Common dental disorders in the donkey

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Keywords: horse; donkey; dentistry; anatomy; dental disorders; dental treatment

Summary

Normal dental anatomy and the range of dental disorders found in donkeys are largely similar to those described in horses. Recent studies have shown dental disease to have a high prevalence in donkeys. Some dental disorders, such as diastemata, displaced teeth and wave mouth can have serious clinical consequences by causing oral pain and weight loss and even predispose to colic. Many of these signs can be prevented by regular dental treatment that can slow down or even prevent the progression of these disorders.

Introduction

Donkey dental anatomy has been shown to be largely similar to that of horses, based on gross, histological and ultrastructural examinations (du Toit et al. 2008d,e). Dental disease in donkeys has recently been well documented and has a high (up to 93%) prevalence in the UK, particularly in older donkeys (du Toit et al. 2008a,c, 2009b). This high prevalence of dental disease in donkeys in the UK may be partly attributed to the longevity of donkeys, with median ages of the studied populations varying from 23–31 years of age (du Toit et al. 2008c, 2009b). The most significant increase in dental disorders in donkeys occurs in the 10–15 year age group (du Toit et al. 2009b), emphasising the need for prophylactic dental treatment in adult donkeys, to prevent or slow down the progression of dental disease.

Anatomy

Donkey teeth are hypsodont (high crowned) which continually erupt throughout the life of the animal by a dynamic process of periodontal ligament remodelling. At the time of eruption there are no true roots and teeth are thus divided into apical and coronal regions, but most of the crown (reserve crown) lies within the alveolus. True roots are formed gradually over a period of approximately 2 years after eruption (Kirkland et al. 1996). Donkeys have 36–44 permanent teeth, with this variation due to presence or absence of 1st premolars (‘wolf teeth’) or canines. The 2nd–4th premolars and molars are collectively referred to as cheek teeth. The ‘modified Triadan’ system has been a well accepted method for numbering and identification of equine teeth and is equally applicable in the donkey. The clinical crown of the caudal cheek teeth (10 and 11) are orientated rostrally and those of the rostral cheek tooth (06) are orientated caudally to ensure that the cheek teeth are spaced tightly against each other to act as a single functional unit (Dixon and Toit 2010).

All 3 calcified dental tissues are exposed on the occlusal surface in hypsodont teeth (compared to only enamel in brachydont teeth) (Fig 1). Additionally, maxillary cheek teeth have 2 enamel infoldings (infundibulae) and incisors have one such infolding to increase the length of enamel ridges exposed on the occlusal surface. Mandibular cheek teeth have no infundibulae, but have greater peripheral enamel infolding. Enamel is the hardest substance in the body and this creates an irregular occlusal surface with a self sharpening mechanism, with the harder enamel forming ridges while the softer cementum and dentine are worn away slightly faster. This occlusal anatomy facilitates more efficient mastication of hard fibrous material.

Donkeys have 5 pulp horns in cheek teeth in the Triadan 07–10 positions, with 6 pulps in the 06s and 11s. These individual pulp horns communicate with one or 2 common pulp chambers more apically in the tooth. A numbering system has been established for identification of the different pulp horns, which can be used when examining the teeth specifically for pathology of the pulp horns (du Toit et al. 2008d) (Fig 2).

Dental disorders

Incisors, canine teeth and wolf teeth

Donkey incisors rarely suffer clinically significant dental disease, but any incisor disorders present are often
detected by the owner, as these teeth are easily visualised. Brachygnathism (overjet/overbite) and more rarely, prognathism (underbite) may occasionally be seen and can result in overgrowths of the incisors if extreme. More importantly, they may be associated with uneven alignment of the cheek teeth with focal overgrowths developing on the rostral aspect of the upper 06s and on the caudal aspect of the lower 11s cheek teeth with overjet/overbite. Similarly the presence of incisor occlusal surface abnormalities such as a ‘slant’ (diagonal bite), ‘frown’ or extreme ‘smile’ may be indicative of the presence of a painful or mechanically obstructive cheek teeth disorder causing an abnormal masticatory action. Retention of deciduous incisors, fractures and supernumerary incisors may also be seen. Senile diastemata of the incisors may also be seen in older donkeys and are also often associated with periodontal disease, although this is highly unlikely to cause quidding or weight loss. Displacements of the incisors are also common in older animals, especially secondary to loss of an adjacent incisor.

