Idiopathic Cheek Teeth Fractures, Including Practice-based and Hospital-based Surveys

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Introduction

Horses can acquire cheek teeth (CT) fractures through many mechanisms, including external trauma, e.g. as a result of kicks, biting inanimate objects and crib biting.[1,2] These traumatic fractures mainly occur in the anatomically more susceptible rostral mandibular CT. Fractures to CT can also be caused by iatrogenic trauma during dental treatments, such as cutting tall CT overgrowths with dental "shears", especially in younger horses where relatively little secondary dentine has been laid down within the tooth.[3] Iatrogenic CT trauma can also be caused to adjacent healthy teeth from a dental punch during CT repulsion[2,4]. However, most horses with CT fractures have no history or evidence of trauma, and such fractures have been termed *idiopathic CT fractures.*[2] In 24 referred cases, fractures involved 25 maxillary CT (82%) and 5 mandibular CT (18%), and the maxillary 09s (Triadan 109 & 209) were most commonly affected.[2]

The commonest type of fracture clinically recognised in that study was termed a lateral "slab" maxillary CT fracture that was (erroneously) described as not involving the pulp cavities, because some slab fragments consisted mainly of enamel and peripheral cementum, and additionally because clinical evidence of apical infection was seldom found in horses with this type of fracture.[2] The second most common type of idiopathic CT fracture described in that study was a midline sagittal fracture of maxillary cheek teeth that had advanced infundibular caries, and all such CT fractures were accompanied by clinical apical infection.[2] O'Connor (1930)[5] and Becker (1962)[4] had previously briefly noted some patterns of CT fractures, which are now recognised as idiopathic CT fractures, with Becker stating that the maxillary CT were most susceptible to fracture, and also that the lateral aspects of CT preferentially fractured.

To further examine the nature and prevalence of equine idiopathic CT fractures, three studies were performed, including a pathological study of 35 CT with idiopathic fractures; a practice based study of idiopathic CT fractures in the general population as detected by equine practitioners and qualified equine dental technicians (EDTs); and finally, a new study of horses with CT fractures referred to Edinburgh University Equine Hospital.

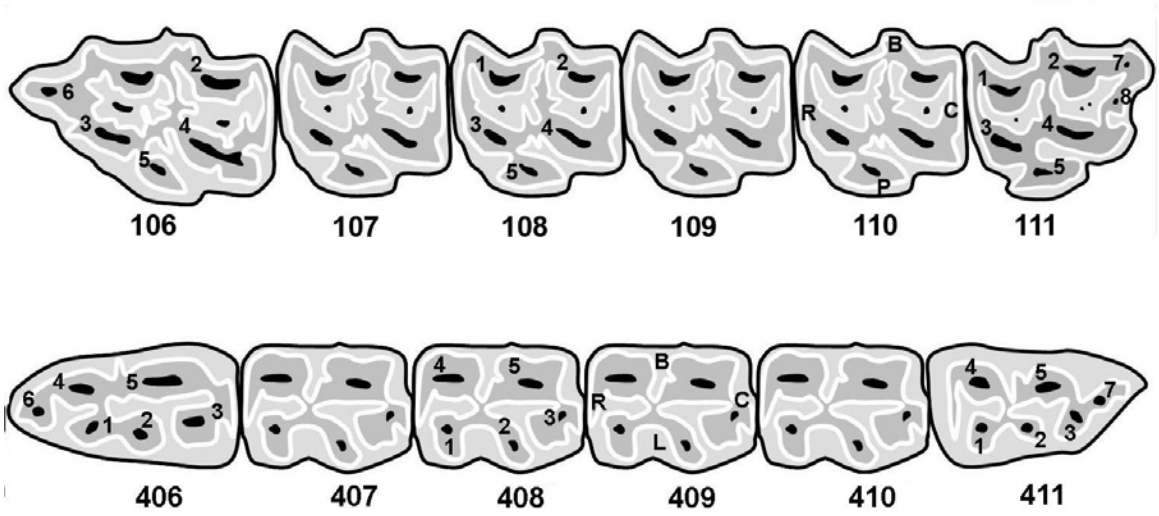

Figure 1. Diagrammatic representation of equine cheek teeth and their pulp chambers.

