Examination for Pulp Exposure at the Occlusal Surface and Classification of Dental Fractures

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Introduction

Equine dental anatomy has been described in many anatomical texts (Dixon 1999; Getty 1975) from as early as 600 B.C. (Kertesz 1993), and from archaeological, evolutionary, and clinical perspectives (Bennett 1992; Levine 1982; Miles & Grigson 1990). A great deal of information can be gained from detailed examination of both normal and diseased equine dental specimens.

Knowledge of anatomical features of the occlusal surface of cheek teeth (CT) and sub-occlusal endodontic features (including whether pulp has been properly replaced by secondary dentine) is important in equine dentistry because this may help the clinician determine if the vital, innervated structures of the dentino-pulpal complex have been or might become compromised (e.g., following dental fracture or when performing large dental reductions).

Examination Technique

The basic requirements for performing an adequate oral examination are a good light source, a system for rinsing the mouth thoroughly, a full-mouth speculum, a dental pick, a dental probe, and a dental mirror. Recently, the use of rigid endoscopy has enhanced examination of the oral cavity. Pathological features such as radiating occlusal dentinal fissures have been frequently observed in one study using this technique (Simhofer 2003). The examination is greatly facilitated when the horse is sedated. Finally, a thorough knowledge of the endodontic anatomically related features of the occlusal surface is also required.

Prior to examining the oral cavity, a thorough history should be obtained, including details of the dietary regime, and the horse should receive a general clinical examination. It is during this stage that systemic disease and abnormal external features of the head, including skull fractures, should be recorded. These considerations are often neglected after the speculum is placed in the mouth. Following sedation and insertion of the speculum, the oral cavity is thoroughly rinsed with tepid water. A dental pick may be used to clear away remaining trapped food particles.

Thereafter all soft-tissue surfaces and dental clinical crowns should be examined. The examination should be systematic to ensure that all areas of the oral cavity are inspected. A dental probe should be used to explore any suspicious areas on clinical crowns, notably

areas of darkened calcified tissue, which may either represent areas of physiologically normal, stained, secondary dentine (e.g. the dental star) or areas of caries.

Normal Endodontic Anatomy

To recognise the pathological features of diseased cheek teeth (CT), a thorough knowledge of CT endodontic anatomy is required. Such anatomy is relatively straightforward for the incisors, canines, and wolf teeth but endodontic anatomy of the CT is more complex. An endodontic numbering system has recently been reported to help identify equine CT endodontic anatomy (Dacre 2004). All six maxillary and mandibular CT (Triadan 06-11) contain five pulp horns (the pulp within individual endodontic chambers or horns that develop in an occlusal sense, each arising initially - in young horses - from the common pulp chamber). In maxillary CT, these five pulp chambers are numbered from 1-5 with the rostro-buccal pulp horn being numbered 1, the caudo-buccal 2, rostro-palatal 3, caudo-palatal 4, and mid-palatal 5 (Fig. 1).

In mandibular CT rows, the rostro-lingual pulp horn is numbered 1, mid-lingual 2, caudo-lingual 3, rostro-buccal 4 and caudo-buccal 5. Numbering begins from the rostral 'high-side' of the CT, this being on the buccal aspect in maxillary CT, and lingually in mandibular CT. Triadan 06 CT in all four rows have an additional smaller rostral pulp horn, numbered 6. Triadan 111 & 211 have irregular caudal extensions to the second pulp chamber, and when distinct, is numbered 7. Triadan 111 & 211 may have an additional pulp chamber palatal to the caudal peripheral enamel infolding that is numbered 8 when present. The endodontic anatomy in Triadan 111 and 211 is less consistent than the endodontic features present in other CT, and pulp chambers 7 and 8 are usually absent in newly erupted upper 11s. Triadan 311 & 411 have an additional caudal pulp horn, numbered 7, but no eighth pulp horn.

Becker (1962) suggested that 10mm of secondary dentine is normally present between the occlusal surface of the CT and the coronal aspect of the pulp. In a more recent study, vital pulp was present in 84/384 (22%) of CT pulp chambers in sub-occlusal transverse sections 2-6mm beneath the occlusal surface (dependent upon the overlying transverse ridging) (Dacre 2004). Based on this recent study, the 10-mm thickness of secondary dentine between the pulp and the occlusal surface suggested by Becker seems to be an over-estimation. This finding has clinical significance considering the current practice of ‘bit-seating’ horses. When creating bit-seats, not only is sensitive dentine likely to become exposed [as shown in a recent study examining the effect of dental rasping on the occlusal surface of CT (Kempson *et al.* 2003)], in more extreme cases, pulp tissue may also become exposed.