The most common problem with canine teeth is the accumulation of calculus and, in extreme cases, this may be associated with gingivitis and even periodontal disease. Due to their long reserve crown, extraction of canine teeth which are severely displaced, enlarged or have apical infections, needs to be performed under regional or even general anaesthesia. Wolf teeth (1st premolars, Triadan 05s) rarely cause problems in donkeys and are often shed at the time of eruption of the permanent second premolar (06). Donkey wolf teeth usually have a very short root and may be extracted under local anaesthesia, but care needs to be taken not to lacerate the adjacent large palatine artery.

Cheek teeth

Sharp enamel points (overgrowths)

Donkeys have marked anisognathia, with the maxillary cheek teeth 27% further apart than the mandibular teeth, resulting in the buccal aspect of the maxillary and lingual aspect of the mandibular cheek teeth not being in wear in the resting (neutral) position. Sharp enamel points on the buccal aspect of the maxillary and lingual aspect of the mandibular cheek teeth, may be regarded as a physiological change associated with the hypsodont masticatory action. A UK study found the prevalence of sharp enamel points to be significantly higher in younger donkeys (54% in donkeys 10 years or less in age) compared to older donkeys, especially those greater than 25 years of age (6% prevalence) (du Toit et al. 2009b). Enamel points often cause ulcers or calluses (chronically scarred epithelium) on the adjacent cheek mucosa and this feature is more common when tight nosebands or head collars are used on affected donkeys (du Toit et al. 2008a).

Diastemata and periodontal disease

Diastemata can be defined as either open (same width from the gingival margin to the occlusal surface) or closed (narrower at the occlusal surface) which can have implications on the severity of the associated dental disease (du Toit et al. 2009a). Closed diastemata generally trap food tightly and act like a one-way valve with food continuing to impact with mastication. Open diastemata, although also often associated with periodontal disease, will mostly have food move in and out easily thereby likely to cause less severe periodontal disease.

Diastemata are one of the most common dental disorders observed in donkeys, with an overall prevalence of >50% (du Toit et al. 2009b). Diastemata are more common in the mandibular cheek teeth and in particular in the interdental space between Triadan 09/10 and 10/11.
In contrast, maxillary cheek teeth diastemata were more common in the 06/07 and 07/08 interdental spaces (du Toit et al. 2008c). Diastemata are often secondary to displacement of an adjacent tooth or due to teeth drifting in a rostral or caudal direction as a result of a missing tooth within the same cheek teeth row. Senile diastemata may form in multiple interdental spaces in geriatric donkeys due to the tapering of the tooth towards the apex such that the clinical crown becomes narrower at an advanced age (Fig 3). Gingivitis and periodontitis associated with diastemata are regarded as one of the most painful dental disorders in equids as they are very often associated with periodontal disease, food impaction and gingivitis (Dixon 1992) (Fig 4). Associated periodontal pockets can sometimes extend several centimetres below the gingival margin along the side of the tooth causing loss of periodontal attachment, alveolar bone resorption and even leading to periodontal to endodontic inoculation of dental pulp leading to apical infections and/or osteomyelitis.

Displaced teeth

Displacement of cheek teeth is very common in donkeys with a prevalence of >40% in donkeys older than 20 years of age (du Toit et al. 2009b). Lateral cheek teeth displacement appears to be slightly more common than medial displacements. Cheek teeth can displace as a result of developmental problems such as impaction of Triadan 08, that are the last permanent teeth to erupt and often have limited space available due to the rostro-caudal angulation of the cheek teeth (Dixon et al. 1999). No studies on the heritability of dental impactions, as has been suggested to occur in certain horse and pony breeds, have been performed in donkeys. These displacements are found in younger animals and are often bilaterally symmetrical. Acquired displacements are secondary to other dental disorders such as periodontal disease, wear abnormalities or adjacent missing teeth. Severe displacements may be associated with corresponding soft tissue ulceration on the cheek or lingual mucosa, causing oral pain and adjacent diastemata and secondary periodontal disease will lead to eventual loosening of the teeth. Furthermore, displaced teeth will result in reduced efficient masticatory surface and may lead to overgrowths or displacements of cheek teeth from the corresponding row.

Wear abnormalities

Overgrown and worn teeth are common in donkeys with a prevalence of over 80% in geriatric donkeys (>35 years) (du Toit et al. 2008c, 2009b). Individual overgrown teeth are often secondary to missing or severely displaced opposing cheek teeth (Fig 5). Cheek teeth often become worn in older donkeys when the enamel infolding decreases in mandibular teeth or when the infundibulae become worn in maxillary teeth, resulting in ‘cupping’ out of the teeth.
(senile excavation) as the softer dentine and cementum become quickly worn away. This senile wear may involve many teeth resulting in what is termed ‘smooth mouth’ and is most commonly seen in donkeys >35 years of age (du Toit et al. 2009b). The presence of smooth mouth in one cheek teeth row is often associated with overgrowth of the entire opposing row.

