

Cheek Teeth Diastemata and Impactions

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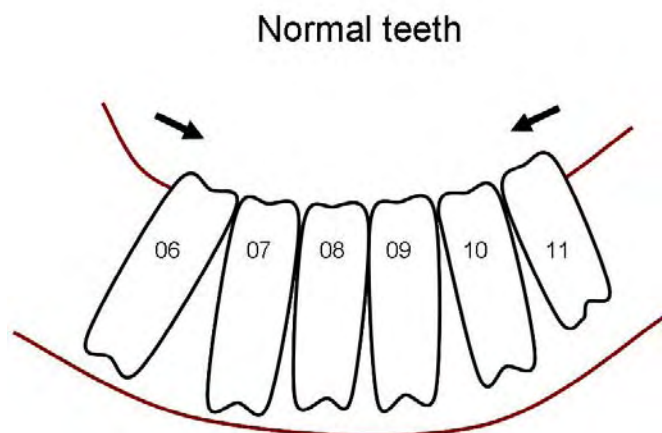
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Introduction

A diastema (plural, diastemata) is the presence of a detectable (interdental) space between adjacent incisor or cheek teeth. Carmalt¹ proposed that the terms *valve diastemata* or *closed diastemata* be used to differentiate pathological diastemata from the physiological (normal) diastema (i.e. “bars of the mouth”) that are present between the incisors (or canine teeth in males) and the cheek teeth and also to differentiate pathological diastemata from very wide (non-problematic) interdental spaces, e.g., at the site where a cheek tooth has been extracted. In the UK, diastemata of the cheek teeth (CT) is the major cause of severe quidding in horses, particularly in cases where no significant dental overgrowths are present. Equine CT diastemata are currently under-diagnosed in equine practice due, in part, to the difficulty of fully clinical examining the interdental spaces, especially of the caudal mandibular cheek teeth where diastemata are prone to occur.²

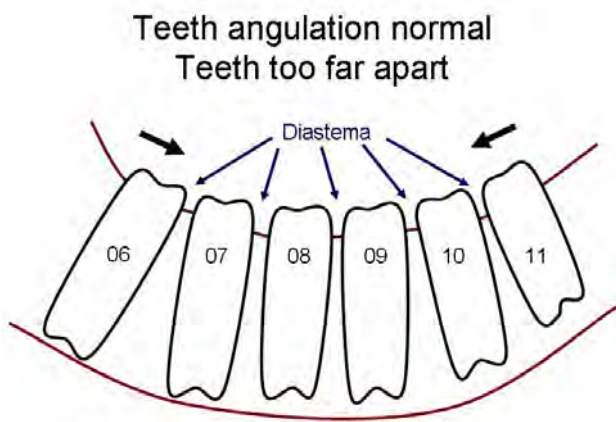
Aetiopathogenesis

In brachydont dentition (such as human or canine teeth), the teeth are normally kept in close contact at their occlusal surface by the rostrally angled last molar teeth (“wisdom teeth”) pressing the true arch of teeth rostrally and then medially (termed “mesial” direction in brachydont



dentistry) towards the 01s (central incisors). However, because the cheek teeth (CT) of horses are in a straight row rather than an arch, the terms distal and mesial do not make anatomical sense and so are inappropriate in relation to CT in this species. During evolution, the horse's CT have become separated from the canines and incisors in order to lengthen the horse's head (possibly an evolutionary development to allow it to observe for predators while grazing tall forage). A complimentary adaptation was that the 1st CT (06s) evolved to face caudally.

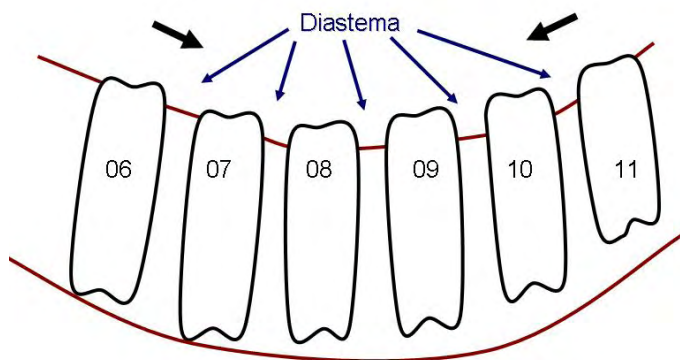
Consequently, the occlusal surfaces of the 6 equine CT in each row are normally tightly compressed together on the occlusal surface due to the growth of the caudally angled first CT (06^s) and rostrally angled last two CT (10^s, 11^s) pressing the occlusal aspects of all six CT together. This rostral and caudal pressure causes each row of 6 cheek teeth to act as a single functional unit,³ with no spaces present between the occlusal surface of adjacent CT that can allow food trapping.



