Spontaneous realigning of a displaced equine premolar post extraction of an adjacent supernumerary tooth – two cases

Spontane repositie van een equiene premolaar na extractie van een aanpalende polydonte tand – twee casussen

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ABSTRACT

Two horses were presented with problems during ridden exercise due to a firm, sensitive swelling at the level of the cheek adjacent to an upper Triadan 06. Oral, radiographic and computed tomographic examinations (n=1) identified the presence of a palatal supernumerary tooth being the causing factor of a buccally displaced 06. In both cases, the supernumerary tooth was extracted on the standing sedated horse. A couple of months following extraction, the buccally displaced tooth had spontaneously moved into a more physiological position due to orthodontic forces of the cheek and masticatory forces. Both horses uneventfully returned to ridden work without further problems.

SAMENVATTING

Twee paarden met klachten tijdens het rijden omwille van de aanwezigheid van een harde, gevoelige zwelling van de wang ter hoogte van het niveau Triadan 06 in de bovenkaak werden aangeboden op de kliniek Heelkunde (Faculteit Diergeneeskunde, UGent). Mondonderzoek, radiografie en computertomografie (n=1) toonden de aanwezigheid van een polydonte tand aan, aan de palatale zijde van element 06, waardoor deze naar buccaal verplaatst werd. In beide gevallen werd de polydonte tand getrokken op het staande gesedeerde dier. Enkele maanden na de extractie vertoonde de buccaal verplaatste tand een repositie naar zijn fysiologische positie door de orthodonte kracht van de wangen en het kauwen. Beide paarden werden nadien opnieuw bereden zonder verdere problemen.

INTRODUCTION

A supernumerary tooth is defined as an additional tooth to the normal number of teeth. Their crown and root morphology as well as their position and eruption pattern can vary substantially from normal to aberrant (Garvey et al., 1999; Dixon et al., 2005b). They are more commonly located distal to the last maxillary cheek teeth although lingual/palatal, buccal and mesial positions have also been reported (Dixon et al., 1999b; Dixon et al., 2005b; Anthony et al., 2010; Rodrigues et al., 2013; Parés and Lozano, 2014). Epidemiological data are not available, but reported prevalences range from 0.6-9.1% to 0.2-2.9% at the level of the incisors and cheek teeth, respectively (Dixon, et al., 1999b; Dixon et al. 1999a; Dixon et al., 2005b; Anthony et al., 2010).

Malocclusion, resulting in abnormal occlusal morphology due to areas of reduced wear, and periodontal disease secondary to impacted food between the supernumerary and adjacent teeth are well-known consequences of polydontia. Treatment options include regular corrective odontoplasty, diastema cleaning, packing and/or widening and tooth extraction (Dixon et al., 2005b; Quinn et al., 2005; Dixon, 2011). A supernumerary tooth can additionally cause displacement of adjacent teeth (Garvey et al., 1999; Dixon et al., 2005b). Individually malpositioned teeth in humans can be realigned within the dental arch by applying orthodontic techniques using anchoring points (Reitan, 1967; Magkavali-Trikka et al., 2018). Indications for the use of comparable techniques in small animals have been reported for incisor and canine orthodontic problems (Ross, 1986; Emily, 1992).

Figure 1. A clear swelling (arrow) is present at the right cheek in the premaxillary region (case 1).

Figure 2. Intraoral view of the horse's mouth (case 1). At Triadan position 106, a buccally displaced tooth with normal crown morphology (106b) and a more irregularly shaped tooth in a more palatal position (106p) can be observed. The surrounding mucosa of the hard palate is thickened but not inflamed.

To date, orthodontic treatment in horses primarily focuses on correction of brachygnathia (Klugh, 2004; Easley and Schumacher, 2011; Easley et al., 2016), although limited literature about principles of equine orthodontics has been published (Fletcher, 2008; Galloway, 2008; Earley et al., 2013).

Physiologic tooth position is determined by interactions between the periodontal tissues and occlusal, tongue and lip forces. Disruption of this equilibrium is known to cause pathologic tooth migration (Weinstein et al., 1963; Proffit, 1978; Ruan et al. 2005). Therefore, post-extraction drift forces initiated by the angulated position of cheek teeth and their continued eruption are capable of closing an extraction gap over time (Vlaminck et al., 2006; Vlaminck et al., 2008).

In this case report, the spontaneous repositioning of a buccally displaced 106 following extraction of an adjacent supernumerary tooth in two horses is described.