The presence of worn and/or overgrown teeth adjacent to each other and corresponding overgrowths and/or worn teeth in the opposing rows, may result in a wave like pattern of wear in a rostro-caudal direction causing a disorder termed ‘wave mouth’ (Fig 6). If the change from an overgrown or worn tooth to normal occlusal margin is exaggerated, this abnormality has been termed a ‘step mouth’. Wave mouth may develop at an earlier age as it is often secondary to other dental disorders and is seen with increasing prevalence from 16–20 years of age (du Toit et al. 2009b). Shear mouth is where the cheek teeth on one side of the mouth (or more rarely both) have extremely high angles (e.g. >45°) on their occlusal surfaces and may occur secondary to other painful dental disorders or abnormal masticatory action (Fig 7). Shear mouth can occur at any age and has a low prevalence in donkeys (<8%) (du Toit et al. 2009b).

Pulpar exposure and apical infections

Occlusal pulpar exposure, as suggested by an occlusal circumferential dark brown to black area around the pulp horn, together with the presence of a fissure in the occlusal secondary dentine on probing (allowing the probe to enter the pulp horn) is usually indicative of severe pulpitis or even death of the tooth. However in some cases, the more distal, healthy pulp can seal off the more occlusal damaged aspect of the pulp horn with tertiary dentine and thus prevent exposure of the deeper pulp.

This may just involve one pulp horn or extend to involve all the pulp horns due to their communication at the common apical pulp chamber. Pulpar exposure usually occurs as a result of an apical infection causing necrosis of the pulp (often multiple pulps are exposed) (Casey and Tremaine 2010) resulting in defects or cessation of sub-occlusal secondary dentine formation. In most cases of apical infections in horse mandibular cheek teeth anaerobic contamination of the pulp is the suspected aetiology (59%), but may also occur as a result of tooth fractures (20%), periodontal disease (19%) and rarely dysplastic changes (2%) (Dacre et al. 2008). Maxillary cheek teeth apical infections are also most commonly due to anachoresis (51%), but infundibular caries (16%) and periodontal disease (12%) are also common aetiologies (Dacre et al. 2008).

In aged donkeys, apical infections most commonly occur secondary to periodontal disease associated with diastemata with deep penetration of oral bacteria allowing bacterial inoculation of the pulp via the apical foramina and fractured cheek teeth (N. du Toit, personal observation). Donkeys with apical infections may present with sinusitis; rarely an oromaxillary or orocutaneous fistula, but more often, oral pain is the only clinical sign. Multiple pulpar exposure is occasionally observed in geriatric donkey teeth with very short apices and these are rarely associated with apical infections, indicating the likelihood that their roots have fully sclerosed and the teeth are no longer viable.

Cheek teeth fractures and caries

The prevalence of idiopathic dental fractures in different donkey populations varies from 2-8% with no age predilection (du Toit et al. 2009b). These fractures can vary from small lateral or medial enamel fragments to complete sagittal fractures through the pulp horns (Fig 8) or infundibulae, particularly carious infundibulae. The presence of small occlusal fissure fractures has recently been described in horses and it is believed that some of these may predispose to either complete dental fractures or to apical infections (Casey and Tremaine 2010; Ramzan and Palmer 2010). Fractures need to be carefully assessed...
to determine if they involve the pulp horns and to assess their depth, to determine if the tooth is likely to remain viable. Infundibular carious lesions are also occasionally seen in donkeys and are also more common in the maxillary 09s as described in horses (Fitzgibbon et al. 2010) (Fig 9). Peripheral caries in donkeys appear to occur secondary to other dental disorders that cause stagnation of food between the cheeks and cheek teeth.

**Diagnosis of dental disorders**

Donkeys with dental disease may present with accumulation of food in their cheek, halitosis, chewing slowly whilst making slurping noises, quidding (dropping boluses of partially chewed food) or, in extreme cases, weight loss. Other clinical signs such as facial swelling, draining facial tracts and unilateral nasal discharge may also be indicative of dental related disease. Cheek palpation may be useful in identifying food pocketing, dental-related swellings and the presence of pain. A full mouth speculum, such as the Hausmann’s gag, a good head light and dental mirror is essential to perform a thorough oral examination. The use of a gum plate with the speculum, rather than the standard bit plate, may be more comfortable for smaller donkeys. A head rest or suspended dental halter is also required to ensure the head is suitably elevated for examination and treatment.