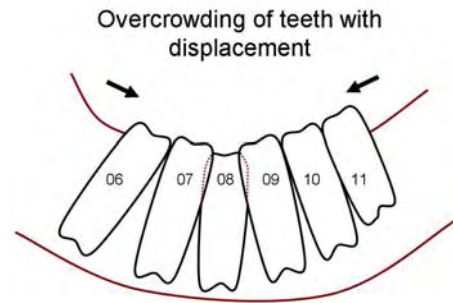
Diastemata of the CT can be classified as primary or secondary diastemata, and also as developmental or acquired. Developmental primary diastema can be due to inadequate rostro-caudal angulation of the rostral and caudal CT and also can be caused by dental buds with normal angulation developing too

far apart, possibly due to an imbalance between the size of the CT and size of the supporting bones. An opposite disparity at eruption between the size of the jaw and of the cheek teeth, occurs

Reduced teeth angulation

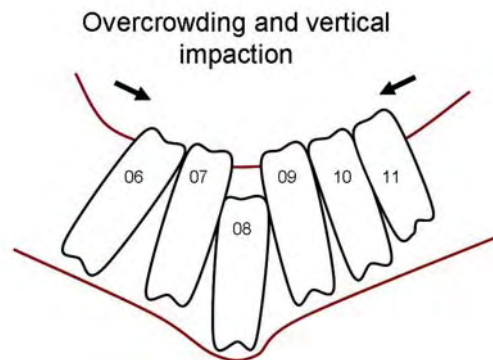


when the supporting bones are not large enough to allow unimpeded dental eruption. The dental buds may now become overcrowded leading to CT impaction, and with subsequent impeded eruption leading to their displacement and the development of *secondary* developmental diastemata at the interdental spaces between normal and



Developmental medial displacement of 409 with slight lateral displacement of 408 and 410. Obliquely directed diastemata are present on both sides of the displaced 409.

displaced CT, despite the teeth having apparently normal angulation. Alternatively, impacted CT may not erupt fully, but continue to grow in an apical direction and distort the underlying mandibular or overlying maxillary bones.



The mandible of this young horse has large eruption cysts due to vertical impaction of the developing cheek teeth.

Cheek teeth taper in towards their apices, but even with age, the progressively smaller reserve crowns usually remain tightly compressed at the occlusal surfaces by continuing eruption of the angulated rostral and caudal cheek teeth.² However, as the older horse's

reserve crown finally wears away (and depending on the degree of tapering and of angulation of the CT), the narrow remaining reserve crown cannot continue to be adequately compressed, and consequently, senile diastemata develops between the cheek teeth in this age group.⁴

Diastemata may also develop secondary to *acquired* cheek teeth displacements, most commonly a medial (lingual) displacement of the mandibular 10s and 11s. Such acquired diastemata can also occur as a consequence of tooth loss, when drifting of adjacent teeth occurs into the empty alveolus, leads to reduced compression of the remaining row of CT.

Individual diastemata can also occur due to cheek teeth displacement in a rostro-caudal direction caused by individual CT overgrowths. For example, with tall overgrowths and subsequent caudal displacement of the lower 11^s (by pressure against the upper 11s), diastemata can develop between the overgrown lower 11 and the adjacent 10; and similarly, diastemata can develop between overgrown upper 06^s that become rostrally displaced and the (adjacent) upper 07^s.

The presence of supernumerary cheek teeth also commonly causes diastemata formation between the supernumerary and adjacent cheek teeth, because supernumerary teeth are often irregular in shape and do not fit tightly against adjacent CT, and also because they usually cause overcrowding and displacement of the adjacent cheek teeth.⁵

Horses may vigorously masticate fibrous food for over 18 hours per day, and so even the smallest space between two CT will allow some food fibres aligned in the direction of the abnormal space to be forced into it. The presence of diastemata can lead to progressive impaction of transversely oriented, long fibres of food in the abnormal interdental (interproximal) spaces. In many horses, because of the shape and size of the diastema, the food may become impacted only in the interdental space of the erupted dental crown but does not reach the sensitive gingival and periodontal tissues and thus will cause no clinical signs. However, in other cases, food fibres will later become compressed down

into the gingival margin between the CT and then are very painfully compressed down into the two adjoining periodontal spaces.

