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Developmental Craniofacial Abnormalities and Disorders of Development and Eruption of the Teeth

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Craniofacial Abnormalities

Foals can develop a number of developmental abnormalities of their craniofacial bones that cause dental malocclusion and dysfunction. Although some of these abnormalities such as overjet and overbite (“parrot mouth”) are often regarded as being primary dental abnormalities, these dental abnormalities are just one manifestation of an underlying craniofacial skeletal abnormality. Consequently, correction of the dental abnormalities, such as reducing dental overgrowths, will not affect the underlying craniofacial abnormality.

Overjet and Overbite

Many horses have some degree of overjet, (“overshot jaw”) i.e. where the occlusal aspects of the maxillary incisors lie rostral to the occlusal aspects of the mandibular incisors.¹ If very marked and untreated, cases of severe overjet will often develop overbite (“parrot mouth”) where the upper incisors lie rostral to the mandibular incisors as above but also now lie in front of the erupted crowns mandibular incisors due to marked overgrowth of the premaxillary incisors and/or to ventral curvature of the premaxillary (incisive) bones due to absence of occlusal contact. Overjet and overbite are aesthetically undesirable but surprisingly, these problems rarely cause difficulty in prehension. As the more rostrally situated incisors (01s) have the least occlusal contact, they overgrow most and so affected horses develop a convex appearance of their premaxillary incisor occlusal surface (“smile”), which should be gradually reduced in stages if it is pronounced. The main clinical significance of incisor overjet or overbite are the concurrent CT disorders usually present, due to the maxillary CT row being rostrally positioned in relation to the mandibular CT row as discussed below.

Underjet

Underjet (prognathism, “undershot jaw”, “sow mouth”) is rare in horses (more common in donkeys) and like overjet is usually clinical insignificant unless there is complete absence of occlusion between the incisors. Horses with underjet usually develop focal CT overgrowths on the caudal aspects of the maxillary 11s and the rostral aspects of the mandibular 06s. Similar to overjet/overbite, concurrent CT focal overgrowths are the main clinical problem with underjet and such CT overgrowths should be monitored at 6-month intervals.

Rostral Positioning of the Maxillary CT Rows

Rostral positioning of the maxillary CT rows relative to their mandibular counterparts is caused by an imbalance between maxillary/premaxillary and mandibular bone growth and as noted, is
nearly always associated with incisor overjet/overbite. Occasionally, this abnormality can be present without incisor malocclusions. Because the maxillary and mandibular CT rows are not in full occlusion, localised CT overgrowths (colloquially termed “beaks”, “hooks” and “ramps”) develop on the rostral aspect of the maxillary 06s. These overgrowths may be pushed against the lips and cheeks by the bit/noseband and so cause mucosal ulceration and bitting problems. If large, these overgrowths can also restrict the normal, but variable, rostro-caudal mandibular movement, relative to the maxilla, while lowering and raising the head. Feeding affected horses fully from the ground rather than from a height may increase normal rostro-caudal mandibular movement and reduce the development of such overgrowths. Large 06 overgrowths should be removed (not necessarily fully if very tall) in stages to prevent pulpar exposure or overheating.

Similar overgrowths usually develop on the caudal aspect the mandibular 11s that can traumatisé the adjacent oral mucosa, but due to the later eruption of the 11s in comparison to the 06s, the caudal overgrowths may not develop until 5-6 years of age. True mandibular 11 caudal overgrowths must be differentiated (e.g. by assessing crown height above the gingival margin) from anatomically normal, upward sloping caudal CT occlusal surface (“curve of Spee”), which can be marked in some breeds.

Larger mandibular 11s overgrowths are best reduced in stages using motorised dental instruments, whilst maintaining the normal high occlusal angulation of caudal mandibular CT. ‘Molar cutters’ or percussion instruments can fracture the overgrown tooth causing pulpar exposure, that can lead to apical infection or even extensive infection of the mandibular and adjacent areas.