Pathological Study

Twenty-one maxillary and 14 mandibular CT with idiopathic fractures were examined following extraction of the complete CT (e.g. if concurrent widespread periodontal infection or apical infection was present) or otherwise of smaller and looser dental fragments, at the Large Animal Hospital at The University of Edinburgh (1990-1999). The fracture plane of all fractured CT was determined to establish the fracture patterns present. Additionally, the Triadan positions of fractured CT were examined to determine if any positions were more prone to such fractures. The pulp nomenclature of Dacre[6,7] (Fig. 1) was used in these studies.

Specimens were examined in depth, including by radiography; histology (decalcified and undecalcified) that included measurement of the thickness of dentine around the pulp chambers; and by scanning electron microscopy using previously described techniques.[6,7] Cheek teeth of similar *dental age* (i.e. age since the CT had erupted) and of similar Triadan positions were used as controls for dentinal thickness measurements, to assess if reduced dentinal thickness was present in the fractured CT, as this finding would indicate that pre-existing disease had been present in that pulp chamber prior to the fracture.[7]

In contrast to expectations, 30 of the 35 fractured CT had fracture planes passing through one or more pulp cavities, with the fractures in the other 5 CT involving infundibula (of maxillary CT). Fracture of the all the CT in this study caused pulp exposure at the time the dental fracture occurred, and many of these referred cases had concurrent clinical apical infection. Whilst the maxillary slab fractures usually involved just the clinical

crown and thus did not extend into the alveolus in most cases, the midline sagittal fractures invariably involved the full length of the tooth.

The fractures were classified into 5 groups as follows.

Group 1 Maxillary buccal 'slab' fractures: Maxillary CT with a vertical fracture plane through pulp chambers 1 and 2 - This was the most common type of fracture seen in maxillary CT (Figs. 2 and 3).

Figure 2. Extracted lateral slab fracture of an upper CT.

Figure 3. This Triadan 09 has had a slab fracture through its two lateral pulp cavities and the smaller (lateral) fragment has been lost. Note the buccal mucosal damage caused by the now exposed corners of the adjacent two teeth.

Group 2 Infundibular sagittal fractures: Maxillary CT with a single vertical fracture plane running through the rostral and caudal infundibula – This was the 2nd most common fracture pattern present in maxillary CT (Figs. 4 and 5).

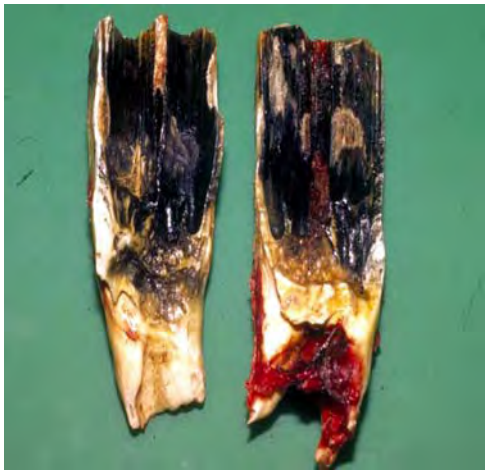

Figure 4. Midline sagittal fracture of maxillary cheek tooth caused by extensive infundibular caries, with coalescence of both infundibula.

Figure 5. Fracture of 108 through the infundibula and later palatal (medial) movement of the medial fragment due to masticatory forces.

Group 3 Miscellaneous maxillary fracture patterns: Maxillary CT with fracture planes different from the above classifications (Groups 1 and 2) were present in the remaining maxillary CT.

Group 4: Mandibular buccal 'slab' fractures: Mandibular CT with a vertical fracture plane running through pulp chambers 4 and 5. This fracture pattern was present in almost all fractured mandibular CT (Fig. 6).