CASE 1

History

A six-year-old Arabian gelding was presented for examination of a slowly enlarging localized swelling of the right cheek. This resulted in a progressive expression of riding difficulties over the last year due to interference with the bridle's nose band. Masticatory problems were not observed.

Clinical and oral examination

There was marked asymmetry of the head due to an out-bulging of the cheek overlying the right maxillary premolar region, which was hard and sensitive on palpation (Figure 1). Oral examination revealed the presence of an additional tooth at the Triadan 106 position. A buccally displaced tooth crown (106b) demonstrated normal occlusal surface features, apart from a slightly prominent mesial tip. There was evidence of excessive previous floating on the buccal side of this tooth. An adjacent, palatally positioned cheek tooth crown (106p) with a highly irregular occlusal oriented side seemed to have developed in a more horizontal plane (Figure 2). A small diastema between both crowns and between 106p and 107 were minimally impacted with food. Endoscopic examination of the right nasal passage showed a slightly constricted ventral nasal meatus at a distance coinciding with the position of the cheek tooth anomaly.

Medical imaging

Radiographic examination (right30° ventral–left-dorsal oblique, dorsoventral with offset mandible) was performed of the right maxillary region and demonstrated the buccally displaced 106b with a deviation and interruption of the maxillary bone at this level and an additional tooth-like structure palatal to 106b. A mild blunting of the tooth roots was observed, but there were no other radiographic signs of apical changes (Figure 3).

Subsequently, a computed tomographic (CT) examination of the head with a 4-slice scanner (LightSpeed QX/i, GE Medical Systems, Milwaukee, Wisconsin, USA) was performed with the gelding under general anesthesia in dorsal recumbence. Acquisition variables were 120 kV, 160 mA, 2.5 mm slice thickness, a pitch of 3, 1.25 s rotation time, 275 mm field of view, and matrix size of 512 × 512. Images were evaluated using DICOM viewing software (Osirix v5.6 64 bit, Open Source, http://www.osirix-viewer.com). CT examination confirmed the presence of

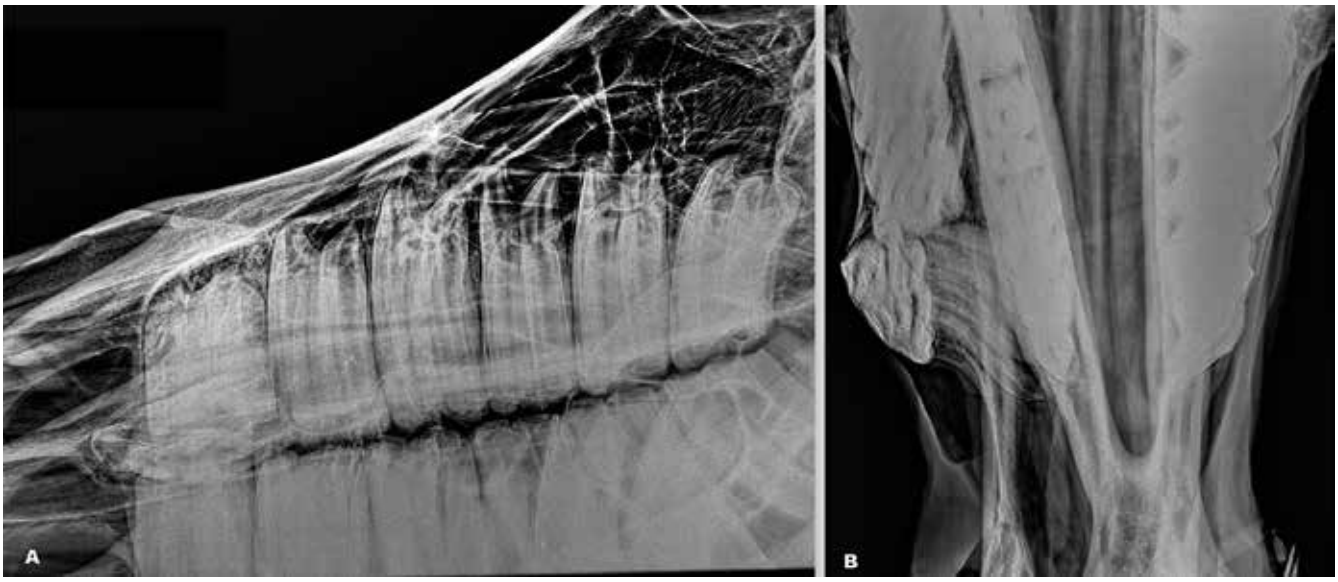

Figure 3. A. Rt30°V-LeD-O and B. Dorsoventral with offset mandible radiographic projections (case 1). A. Mild blunting of the tooth roots is visible. A superimposed tooth structure is visible at the level of the clinical crown of Triadan 106. B. The Triadan 106 tooth is buccally displaced causing deviation of the maxillary bone. A more horizontally positioned tooth structure is visible at the palatal aspect of Triadan 106. This structure contacts both 106 and 107. Left is right.