**Wry Nose (Campylorrhinis Lateralis)**

Wry nose is a syndrome involving lateral deviation and possibly shortening of the premaxillary (incisive) and maxillary bones, and can less commonly involve the nasal and vomer bones. Malocclusions of the incisors and of the CT at the extremities of the CT rows can occur. Milder cases will later develop a diagonal incisor occlusal plane (“diagonal bite”, “slope mouth”, “slant mouth”) with one incisor arcade permanently displaced to one side and unilateral maxillary 06, and mandibular 11 CT overgrowths. Surgical correction is possible up to about one year of age. Incisor and CT overgrowths should be assessed at 6 month intervals.

**Disorders of Dental Development**

**Hypodontia (Anodontia)**

Hypodontia is a failure of differentiation of the dental lamina and tooth germs for the deciduous and/or permanent teeth - in contrast the presence of supernumerary teeth is due to the development of too many dental buds. Developmental hypodontia is relatively uncommon in horses, with absence of equine teeth usually due to traumatic loss, disease or to age-related wear. True hypodontia generally affects the permanent equine dentition. In many species (including the horse) multiple hypodontia is often associated with the presence of other dental abnormalities (such as dysplastic teeth) or even generalised ectodermal disorders involving the hair and hoofs.
The development of an overgrowth on the **opposing** tooth is often the first indication of hypodontia.

**Supernumerary Teeth (Polydontia)**

The presence of supernumerary (additional) teeth is relatively uncommon in horses, usually developing in the permanent dentition. Single supernumerary teeth can be categorized into three types, i.e. **Supplemental** (similar to normal teeth); **Haplodont** (simple conical shape) or **Tuberculate** (complex shape). They also may be composed of more than one tooth joined together (**connate or double tooth**).[^1]

**Supernumerary Incisors**

Equine supernumerary incisors may be more common (or possibly more readily identified) than supernumerary CT. Equine supernumerary incisors can vary in number from 1-6 and are usually of normal morphology (supplemental) and so can be confused with retained deciduous incisors, but radiography will usually distinguish between them. Supernumerary incisors may cause overcrowding and displacement of the normal incisors, and diastemata often occur beside displaced incisors.[^5] If the supernumerary incisors lie rostral (labial) to the normal incisor arch, it is usually possible to extract them but if interwoven amongst the other incisors, differentiation of supernumerary teeth and safe extraction may be impossible. The incisors should regularly be assessed for periodontal disease and protruding overgrowths that may cause soft tissue trauma. Protruding incisors should be monitored biannually, preferably using motorised equipment.[^5]

**Supernumerary Canine and 1st Premolar Teeth (“Wolf Teeth”)**

Supernumerary canine or first premolar teeth rarely occur. Most suspected supernumerary canines are in fact rostrally displaced, large “wolf teeth”. Radiography will readily differentiate between these types of teeth. Many suspected supernumerary “wolf teeth” are retained fragments of the deciduous 06, that are flattened, superficial structures that are readily removed.

**Supernumerary Cheek Teeth**

The most common site for supernumerary CT development in horses is as noted, the caudal aspect of the maxillary 11s and less commonly mandibular 11s. Supernumerary CT may also develop medial, lateral or rostral to the maxillary or mandibular CT rows.[^5-^7] There is often overcrowding and/or the presence of irregular interdental margins associated with supernumerary CT and the resultant large interdental (interproximal) space (i.e. diastemata) lead to food pocketing and often painful periodontal disease. Additionally, continued eruption of unopposed supernumerary CT causes an overgrowth (usually at the caudal aspect of the CT rows). Consequently, it should always be determined if caudal overgrowths are Triadan 11 overgrowths or supernumerary CT. Treatment includes oral extraction, widening or filling of diastemata or continuous reduction of overgrowths.[^5]

**Dental Dysplasia**

Dysplasia or abnormal development of teeth can involve the crown, roots or all parts of the tooth. Dysplasias in the gross anatomy include dilacerations (abnormal bending of teeth), double teeth,
abnormalities of size and concrescence (roots of adjacent teeth joined by cementum) of teeth. Other dysplastic teeth will be of normal morphological structure and of normal shape but will be excessively large i.e. **macrodontia** or too small, i.e. **microdontia**. Disturbance in the structure of teeth include dysplasias (disturbances of development) of the individual calcified dental tissues or pulp. In human dentistry, there is now much knowledge of the genetic defects causing some dental dysplasias.