Figure 6. Idiopathic fracture of a mandibular cheek tooth through 4th and 5th pulp chambers. The lateral fragment was iatrogenically fractured during extraction. Note the exposure of all pulp horns.

Group 5: Miscellaneous mandibular fracture patterns: Mandibular CT with fracture planes other than as for Group 4 were present in a minority of mandibular CT fractures.

Dentinal thickness was measured around the periphery of pulp cavities that were involved in fractures, and reduced dentinal thickness was found in a minority of fractured CT. This indicates that pre-existing endodontic pathology, such as apical infection with pulpar death, had not been present for a significant length of time prior to the fracture in most teeth, showing that most fractured teeth were endodontically healthy at the time of fracture. In maxillary CT with fractures involving the infundibula, advanced infundibular caries, with coalescence of both infundibula, was present. Examination of the Triadan positions of fractured CT showed that the maxillary 09 and 10 positions were more commonly affected with idiopathic CT fractures than any other Triadan positions.

Practice Survey of Idiopathic CT Fractures

In order to gain more information on the prevalence and nature of CT fractures in the general equine population, a questionnaire was sent to suitably experienced veterinary practitioners and equine dental technicians (EDTs) to enable them to document details of cases of idiopathic CT fractures they had encountered in the general equine population.

Nineteen EDTs and veterinarians supplied details of 147 horses that suffered idiopathic fracture of a total of 182 CT, Circa 0.5% of horses examined by respondents were diagnosed with such CT fractures. The maxillary CT were nearly 3 times more likely to be fractured than mandibular CT, and in particular, the maxillary Triadan 09s and 10s were preferentially fractured.

The fracture patterns included maxillary CT "slab" fractures (through 1st and 2nd pulp chambers) in 88 teeth; maxillary CT midline sagittal fractures (through the infundibula) in 31 CT; and various other types of maxillary CT fractures in 15 CT. In the mandibular CT, lateral fractures (through 4th and 5th pulp chambers) were found in 28 CT, and various other CT fracture patterns in 20 mandibular CT.

Clinical signs included quidding in 33% of cases, bitting and behavioural problems (29%), and halitosis (12%). Surprisingly, 39% of horses with idiopathic CT fractures were asymptomatic with the lesions detected during routine dental examinations. There were some differences in the incidence of clinical signs in horses with different CT fracture patterns, e.g. horses with maxillary CT slab fracture were more commonly asymptomatic than those with other fracture patterns, including those with midline maxillary fractures. Bitting and behavioral problems were most common in horses with lateral mandibular fractures (38% incidence) and least common in horses with maxillary slab fractures (22%). Quidding was most common in horses with miscellaneous patterns of maxillary CT fractures (54% incidence). Only 3% of all cases had clinical evidence of apical infection (e.g., bony swelling, draining fistula or nasal discharge).

Management of these cases included oral extraction of the smaller dental fragment (when present), oral extraction of the entire fractured tooth, removal of sharp edges on the

remaining part of the fractured tooth, reduction of the height of the opposite CT to prevent pressure on the remaining part of the fractured CT, other surgical or endodontic treatments; referral of case, or no specific treatment. Following treatment, 80% of horses were reported to be asymptomatic, 6% had ongoing problems, and the outcome in 14% was unknown or unsure.

Equine Hospital Based Survey

A further survey was conducted on referred patients examined at the University of Edinburgh Equine Hospital between 1999 – 2005, i.e. on all new patients examined since a previous survey was completed.[2] Similar to the field survey, it was found that the maxillary CT were 3 times more likely to suffer idiopathic fractures than the lower CT. Similar to the two other studies, the maxillary 09s were the most commonly fractured CT, however, with no increased prevalence of fractures in the maxillary 10s apparent in these referred cases.