two separate teeth. Element 106b erupted in a vertical but significant more buccal position than Triadan 206 (Figure 4). The buccal cortical and alveolar bone was not distinguishable at the level of the reserve crown. The palatal alveolar bone was only present in the apical third of the tooth. Element 106p, which was considered the supernumerary tooth, was more horizontally positioned with its apical area located near the midline and rostral to the most mesial edge of 106b. Its crown was directed slightly distoventral and contacted the distopalatal aspect of 106b causing an indentation of the tooth at that level. Element 106p was embedded in dense bone tissue. Narrowing of the ventral nasal meatus at the level of the position of 106p was evident. Both teeth displayed a normal internal architecture with five pulp horns and two infundibula. The distopalatal root of 106b was absent and at this level there was a mildly widened periapical space and thickening of the cortical bone. Pulp horn 2 (Du Toit et al., 2008) of 106b showed a low density along its entire length and at the most apical aspect of this pulp chamber, there appeared to be a partial mineralization (Figure 4).

Treatment

Mild apical changes observed around element 106b were considered secondary as a result of apical inflammation due to abnormal forces exerted at this level by the presence of the supernumerary tooth (Ketcham, 1929; Newman, 1975) or due to excessive floating at this level (thermal pulpar insult) (Spierings et al., 1985; Zach and Cohen, 1965; O'leary et al., 2013). Specific treatment was not considered necessary at this stage. Treatment was directed at extraction of 106p. In the second stage after allowing sufficient healing time for the extraction site, an orthodontic procedure was planned to realign 106b with the other cheek teeth in that arch. The intention was to perform an orthodontic procedure to displace the tooth 106b to its normal position after healing of the extraction site with using temporary anchorage device (TAD). TAD's are biocompatible screws or mini-implants fixed to bone for the purpose of moving teeth in humans for a certain period of time, with the devices being subsequently removed after orthodontic treatment. The plan was to insert lag screws in the cortical

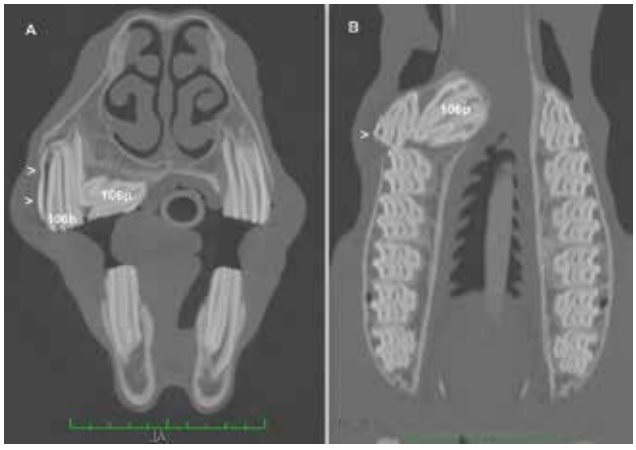

Figure 4. A. Transverse and B. Dorsal reconstructed computed tomographic images of the horse's head in bone algorithm (case 1). A. Transverse image taken at the level of pulp horn 2 of Triadan 106b. The right side of the horse's head is clearly deformed due to the abnormal position of the premolar teeth. Low density of the pulp canal indicate the presence of pulp pathology (arrow heads). B. The supernumerary 106p has substantially displaced 106b. Pulp canal 2 of 106b shows a low density (arrow head).

Figure 5. Cast models of the right maxillary premolar region (case 1). Left: four days after extraction. Triadan 106b is clearly buccally positioned and the extraction defect is visible. Middle: six months post extraction. The 106b clinical crown has moved into alignment with the dental arcade. A small open diastema has developed between 106b and 107. The hard palate defect is decreased in size. Right: nineteen months post extraction. The Triadan 106b has slightly rotated causing the diastema to close on the palatal aspect of the interproximal space. The hard palate defect has further decreased in size and depth.

