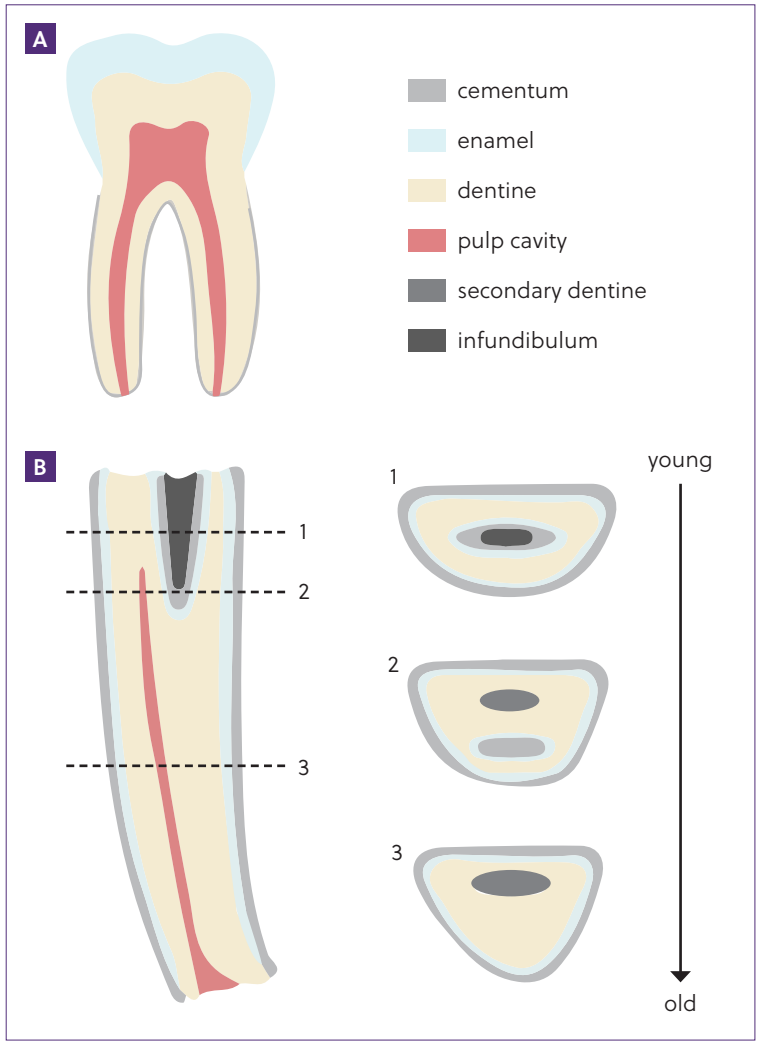

Figure 1. Schematic to show the structural differences between brachydont and hypsodont teeth. a) Brachydont tooth (molar) has a low crown covered with enamel, and cementum is only present below the gumline. b) Hypsodont tooth (incisor) has a long reserve crown and continually erupt with the appearance of the occlusal surface changing as the animal ages.

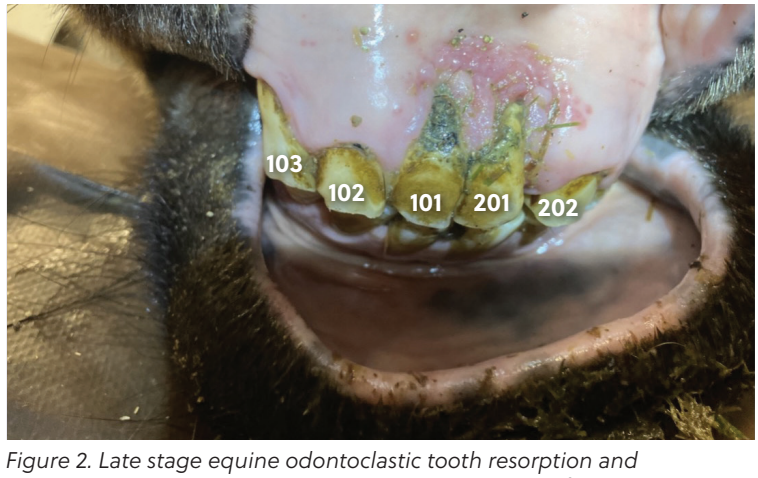

Figure 2. Late stage equine odontoclastic tooth resorption and hypercementosis with teeth numbered using the modified Triadan system. 202 shows apical hypercementosis, 101 and 201 show bone loss and 101, 102 and 103 show resorption lesions. Images courtesy of North Wales Equine Dental Practice.