Standing sedation of the animal will ensure that less obvious (but clinically important) lesions, such as caudal mandibular diastemata are not missed. Some donkeys are amenable to examination and treatment without sedation, but careful consideration needs to be given to the safety of the handlers and patient. Sedation with a combination of butorphanol (0.02-0.06 mg/kg bwt) and either detomidine (0.02-0.04 mg/kg bwt) or romifidine (0.04-0.12 mg/kg bwt) is usually effective to ensure a good oral examination is performed and to enable treatment of a fractious donkey. Oral endoscopy has also increased in popularity over the last few years and is extremely beneficial in detecting more subtle lesions such as fissure fractures, pulpar abnormalities and even small caudal diastemata (Simhofer et al. 2008a; Ramzan 2009).

Radiography is an important ancillary diagnostic tool that will not only allow imaging of the deeper structures such as dental apices, alveoli and sinuses, but is also useful for assessing intraoral (clinical crown) lesions by means of the open-mouth oblique view (Barakzai and Dixon 2003). Radiographs are also useful in detecting supernumerary cheek teeth and evaluating teeth fractures. Apical infections are conclusively diagnosed by a combination of clinical signs, oral lesions (pulpar exposure and/or draining periodontal tract) and radiographic changes, such as periapical lysis, apical clubbing and sclerosis. Further imaging modalities such as scintigraphy or computed tomography are of use in some cases to confirm the diagnosis (Barakzai et al. 2006).

**Treatment**

A number of small sized, manual rasps are required in order to perform proper dental treatment. Generally, solid carbide blades are used to reduce (rash, float) sharp enamel points and overgrowths, whereas the carbide chip blades are often used as a final rasp to ensure there are no remaining small sharp areas. A wide array of motorised dental equipment has recently been developed which enables faster rasping/floating of enamel points and overgrowths, but special care needs to be taken to avoid pulpar exposure, thermal pulp horn damage, excessive rasping of teeth or soft tissue trauma. Routine floating of sharp enamel points is particularly important in ridden donkeys because tight fitting nosebands may push the cheeks onto the enamel points predisposing to the formation of buccal mucosal ulceration. It is particularly important to ensure removal of the enamel points on the vertical ridges of the caudal maxillary cheek teeth, where the maxillae curves medially and an angled head manual...
or motorised rasp is required to remove these overgrowths. It is very important not to rasp the occlusal surface as an irregular surface is required for mastication.

Treatment of diastemata with food impaction and periodontal disease is very difficult and no single technique is effective in all cases. Flushing out of the food material with a dental irrigation pick and evaluation of the interdental gingiva are essential to determine a treatment strategy. Initially a conservative approach can be attempted in mild to moderate cases by removing opposing transverse ridges and overgrowths if present and even reducing an area of the occlusal surface by a few millimetres of the opposing teeth to take them out of occlusion, with the aim of preventing the impaction of food into the abnormally wide interdental space. Recently, the use of polysiloxine or similar material to ‘bridge’ the interdental space over the inflamed gingiva has been used with reasonable success and may allow the underlying gingiva to heal (N. du Toit and G. Lilly, unpublished data). These ‘bridges’ need to be checked and replaced if necessary at approximately 2–4 week intervals to ensure that they do not cause discomfort or trap food beneath them. Complete resolution of the periodontal disease can take from 3–6 months. However, there are no published studies to validate this treatment.

In severe cases or cases that have not responded to conservative treatment, mechanical enlargement of the interdental space can be performed to ensure food does not get trapped in the diastemata with resolution of the painful periodontal disease (Dixon et al. 2008). This is a specialised procedure for experienced veterinary surgeons because, if it is not performed accurately, there is high risk of opening an adjacent pulp horn and possibly causing apical infection of the affected teeth. Treatment of diastemata should also include a course of nonsteroidal anti-inflammatoryatories to relieve pain and antibiotics in cases with severe periodontal pockets.

Mild displacement of cheek teeth may be managed by rasping the protruding surface smooth to minimise soft tissue discomfort. However, in cases with severe displacement, especially if associated with periodontal disease or mucosal ulceration, extraction may be required. Careful assessment of the displaced teeth is important as some can be very difficult to extract due to their associated angulation and position.