Figure 6. Dorsal view of the horse's head after six months illustrating the disappearance of the external swelling (case 1).

bone of the palate. Then, an elastic chain could be attached from the screw heads around the tooth to deliver a light continuous force on the tooth that would be capable of producing a tooth movement without tissue damage. Orthodontic tooth displacement uses the potential of the periodontal ligament for bone remodeling (Cope, 2005; Papadopoulos and Tarawneh, 2007; Schatzle et al., 2009; Magkavali-Trikka et al., 2018).

Preoperatively, the horse received sodium benzylpenicillin (penicillin 20.000 IU/kg i.v., Kela Veterinaria NV, Sint Niklaas, Belgium), benzylpenicillinum procainum (Peni-kel, 21.000 IU/kg i.m., Kela Veterinaria NV, Sint Niklaas, Belgium) and flunixin meglumine (Emdofluxin 50,1.1 mg/kg i.v., Emdoka BVBA, Hoogstraten, Belgium). A standing oral tooth extraction of the palatal tooth was performed under i.v. sedation with detomidine (Detogesic, Ballinskelligs Veterinary Products, Ballinskelligs, Kerry, Ireland) (15 µg/kg) combined with butorphanol (Torbugesic, 25 µg/kg, zoetis Manufacturing & Research Spain, S.L., Girona, Spain) initially. Further increments of sedatives were administered as required. Regional anesthesia of the right maxillary nerve was performed with 10 ml mepivacaine (scandicaine 2%, Dornier Medtech Europe, Wessling, Germany) as described by Staszyk et al. (2008). Following placement of a full mouth speculum, additional local anesthetic (Procaine hydrochloride 4%, 15 ml, VMD vetsupport Benelux, Arendonk, Belgium) was infiltrated in the mucosa of the right cheek at the level of 106b and in the mucosa of the hard palate surrounding 106p. The gingiva surrounding the tooth was separated from 106p using a dental pick and the tooth was loosened with elevators. A screw extraction technique was used to remove the tooth because the specific position and shape of the tooth did not allow use of extraction forceps (Stoll, 2007). Due to the tooth's rostral location, a transbuccal approach was not necessary as all instruments could be introduced directly through the mouth. A 6 mm-diameter hole was drilled 2 cm into the tooth. This hole was tapped, which allowed firm anchorage of the extraction pin. Removal of the tooth followed using a slotted hammer system. After extraction, the alveolus was rinsed and gauzes soaked in chlorhexidine digluconate 0.1% (Hibitane, Molnlycke Health Care, Goteborg, Sweden) were placed inside to be removed two days postextraction. The alveolus was subsequently left open to heal by second intention. The horse received phenylbutazone (butagran Equi2.2 mg/kg btw p.o., Dopharma Research B.V., Raamsdonksveer, the Netherlands) once daily for seven days. Four days after extraction, a dental impression of the right upper premolars was made using polyvinylsiloxane (president putty, Coltène-Whaledent, Altstätten, Switzerland) and a dental cast was subsequently obtained for orthodontic treatment planning (Figure 5). Seven days post surgery, the horse was discharged from the clinic.

Follow-up

Bitless riding activities were started four weeks after surgery and a bit was reintroduced two weeks later, which was well accepted by the horse. The external swelling progressively decreased in time, which resulted in absence of any riding difficulties at the time of resuming ridden activities.

Four months after extraction, an oral inspection was performed at the horse's property. The horse showed no clinical symptoms and could be ridden without problems. The external swelling was much reduced. The extraction site was covered with healthy gingiva. Tooth 106b was slightly mobile and had moved palatally, more in line with the other cheek teeth. A small open diastema was found between 106b and 107 without any further periodontal problems.

Six months after surgery, the horse was readmitted to the clinic. The original external swelling was not visible anymore (Figure 6). A small, non-painful bony swelling could be palpated at the level of the apical region at the Triadan 106 position. On oral examination, a more palatal position of 106b was evident with its buccal side almost parallel to the buccal plane of the right upper dental arcade. Digital manipulation of the tooth revealed a slightly increased mobility. Gingival attachment around the tooth was firm. The open diastema that developed between 106-07 remained uncomplicated by any periodontal changes. A defect in the occlusal secondary dentin was detected at the level of pulp horn 2 of 106b (Figure 7). A new dental cast was made after taking another dental impression (Figure 5). CT examination was repeated under general anesthesia as described above. The positional change of Triadan 106b was caused by a palatally directed tilting action, which in turn caused outward repositioning of the apical region with secondary cortical bone remodeling (Figure 8). Inside the number 2 pulp canal, two small, circular zones with a low density could be identified, indicative of ongoing pulp disease. The extraction site had healed and was filled by complex bony tissue. On the oral side of the hard palate, dense cortical bone had developed from the midline to halfway the distance to Triadan 106b. A palatal alveolar bony lining had not been restored, but the buccal alveolar lining had advanced more occlusally.