These periodontal food pockets will usually spread from the restricted interdental spaces to the less restricted periodontal spaces on the lateral and medial aspects of the teeth on each side of the diastema, and food impaction will become deeper at these sites.



This specimen has a valve diastema between 406 and 407 with periodontal pocketing of food.

Progressive stretching, inflammation, and destruction of the periodontal ligament will be induced by these foreign bodies, and secondary anaerobic infection will further exacerbate this very painful periodontal disease. Not surprisingly, during mastication, when more food is compressed into the diastemata, causing pressure on the painful periodontal area, the horse may quid to relieve the pain. Destruction of periodontal fibres may even delay eruption of affected teeth, possibly resulting in the development of wavemouth. In occasional cases, diastemata can lead to periapical infection, loosening of CT, oromaxillary fistulas with secondary sinusitis, and osteomyelitis of the supporting mandibular or maxillary bones.



This specimen has a long-term valve diastema between 410-and 411 with deeply impacted food and evidence of chronic periodontal disease with extensive re-modelling of mandibular bone.

Exaggerated transverse ridges can develop on the occlusal surfaces of CT opposite wider diastemata, due to lack of attrition. They do not usually develop opposite the more clinically significant valve diastemata that have a small interdental space on the occlusal surface. When present, these abnormal ridges will selectively widen, and also selectively force food into the diastemata, leading to worsening of clinical signs.

Clinical Signs

Diastemata of the CT may cause halitosis, quidding, buccal food packing, and in advanced cases, weight loss or the previously noted infections of the CT apices, supporting bones, and paranasal sinuses. Horses with CT diastemata have more difficulty chewing long rather than chopped fibre, because short fibres (e.g. <5mm) are less likely to become physically trapped in diastemata. Affected horses are also often asymptomatic on short grass, which has softer and finer fibres, as compared to hay or silage. In the author's opinion, periodontal disease associated with diastemata causing periodontal food impaction and inflammation is the most painful equine dental disease and the most common cause of severe quidding in the horse

Some affected horses will be noted to chew very slowly and not make the normal loud masticatory 'crunching' sounds. Affected animals may also be observed to preferentially chew on one side of their mouth (avoiding the side with the most painful diastemata), or they may hold their head in abnormal positions when eating. Sometimes, these horses present with weight loss and poor condition, although most animals can maintain their weight by re-eating the quidded boluses. Undigested grains or long strands of forage may also be seen in their faeces. These horses may be more prone to large colon impactions or oesophageal obstruction because they fail to chew their long forage adequately, but little objective evidence is available on this subject.

Oral Examination

As noted, diastemata are more common in the mandibular cheek teeth rows and particularly between the caudal teeth. The use of a dental mirror, flexible or rigid endoscope or basket retractors will greatly aid visual identification of significant

diastemata. Food fibres are commonly observed packed transversely in small spaces between adjacent cheek teeth, just above the gingival margin. If secondary diastemata are present with dental displacements, these lesions are easier to detect on both sides of the displaced CT. It may help to try to insert a fingernail between the occlusal surface of adjacent cheek teeth to determine if a detectable dental space (which may be only a few mm wide) is present, followed by careful palpation of the buccal and lingual margins of the teeth to identify the characteristic doughy feel of protruding, impacted food or the presence of larger periodontal pockets. Pressure on this area will often cause pain, even in well sedated horses.

As diastemata are often present at multiple sites, a careful search of the cheek teeth rows should be made, on both their lateral and medial sides, as these lesions can predominantly affect just one side of the cheek teeth. A long, right-angled dental pick, long alligator forceps, or proprietary pressurised water or compressed gas dental instruments can be used to clean out the diastemata of trapped food. A periodontal probe can also be used to assess the depth and extent of periodontal pockets, which may be up to 5cm deep in advanced cases.²



This figure shows a basket retractor in use to show extensive forage protruding from a mandibular cheek teeth diastema.

Visual assessment of the degree of gingivitis, focal gingival retraction, and periodontitis associated with the diastemata, and also the amount of pain elicited on palpation of this area are important to ascertain whether the diastemata are clinically significant.

Diastemata with just a few fibres between adjacent CT and no or minimal evidence of periodontal disease are common and usually not clinically significant and are usually best left alone, especially if multiple.

Occasionally, some horses with unilateral, painful cheek teeth diastemata (e.g. secondary to a unilateral CT displacement) may present with an oblique incisor occlusal surface (“slantmouth” “slopemouth”), because they preferentially chew on one side. In turn, this will result in reduced normal occlusal wear and generalised overgrowths on the painful cheek teeth rows. As noted previously, wavemouth or loose teeth may also eventually occur.