Reductions of overgrown teeth need to be performed carefully, with only 2–3 mm reduced at one time to avoid exposure of the pulp horns. It is also important to maintain the normal cheek teeth occlusal angle which ranges from 19–30° in the mandibular cheek teeth (increasing caudally) and 9–19° in the maxillary cheek teeth (decreasing caudally) (Brown et al. 2008). Wave mouth is difficult to treat and severe cases can never be restored to normal. Even less severe cases will often require several treatments to correct. The severely overgrown teeth should be reduced gradually to the height of normally erupted crown height and not the height of worn teeth. It is also important to realise that reduction of overgrown teeth will effectively reduce the masticatory surface until the worn teeth have erupted more and dietary changes may need to be implemented in the interim to prevent weight loss.

Management of step mouth is similar but it is also important to note that the presence of an exaggerated step mouth will often impede normal masticatory action. Overgrown teeth do not have to be taken back to the level of normal teeth, but just enough to stop them preventing normal jaw movements. Shear mouth is rarely resolved and regular dental treatment (every 3 months) is usually required to manage this condition. Smooth mouth is an age-related condition and although there is no treatment, dietary management is required to ensure the required daily calorific intake is met.

Careful assessment of pulpar exposure, noted on examination, will be required to determine tooth viability and will determine appropriate treatment. Due to presence of multiple pulp horns with common apical pulp chamber communication, endodontic treatment of cheek teeth is not feasible. If there is pulpar exposure with no other clinical or radiological signs indicative of apical infection, it may be that tertiary dentine was laid down in response to the initial insult of the pulp horn tips and the apical pulp horn is still viable (du Toit et al. 2008b). Some older donkeys may have multiple pulpar exposures of multiple teeth that remain viable because of the above mechanism. In cases of pulp horn exposure with clinical signs of apical infection, extraction of the affected tooth is usually required. Donkeys are amenable to oral extraction under standing sedation, as previously described in horses (Dixon et al. 2005). The use of local nerve blocks is strongly recommended to facilitate patient compliance and reduce the amount of sedative drugs (Tremaine 2007). Recently apicoectomy with endodontic treatment of cheek teeth have been described, but the long-term success is unpredictable (Simhofer et al. 2008b).

Cheek teeth fractures are relatively rare in donkeys and many of them will be incidental findings, as they only involve the peripheral enamel. Sometimes these enamel fractures may be associated with sharp enamel edges which can be rasped carefully. Teeth with larger idiopathic lateral (‘slab’) fractures need to be assessed for pulpar exposure and apical infections. Usually, the smaller or displaced fragment is removed and, only if definite changes associated with apical infection are identified, is the larger, usually more stable fragment removed. Extraction of cheek teeth with sagittal fractures are usually complicated by the inability to securely place molar extractors of the affected teeth, and preparations should be made to perform repulsion using a punch, if required. Endodontic treatment of incisor fractures, particularly in young donkeys has been reasonably successful and may allow the continued eruption of the fractured tooth until normal occlusion is achieved.

Conservative treatment of infundibular caries is usually performed by rasping 2–3 mm off the opposing cheek
teeth occlusal surface to temporarily take the teeth out of occlusion and reduce food impaction into the infundibular defect. Cleaning, burring out and filling of infundibular caries have also been performed in horses, but the efficacy of this treatment is controversial due to the inability to clean out the entire infundibular cavity in some horses and the questionable durability of filling materials.

Many donkeys with advanced dental disease and reduction in the masticatory function, may require special dietary management to maintain an adequate daily calorific intake. The use of short chopped forage i.e. hay and/or straw, or soaked forage based pellet diets are preferable, as grain based diets predispose to gastric ulceration and may result in excess weight gain, metabolic disease and subsequent laminitis in donkeys. The daily dry matter intake in donkeys is only 1.3–1.8% of total bodyweight and this should consist entirely of forage. It is important to avoid hard, short, chopped forage such as alfalfa as these stalks may become entrapped within diastemata spaces.

Conclusion

Dental related clinical signs are less likely to be reported in donkeys due to the fact that they are rarely kept as riding animals and are stoic by nature. Client education on the need for regular prophylactic dental treatment in donkeys, even in fully asymptomatic donkeys, is imperative. Many dental disorders seen in donkeys require regular treatment to prevent or slow down the progression of the disease, which have been shown to increase in prevalence from 15–20 years of age. In some cases, specific dental disorders such as diastemata cannot be resolved definitively and may predispose to other dental diseases such as wave mouth. It is important to inform donkey owners that regular dental treatment and dietary management will be required to manage these complex disorders in the long term.

Authors’ declaration of interests

No conflicts of interest have been declared.

References