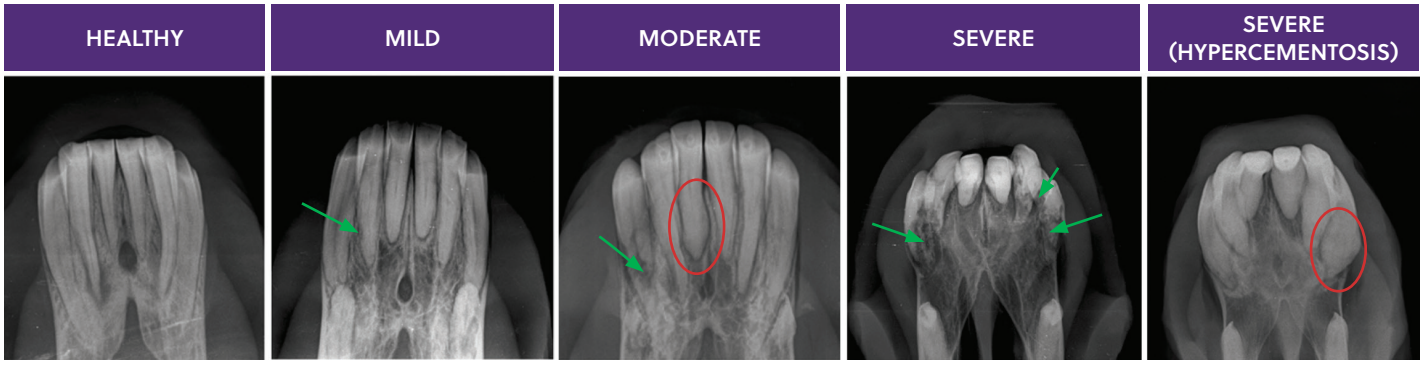

Figure 3. Progression of equine odontoclastic tooth resorption and hypercementosis in equine incisors using radiography. Green arrows indicate areas of resorption and red circles indicate where the tooth has undergone hypercementosis and the intra-alveolar part of the tooth is becoming wider. Radiographic images courtesy of North Wales Equine Dental Practice.

Table 1. Radiographical scoring system for equine odontoclastic tooth resorption and hypercementosis

Scoring	Stage	Radiological findings
Severe	3	Loss of tooth shape/intra-alveolar tooth part is wider than the clinical crown/footh fracture. Rough surface/irregular
Moderate	2	Tooth shape largely preserved/intra-alveolar tooth part is not wider than the clinical crown. Surface irregular/rough
Mild	1	Tooth shape preserved/slightly blunted root tip. Surface irregular/rough
Normal	0	No radiological findings

Hüls et al, 2012; Rehrl et al, 2018

(Moore et al, 2016). Generally, the disease starts at the most commonly affected third incisor, progressing to the next most affected second incisor and then to the first (Rahmani et al, 2019) (*Figure 2*). It may only become clinically apparent at a more advanced stage and is often left undiagnosed (Rehrl et al, 2018). Clinical signs include pain, inability to masticate, quidding, halitosis and weight loss (Earley and Rawlinson, 2013; Rahmani et al, 2019). Within the mouth, gross changes include gingivitis, gingival recession, periodontitis, gingival ulceration, abscessation, increased periodontal ligament space and increased tooth mobility which may lead to fracture (Staszyk et al, 2008; Earley and Rawlinson, 2013; Rahmani et al, 2019). As many changes occur sub-gingivally, radiography is useful to assess or diagnose the disease (Hole and Staszyk, 2018). Radiographic signs include irregularity of the tooth surface (Rehrl et al, 2018), widening of the sub-gingival crown and periodontal space, loss of normal tooth structure and occasional fractures (*Figure 3*) (Earley and Rawlinson, 2013).

Histopathology

Equine odontoclastic tooth resorption and hypercementosis shows three main altered pattern types within the dental tissues: predominant tooth resorption, predominant hypercementosis and a combination of the two (Earley and Rawlinson, 2013; Rahmani et al, 2019). It is grossly evident as roughening of the sub-gingival crown and enlargement of the apical portion (Staszyk et al, 2008; Rahmani et al, 2019). On a transverse cross section within the cementum, there are necrotic areas in the dentine (Staszyk et al, 2008; Smedley et al, 2015; Rahmani et al, 2019). Although hypercementosis is not always grossly associated with all teeth, histologically it is apparent more widely (Smedley et al, 2015; Rahmani et al, 2019). The arrangement of cementum is in parallel incremental lines, mostly near to resorption lesions and contains vascular channels (Staszyk et al, 2008; Smedley et al, 2015; Rahmani et al, 2019). The surface of these lesions can be lined with odontoclasts and osteoclasts (Staszyk et al, 2008; Smedley et al, 2015; Rahmani et al, 2019) and may sometimes be filled with cementoblasts (Staszyk et al, 2008; Smedley et al, 2015), indicating the removal and deposition of cementum characteristic of the disease. In lytic areas, there is necrosis (Staszyk et al, 2008) and bacteria or plant material may be present (Smedley et al, 2015; Rahmani et al, 2019). Cementoblasts are sometimes associated with necrotic cementum (Smedley et al, 2015). Resorption lesions can extend into the dentine and in some cases all the way to the pulp cavity (Staszyk et al, 2008; Smedley et al, 2015). Inflammatory cells are present around the teeth (Smedley et al, 2015) and there is lymphoplasmacytic inflammation at the periodontal ligament (Smedley et al, 2015; Rahmani et al, 2019).