For further evaluation of suspect diastemata cases, open mouth oblique radiographic views can be used to assess the depth, number, and severity of cheek teeth diastemata, and this is also a useful tool for monitoring progression (or regression) of diastemata over time. These x-rays can also be of prognostic value with cases of developmental primary diastema, because they can reveal the angulation of the CT. If very little angulation is present, the long term prognosis is poor, in contrast to horses whose CT are too far apart but well angled, that may develop normal alignment of the CT occlusal surface over the following years. These oblique views avoid superimposition of the opposing cheek teeth over the area of interest, as occurs in standard (closed-mouthed) radiographic projections of the equine cheek teeth. The open mouth oblique views are taken at 15° ventrolateral-lateral for the maxillary cheek teeth, and 10° dorsolateral-lateral for the mandibular cheek teeth.^{6,7} If diastemata are secondary to displacements, the width of these obliquely-orientated diastemata may not be radiographically apparent or may appear small, due to their angulation.

Treatment of CT Diastema

Widening of Interdental Spaces

With cases of primary diastema, enlargement of ‘valve’ type diastemata with a diastema burr attachment (carbide or diamond-coated burrs) on a motorised rasp (e.g. Powerfloat)^a (Figs. 10 and 11) is the best current treatment.^{5,9} Widening the diastemata to 6 - 8mm

wide at the occlusal surface reduces or even eliminates the long-term entrapment of long fibres between the teeth as it allows food to more easily cycle (move) through the now widened interproximal space.^{3,9} It is safer to use this technique in older horses, because younger horses have wide pulp cavities lying just beneath the occlusal surface, and also close the caudal border of the tooth, and thus there is a risk of pulp cavity exposure with this procedure, that potentially can lead to secondary periapical infection.



A diastema burr is being inserted into the lingual side of a diastema just above gingival level. The burr will then be elevated to “open” the diastema on that side of the tooth.

Prolonged burring of an interdental space, especially with a blunt burr or a burr that has become clogged with food or ground dental debris, can generate much heat. This can potentially cause thermal damage and even death of the underlying pulp – later leading to loss of secondary dentine deposition at that site and subsequent pulpar exposure and apical infection.



The diastema has been widened on the lingual side to occlusal level.

Diastemata widening is performed in standing, heavily sedated horses, e.g. following alpha-2 agonist and butorphanol administration (some operators also administer flunixin). A mandibular nerve block can be used to reduce pain when treating mandibular diastemata. As much food as possible should be first removed from the diastema prior to burring, to prevent the burrs from becoming clogged. This removal of food is usually the most painful part of the procedure. Access to the more caudal cheek teeth can be problematic, due to tongue and head movement but is possible in well sedated horses. The operator should constantly examine the interdental area being widened with a dental mirror or endoscope and less satisfactorily by palpation, to ensure that the correct area is being burred – it is easy to mistakenly cut into one of the (normal) vertical grooves in a tooth, rather than into an interdental space, and so accidentally expose pulp cavities.



The diastema burr is now directed ventrally, and the diastema is opened in a medial to lateral (lingual to buccal) direction.

The diastemata are initially widened with a pointed diastema burr inserted horizontally on the medial aspect of the interdental space at the widest area of the diastema (just above gingival level). The rotating burr is elevated towards the occlusal surface in a slightly caudal direction (the pulp cavity is closer to the caudal than the rostral aspect of the tooth) until it exits on the occlusal surface. The burr can now be directed apically into the

opened space on the medial aspect of the interdental space, and burring is continued in a lateral direction until resistance ceases when the lateral interdental margin is reached.

The author does not burr for more than 5 seconds without spraying cold water on the site, both to cool the teeth and to help keep a hot burr from becoming clogged with dried dental and food debris. Depending on the size and shape of the diastemata, they can be further widened, e.g. using a cylindrical 8 mm diameter burr. Widening beyond this width has usually not been found to be necessary and also increases the risks of exposing a pulp cavity.



The diastema has now been fully opened across the occlusal surface to gingival level



A maxillary CT diastema being widened with a dental burr

The diastemata adjacent to displaced or supernumerary CT are usually in an oblique direction that must be first well assessed with a dental mirror. The burring is performed with the burr in a vertical position, from a medial direction, taking care to follow the oblique course of the interdental space.

Horses are given intra-muscular penicillin and an aminoglycoside, prior to the procedure, and anti-inflammatory drugs and oral antibiotics are administered for 5 -7 days post treatment. Cases are reassessed 3 months later when some diastemata may need further widening, and thereafter at 6-12 month intervals, if necessary.