Amelogenesis imperfecta include a range of hereditary disorders affecting enamel formation in both deciduous and permanent teeth and can be divided into two types, i.e. defects in enamel matrix formation or in the mineralisation of enamel. Amelogenesis imperfecta as part of a generalised ectodermal syndrome has been described in a horse. A wide range of developmental defects of dentine have been described in humans including dentinogenesis imperfecta and others caused by mineral and vitamin deficiencies. Developmental cemental defects are uncommonly found in any species. Root hypercementosis, (increased deposition of cement on roots) is a feature so commonly found in older equine teeth to be almost regarded as physiological. Marked hypercementosis is also present in some chronic equine CT apical infections.

**Abnormalities of Dental Eruption**

**Maleruption of Cheek Teeth**

Some cases of “stepmouth” and “wavemouth” are caused by mismatching of eruption times of opposing permanent CT, allowing overgrowth of the teeth which erupt first. Bilateral overgrowths the maxillary 10s are a common pattern of this disorder in some breeds. These developmental overgrowths may remain for life and even increase in size with time, and later initiating further abnormalities of CT wear and diastemata. Recognising and removing such overgrowths at an early stage (in stages if necessary) is the key to their management.

**Retention of Deciduous Teeth**

**Retention of Incisors**

Deciduous incisors are occasionally retained for a significant period beyond their normal time of shedding, which is approximately 2.5, 3.5 and 4.5 years of age, respectively, for the 01s, 02s and 03s and the deciduous and permanent teeth then occupy the same tooth position. Retained incisors are usually displaced labial (rostral) to the erupting permanent incisors or they can lie between and displace the permanent incisors. Rarely, incisors are displaced on to the lingual aspect of the permanent incisors. It can sometimes be difficult to assess if additional teeth in the arcade are supernumerary incisor. Radiographs should be taken prior to attempted extraction of any additional incisor, unless it can be positively identified on morphological appearance as being a retained incisor.

**Retention of Cheek Teeth**

Abnormal retention of the remnants of the deciduous CT (termed “caps”) can occur in horses between 2 - 4.5 years of age but there is much individual variation in the timing of deciduous
cheek tooth shedding. If the deciduous teeth become very loose they may tear periodontal ligaments or gingival attachments during eating, causing oral discomfort for a couple of days. Clinical signs of oral discomfort in 2-4-year-old horses warrant careful oral examination for evidence of deciduous teeth that are loose or have a distinct space between them and the permanent teeth.

The practice of methodically removing deciduous teeth at set ages will result in the premature removal of deciduous CT in some horses. Once the deciduous tooth is removed, the fleshy dental sac covering the underlying developing permanent cheek tooth is exposed and quickly destroyed by mastication. This will lead to loss of blood supply to the occlusal aspect of the infundibula of the rostral 3 maxillary CT where active cement deposition may still be occurring. This may result in marked central infundibular cement hypoplasia and so predispose to the development of infundibular caries later in life.

**Vertical Impaction of Cheek Teeth (“Eruption Cysts”; “3-Year-Old and 4-Year-Old Bumps”)**

As noted in the pervious section, many horses develop focal, bilateral swellings of their mandibles and also less obviously (due to the presence of overlying muscles) of their maxillae beneath the developing apices of the 07s and 08 CT. Certain breeds, especially lighter breeds and miniature horses in particular, are more prone to develop these bony swellings. These eruption cysts may be due to vertical impaction of the CT that erupt last, but with time, as the mandible and maxillae lengthen, the impacted CT have room to erupt normally and the overlying bones remodel to a normal contour over the following year or so.

**Developmental Diastema(ta)**

The occlusal surfaces of the individual CT rows are normally compressed tightly together so that the occlusal surface of the 6 CT in each row function as a single grinding unit (Fig. 1).