Occlusal Pulp Exposure

Becker described ‘spontaneous’ pulp exposure (which he termed “porodontia”) on the occlusal surface of equine cheek teeth, and cited three other authors who also reported this disorder (Becker 1962). These authors reported the incidence of this disorder to be 2.8-3.5%. Wafa (1988) noted an incidence of 6.5% of pulp exposure in his abattoir

survey. Dixon *et. al* (2000a) clinically recognized pulp exposure in some horses with apical dental infection, but commented that such lesions may not be detected unless teeth are specifically examined for them. Subsequent examination of extracted apically infected CT from that study revealed that many (i.e. 44% of apically infected maxillary CT and 41% of mandibular CT) had occlusal pulp exposure of non-traumatic origin that went undetected during dental examination (Dacre 2004). Equine practitioners should be aware of such subtle lesions and use a fine dental probe on the occlusal surfaces of teeth to aid in their detection. Recognition of such lesions early in the disease process may make endodontic treatment more successful.

Occlusal Fracture Patterns

'Idiopathic' dental fractures are those fractures whose aetiology cannot be identified (Dixon *et al.* 2000b). Of 27 CT with iatrogenic fractures examined, 22 (81.5%) were maxillary and 5 (18.5%) were mandibular, with the maxillary 09 being the most commonly affected tooth (12/27, 44%) (Dacre 2004). Gross caries with subsequent sagittal fracture was recognised in 8 maxillary CT (30%), lateral "slab" fracture was recognized in 14 (52%) maxillary CT, and medial 'slab' fractures was recognized in 3 (11%) maxillary CT. The remaining 2 (7%) maxillary CT had lost an oblique portion of the occlusal aspect of the clinical crown. The slab fractures, which involved less than 20% of the total tooth width, were previously erroneously reported to seldom involve the pulp cavity. It was later recognised that most slab fractures resulted in pulp exposure (Dacre 2004). Only 24% of horses with a slab fracture of a CT developed apical infection of that tooth, whereas 100% of horses with a (midline) sagittally fractured tooth developed apical infection of that tooth.

Histologically, most crown fractures involve all three mineralised dental tissues, and the direction is normally perpendicular to equine type-1 enamel planes. The fracture sites are usually points of anatomical weakness where these mineralised dental tissues are at their thinnest, the exception being the dental midline sagittal fractures seen in maxillary CT with advanced infundibular caries. Less secondary dentine is observed in fractured teeth than would be expected in normal CT of a similar dental age (Dacre 2004).

Most slab fractures do not involve the full length of the tooth. This is in contrast to midline sagittal fractures where the tooth involved has usually fractured in half over its full length. Although both fracture types usually result in pulp exposure, the percentage of horses with a dental slab fracture that develop apical infection (24%) is much lower than the percentage of horses with a dental sagittal fracture that develop apical infection (100%). Therefore, a horse with a slab fracture may warrant different management than a horse with a midline sagittal fracture. Further studies on idiopathic fractures will be presented at this meeting.

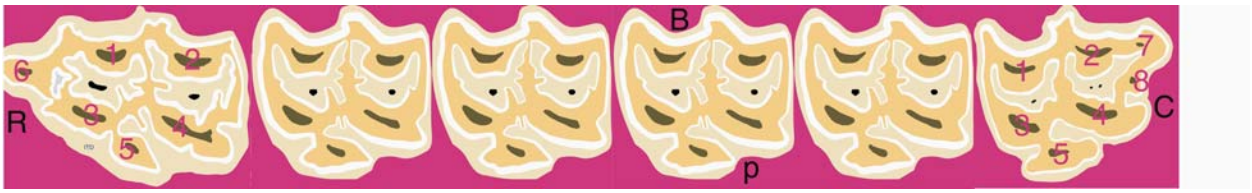

Figure 1: Diagrammatic representation of the occlusal surface of a maxillary cheek teeth row, from 1/206 at the left margin, to 1/211 at the right. Pulp horn positions are indicated by the overlying secondary dentine (shown here as dark brown, with enamel being white, primary dentine tan, and cementum cream). Pulp horn numbers 1-8 are identified adjacent to the pulp horn. Triadan teeth 07, 08, 09 and 10 all have similar pulp horn numbering, being from 1-5. Pulp horns 7 and 8 are not always present on tooth 1/211. (B) buccal; (P) palatal; (R) rostral; (C) caudal.

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