Imaging and classification

To classify teeth based on radiography, a scoring system has been established (*Table 1*) (Hüls et al, 2012; Rehrl et al, 2018).

Radiography is a useful tool when diagnosing equine odontoclastic tooth resorption and hypercementosis, as it can diagnose patients without clinical signs (Bishop, 2022). The bisecting angle technique used for performing dental radiographs is shown in *Figure 4*. However, when comparing radiography and microcomputed tomography techniques, 10.2% and 69.2% were classified as equine odontoclastic tooth resorption and hypercementosis respectively, indicating microcomputed tomography as a more sensitive imaging technique (Albers et al, 2023). On the other hand, one study only carrying out microcomputed tomography found a lower prevalence of equine odontoclastic tooth resorption and hypercementosis compared to other radiographic studies (Bearth et al, 2023). Nevertheless, this study only included Warmblood horses and they had a smaller age-range compared to other studies (Bearth et al, 2023). For comparison, it would be more reliable to compare radiography and microcomputed tomography together, highlighting the need for further research.

Treatment

Although the condition is now better recognised, there is no curative treatment and currently the only treatment for equine odontoclastic tooth resorption and hypercementosis is exodontia (extraction) of the affected teeth (Foster, 2013; Rawlinson and Earley, 2013). Generally, extraction is indicated in teeth which are loose and/or painful and when it is apparent on radiography that there is extensive resorption below the gumline. Some patients may require surgical extraction of all their incisors (Rainbow, 2023), which can result in the tongue protruding from the mouth (Lorello et al, 2016). Despite losing the teeth necessary for prehension of food material, horses are still able to use their lips and tongue for prehension (Goer, 2002). The number of horses with a body condition score below a desired level were reduced by 50% and clinical signs of odontoclastic tooth resorption and hypercementosis (including quidding, slow eating, resistance to bridling and headshaking when bridled) were significantly decreased following surgery (Rainbow, 2023).

Conclusions

Equine odontoclastic tooth resorption and hypercementosis is a common and clinically significant disease in older horses. While sex may be a predisposing factor, there is controversy regarding breed predilection. Although research has been undertaken into the aetiology of the disease, there is no one clear cause and further research is required in this area. Radiography is currently a common imaging technique used in diagnosis but there is evidence to suggest microcomputed tomography is more sensitive, although less convenient to be undertaken in a practice setting. Currently, the only treatment for equine odontoclastic tooth resorption and hypercementosis is exodontia. By addressing gaps in knowledge, the ultimate goal of additional research is to develop regenerative treatments and early intervention protocols, alleviating the pain and distress associated with the condition. EQ

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KEY POINTS

- Equine odontoclastic tooth resorption and hypercementosis was first recognised as a condition in 2008.
- It is highly prevalent in the aged equine population.
- It is a painful condition, and exodontia is the only treatment option.
- Its cause is likely multifactorial but further research is required.
- Radiography and, to a lesser extent, microcomputed tomography are used in its diagnosis.

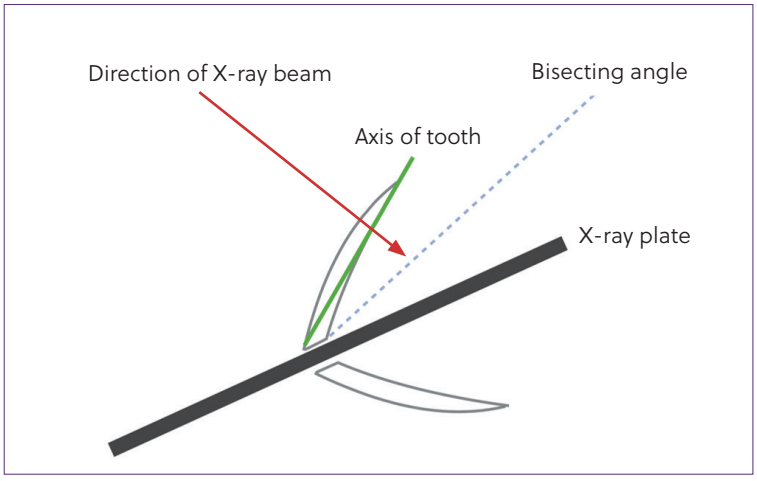

Figure 4. Schematic to show the bisecting angle technique for dental radiographs. The direction of the X-ray beam is aimed at the bisecting angle located halfway between the X-ray plate and the axis of the teeth of interest.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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