![Normal CT Occlusion](figure1.png)

Figure 1. Normal CT occlusion.

However, if spaces, i.e. diastema(ta) develop in the interdental (interproximal) space between the CT, food impaction will occur in these spaces. Developmental mechanisms that can allow
CT diastemata to develop\textsuperscript{7,10} include inadequate angulation of the rostral (06s) and caudal (10s, 11s) CT that normally compress the occlusal aspects of all 6 CT together (Fig. 2). Alternatively, CT may have normal angulation but develop too far apart due to disparity between size of teeth and supporting bones or because the CT buds develop too far apart (Fig. 3).

![Figure 2. Reduced CT angulation.](image1)

![Figure 3. CT angulation normal, CT too far apart.](image2)

Valve diastemata where the abnormal interdental space is narrower at its occlusal than gingival aspect are more problematic than open diastemata where the abnormal space has similar width from the occlusal surface to the gingiva. du Toit, et al has shown that clinical examination of diastemata can be accurately differentiated between valve diastemata or open diastemata with mean occlusal to gingival diastema width ratios of 0.4 found in valve diastemata and of 1.07 in open diastemata.\textsuperscript{11}

The massive and prolonged forces of mastication on equine CT occlusal surfaces cause progressively deeper impaction of long fibres into widened interdental space which can later spread sub-gingivally to the lateral and medial aspects of the two affected teeth. This leads to a painful and usually progressive secondary periodontal disease with remodelling and lysis of the alveolar bone - that occasionally may even lead to extensive osteomyelitis of the supporting mandibular or maxillary bones or if involving the maxillary 08s-11s, to sinusitis or an oromaxillary fistula - with the overlying maxillary sinuses becoming filled with food and exudate. CT diastema can be recognised by finding food fibres packed in between teeth and more significantly in periodontal pockets between the CT just above the gingival margin, especially between the caudal mandibular cheek teeth (09s-10s; 10s-11s). Due to their common position between the caudal mandibular CT where they are hidden by the tongue, mandibular CT diastemata are difficult to clinically detect unless these sites are carefully examined with an intraoral mirror or endoscope.

The main consequence of CT diastemata is periodontal disease which is discussed in a further abstract.

**Developmental Displacement of Teeth**

*Displacement of Incisors*
In addition to displacements in the presence of supernumerary incisors, occasionally gross displacement of permanent incisors can occur in horses with a normal number of teeth. Previous trauma may have displaced the buds of the developing permanent incisor(s), but they also may be displaced because of intrinsic developmental reasons.

**Displacement of Cheek Teeth**

Displacements are rare in deciduous equine CT, but are common in permanent CT. Two different types of permanent CT displacement (i.e. developmental and acquired) are recognised in horses. Most severe CT displacements, especially in younger horses, are developmental and often appear to be caused by overcrowding of the dental rows during eruption and less commonly, by developmental displacement of the CT buds. Developmental CT displacement may be bilateral, and displaced CT may be bent suggesting that dental overcrowding occurred prior to calcification of the developing tooth. Jaw trauma can also damage or displace a developing CT bud, causing later maleruption.

The 09 and 10 positions are most commonly displaced, and equine mandibular CT are three times more likely to be displaced than maxillary CT. Large overgrowths can develop on aspects of displaced and their opposing teeth, that are not in occlusal contact. More importantly, displaced CT invariably have diastemata beside them (Fig. 4) which allows painful food pocketing. Marked displacements where CT lay horizontal in the mandible or the maxilla and never erupted have been reported.

![Image of Overcrowding of CT with displacement](image)

**Figure 4. Overcrowding of CT with displacement.**

Abnormal protrusions or overgrowths of displaced and opposing CT should be reduced and impacted food in diastemata should be removed. Diastemata can be mechanically widened (removing most dental tissue from the displaced tooth. Finally, displaced teeth can be extracted, especially when markedly displaced or rotated, and this procedure is most readily performed in older horses, especially when deep periodontal disease is present.

**References**