Three days later, an orthograde endodontic procedure was performed in the standing, sedated horse using the same sedation/regional analgesia protocol and intraoperative medical treatment as used for the extraction procedure (Lundstrom and Wattle, 2016). Access to pulp canal 2 was achieved using a water cooled high-speed hand piece mounted with a round bur. The pulp canal contained food and necrotic material and was subsequently debrided with different sizes Hedström files. The files could be advanced until the root, where a hard bottom was encountered. Due to the absence of evidence of insult to the other pulp horns on CT, the other pulp canals were not opened.

Figure 7. Intraoral view of the right maxillary arcade (case 1). Triadan 106b has moved to a better alignment with the other teeth. A defect is noted in the secondary dentine at the level of pulp horn 2 (arrow). There is clear evidence of excessive previously floating (at home) and a mesial overgrowth at the level of 106.

Figure 8. A. Transverse and B. Dorsal reconstructed computed tomographic images six months after extraction in bone algorithm (case 1). A. Transverse image taken at the level of pulp horn 2 of Triadan 106b. The extraction site is characterized by new bone formation. Triadan 106b has tipped towards the palatal side. The maxillary cortical bone adjacent to the apical region is irregular and thickened. Two zones with a low density in pulp horn 2 illustrate ongoing pulp disease (arrowheads). B. Better alignment of 106b with the dental arcade is visible. The palatal alveolar bone has not been restored yet.

Figure 9. A. Rt30°V-LeD°O and B. Dorsoventral radiographic projections (case 1). A. No gross radiographic changes indicative of apical disease are evident. The tooth roots are mildly blunted and the periodontal space is irregularly outlined. B. The tipped position of Triadan 106b is illustrated on this view. Deformation and thickening of the maxillary cortical bone on the buccal side of 106b are observed. Left is right.

Pulp horn 2 was disinfected with sodium hypochlorite 3%, rinsed with sterile saline and dried. The pulp canal was filled with a cement (Provicol QM, VOCO, Cuxhaven, Germany) and a final restoration of the occlusal surface was performed with a dual cure, flowable composite material (Rebilda DC, VOCO, Cuxhaven, Germany). Two days later, the horse was discharged from the clinic.

Eighteen months after surgery, the horse was re-examined by the authors at home. He was performing without any clinical complaints, although he had suffered from a limb related lameness problem. The external residual swelling at the apical region had remained unchanged. Oral examination and a new dental cast showed that Triadan 106b had started to rotate palatal along its axis causing the distopalatal side to contact the mesiopalatal side of 107 (Figure 5). The surrounding gingival attachment was healthy. The occlusal restoration of pulp horn 2 was intact. Buccal gingival health and attachment were normal. A mesial overgrowth was present at the level of 106, which was reduced with motorized equipment to promote distal movement of element 106 (Collins and Dixon, 2005). The diastema between 106b and 107 had evolved to a valve diastema with food impaction on the palatal side, which caused a low degree of periodontal inflammation. The occlusal plateau opposite the diastema had developed a single accentuated transverse ridge on the mesial aspect of Triadan 407. The ridge was reduced with motorized equipment (Collins and Dixon, 2005). The diastema was debrided and packed with impression material (president putty, Coltène-Whaledent, Altstätten, Switzerland) to avoid recurrence of food impaction. Repeated radiographs of the right premolar area showed an irregular, outlined, periodontal space, but no gross indications for ongoing apical inflammatory process. The tilted position of Triadan 106b and the subsequent bone remodeling at the apical region were evident on the dorsoventral projection (Figure 9).

CASE 2

History

An eight-year-old warmblood gelding was referred to the clinic for an abnormally sized premolar pushing against the cheek and causing an external swelling and riding difficulties (head tilt) of long duration. The swelling at the cheek was observed at the age of six. Masticatory problems were not observed.