When performed by a trained operator, this procedure is of enormous value to most cases, with many horses that have had severe oral pain and quidding for years becoming asymptomatic within a week or so of treatment and some younger horses becoming permanently cured.

Dietary Modification

Dietary modification involves eliminating food containing long fibres of forage by substituting a finely chopped forage diet, e.g. grass or alfalfa pellets and some grain, having first cleaned out all the periodontal pockets of deeply impacted long fibres. Dietary modification can be reasonably successful, but is an expensive treatment. Horses should be weighed regularly to ensure they maintain their weight. Horses on such diets require routine dental floating every 4 months as this type of diet causes horses to chew with a more vertical than lateral mandibular action, and also reduces the overall time of mastication, thus encouraging the development of cheek teeth enamel overgrowths.⁶

Removal of Exaggerated Transverse Ridges

Reduction of any exaggerated transverse ridges that have developed opposite the diastemata is a useful treatment, but as noted, obvious ridges do not develop opposite the most problematic diastemata, i.e. valve diastemata that have minimally enlarged interdental space.

Reducing Occlusal Pressure on Diastemata

Reducing the occlusal surface crown height on either side of the diastemata by 2-5 mm, for a width of 10-15 mm along the occlusal surface, using a motorised rounded burr and similarly reducing the height of the occlusal area of the opposing teeth and cleaning out of impacted food may also be palliative.⁵ By so taking the diastemata out of occlusion, less food will be compressed into these treated sites. Care must be taken not to overheat or expose pulp.

Extraction of Teeth

Where a diastema is secondary to severe developmental displacement, especially if only one or two CT are involved, extraction of the displaced CT has proved to be a radical but successful treatment, even in young horses. However, widening the interdental space and reducing the protruding areas of the displaced teeth (and any overgrowth on opposite teeth) should be the initial option.² In some cases, especially in older horses, the periodontal disease that develops secondary to diastemata may have loosened the periodontal ligament, facilitating oral extraction. However, subsequent drifting of the remaining teeth caused by the tooth extraction may create new diastemata, or widen other existing diastemata.

Reduction of Overgrown Displaced Teeth

When single diastemata have developed secondary to dental overgrowths, e.g. an acquired diastema between 06 and 07 caused by an overgrown 06 removal of impacted food and reduction of the causal overgrowths may reduce the quidding and can prevent progression, and in some cases, even result in resolution of the diastemata.

Packing Diastemata with Plastic Impression Material

A further treatment, that can be used on its own or in conjunction with diastema widening, consists of initially cleaning out of the periodontal pockets of all impacted food and then irrigating them fully of impacted food, e.g. using the Equine Dental System^b with sodium bicarbonate solution or a manual water pump. The now empty periodontal pockets are then filled with plastic impression material,^c possibly with a layer of

antibiotics such as doxycycline gel (Doxirobe gel^d) beneath the impression material. Some horses will have good healing of the periodontal pockets and so have a temporary relief of periodontal pain following this treatment. This improvement may persist in some horses after the impression material falls out (usually in a few weeks). However, if no other dental treatment is performed, the fundamental mechanical problems that initially predisposed to food impaction in the diastema will remain, and so the clinical problem will likely re-occur later.

Orthodontic Treatment

Orthodontic correction of the abnormal spaces is theoretically the ideal treatment, with orthodontic wires pulling the adjacent teeth into normal alignment. The presence of wires crossing the interdental spaces would also reduce the ingress of food into the diastemata. However, major potential problems with such a technique include the limited access to the caudal cheek teeth, breakage of orthodontic wires due to the massive and continuous forces of equine mastication and a likely inability to achieve sufficient compression on appropriate areas of affected CT to reduce the diastemata.

Euthanasia

Euthanasia may be occasionally required, especially in younger horses, if widespread diastemata with deep food pocketing, and severe, widespread osteomyelitis of the supporting bones are present, especially with less valuable horses where economic considerations are present. In more valuable horses, extraction of multiple CT to allow removal of food from deep within the supporting bones would be an option.

References and Footnotes

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^aPowerfloat; D&B Equine Enterprises Inc., Calgary, Alberta, Canada.

^bThe Equine Dental System; Pacific Equine Dental Institute (P.E.D.I), El Dorado Hills, CA 95762.

^cImprint 11 Garant; 3M ESP E, St. Paul, MN, USA 55144.

^dPfizer Animal Health, Walton Oaks, Dorking Road, Tadworth, Surrey, KT20 7NJ, UK.