In this referred population, maxillary slab and maxillary midline sagittal fractures were the more common types of fractures. In contrast to the practice-based survey, more severe clinical signs were exhibited by these *referred* cases, with nasal discharge present in 29% of cases, bony swellings in 23%, and draining fistulas present in 2% of cases – all indicative of clinical apical infection. Forty-four percent of cases were quidding, and surprisingly, 24% of these referred cases were asymptomatic, with the fractures being detected during routine dental prophylactic procedures by veterinarians. This is a reflection of the increased attention being paid to this area by UK veterinarians, because in a previous survey, no such asymptomatic cases of idiopathic CT fractures were detected.[2] In cases that were asymptomatic, radiographic changes were often present in the apex of the fractured CT, and in all cases scintigraphically examined, increased radionucleotide uptake was present around the apex of affected CT. These findings indicate the present of alveolar remodeling in response to the pulpar exposure, but it appears that in most cases, the infection is controlled, at least in the short-term. As expected, a higher proportion of these referred cases required partial or total dental extraction, as compared to cases diagnosed in the general population.

Discussion

The overall median incidence of idiopathic fractures in the general practice study of 0.5% is similar to the findings of Becker,[4] who recorded an incidence of 0.71% of *all* types of dental fractures in *all* teeth in 30,000 cavalry horses in Germany. Higher levels of equine dental fractures of all teeth (including incisors) have been recorded, including an incidence of 8.8% in an abattoir survey by Gnadinger, but it is likely that many of the dental fractures in these abattoir studies were iatrogenic incisor fractures, occurring at the time of death.

Examination of all fractured CT showed that the pulp chambers and respective dental pulps were found to be involved in *all* idiopathic fractures. This finding changes the clinical implications when such fractures are identified, with the very likely exposure of

pulp making pulpitis and possible apical tooth infection possible sequelae. When pulp is exposed in brachydont teeth, it becomes infected almost immediately. Following development of pulpitis, with or without subsequent apical infection, most human teeth require a pulpectomy and endodontic (root canal) filling in order to remain viable. Pulpitis was invariably present initially in the CT with idiopathic fractures examined in this study, but accurate techniques for assessing and monitoring pulpitis ante-mortem have yet to be established for the horse, although as noted, scintigraphy and dental radiography can commonly detect changes in the apical area of otherwise asymptomatic fractured CT. However, follow-up information in cases of lateral 'slab' fracture typically showed total resolution of signs and no progression to apical infection in these cases,[2] indicating that the inevitable pulpar infection in these CT was contained or was of a level that did not cause clinical changes in the adjacent bones or paranasal sinuses, at least in the few years following examination by the authors.

Although pulpar exposure is commonly recorded in apically infected CT and may be the cause of pulpar and thus apical infection in some of these cases,[6,7] histological examination of CT with idiopathic fractures has not shown evidence of long-standing pulpar exposure. This finding suggests that the idiopathic fractures occur at these sites because they are anatomically weak as the mineralized tissues are at their thinnest here, rather than as pathological fractures secondary to pulpar exposure and caries of calcified dental tissues.

Maxillary 09 CT have been identified as being more susceptible to caries of infundibula, possibly because they are the oldest maxillary CT in the skull.[2] O'Connor[4] proposed that CT may fracture following carious attack, "in consequence of its weakened condition by the force of mastication. The disease most commonly occurs at nine or ten years of age." These suggestions about 09s being the oldest CT and also possibly subjected to most occlusal force as a result of its central position in the CT row may be possible reasons for the over-representation of maxillary Triadan 09 in these fractures. Dixon *et al*[2] also proposed that these fractures occurred preferentially in upper CT because of their higher proportion of equine Type-1 enamel, with this type of enamel having parallel lines of brittle enamel prisms with limited decussation (inter-weaving)[9] that made it more susceptible to idiopathic fracture.

Defective enamel, dentine, and cementum have been reported as causal factors in equine dental fracture,[4] however, apart from the possibility that infundibular cemental hypoplasia predisposed to infundibular caries and CT fracture, no such predispositions were identified in fractured CT examined in this study. Becker[4] also suggested that senile excavation ("cupping") of CT may also lead to CT fractures, but this feature was not recognised in this study, and the age-profile of affected cases also does not support this aetiology.

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