Clinical and oral examination

Clinical examination revealed no abnormal clinical parameters. On palpation of the head, there was a firm, sensitive swelling at the left cheek at the level of Triadan 206. On oral examination, a supernumerary tooth was observed on the mesiopalatal side of 206 (206m). This tooth showed a normal anatomical appearance (five areas of occlusal secondary dentin, two infundibula), but had an abnormally large size compared to the other cheek teeth. Tooth 206 (206b) was buccally displaced on its mesial side causing bruising of the cheek mucosa (red, inflamed). There was a diastema present between 206m and 206b with food impaction, but without signs of gingival inflammation. Except for some labial zones of increased wear on the mandibular and maxillary 02-03 incisors, no other dental anomalies were found.

Medical imaging

Radiographic examination (laterolateral, left 30° ventral–rightdorsal oblique and dorsoventral projection) was performed of the left maxillary region, which showed no anomalies in the apical area. The dorsoventral projection illustrates the rotated position of 206b with a deformation and slight thickening of the maxillary cortical bone on the buccal side of the tooth (Figure 10).

Treatment

A standing oral tooth extraction of supernumerary tooth (206m) was performed. Preoperatively, sedation and local analgesia protocol were performed as described in the first case. A dental impression of the left upper premolars was made using polyvinylsiloxane (president putty, Coltène-Whaledent, Altstätten, Switzerland). After extraction, the alveolus was rinsed and gauzes soaked in chlorhexidine digluconate 0.1% (Hibitane, Molnlycke Health Care, Goteborg, Sweden) were placed inside to be removed two days post extraction. The alveolus was subsequently left open to heal by second intention. The horse received phenylbutazone (butagran Equi, 2.2 mg/kg btw p.o., Dopharma Research B.V., Raamsdonksveer, the Netherlands) once daily for three days. Three days post surgery, the horse was discharged from the clinic with the advice to flush the mouth twice daily over a period of two weeks.

Follow-up

The owner reported that three to four weeks after the extraction, the swelling was significantly reduced and the ridden work was progressively resumed. The horses behavior during ridden work was significantly improved, with no recurrence of the previously reported head tilt.

Four months after extraction, the horse was readmitted to the clinic. On oral examination, element 206 showed a physiological position in line with the other cheek teeth, but had developed a mesial overgrowth, which was subsequently reduced with motorized equipment. The extraction site of element 206m was covered with healthy gingiva.

DISCUSSION

Polydontia is a developmental dental abnormality that occurs in many species. The few studies that report on supernumerary cheek teeth in horses demonstrate the rarity of this pathology (Dixon et al., 1999a; Dixon et al., 1999b; Quinn et al., 2005). Some supernumerary cheek teeth are incidental findings on routine dental examinations. Disto-molars (a supernumerary cheek teeth triadan 12) are more frequently encountered in the maxilla than in the mandible, often bilaterally (Dixon et al., 2005b; Quinn et al., 2005; Dixon, 2011; Pasicka et al., 2017). Clinical signs of oral discomfort appear as dental overgrowths and periodontal disease secondary to food impaction develop (Dixon et al., 2005b; Quinn et al., 2005; Parés and Lozano, 2014). Cases causing mild clinical symptoms can be conservatively managed by repeated reduction of overgrown teeth, and diastema cleaning, widening and/or filling (Baker, 1970; Carmalt, 2007). In unmanageable cases, extraction of the supernumerary tooth is the preferred treatment (Dixon et al., 1999b; Tremaine, 2004; Dixon et al., 2005a; Dixon et al., 2005b; de Mira et al., 2007).

The supernumerary tooth described in the first case seemed abnormally shaped based on its intraoral appearance. Further CT examination illustrated the presence of all three dental components arranged in a structured manner, but identified the tooth to be positioned in a more horizontal plane with the clinical crown touching the palatal side of Triadan 106b. Analysis of the acquired images allowed identification of this tooth as the supernumerary element. The characteristics of the intraorally visible tooth surface

Figure 10. Dorsoventral radiographic projection (case 2). The rotated position of 206b is illustrated. The mesial aspect of the tooth is buccally displaced. There is deformation and slight thickening of the maxillary cortical bone on the buccal side of the tooth. Right is left.

can be attributed in part by wear induced by direct and indirect contact with opposing teeth during mastication, although incomplete maturing of this tooth, its aberrant position of development and eruption pattern might also have contributed to its final shape. In the second case, the tooth showed a normal morphology, except for its larger size. Palatally positioned supernumerary teeth are known to be associated with displacement of the adjacent teeth (Dixon et al., 1999b; Quinn et al., 2005). Whether the palatal side of this tooth was attached to the hard palate by a functional periodontal membrane was not verified by histological processing. The presence of a functional periodontal attachment might have contributed to the abnormal position of the buccally displaced 106 in both cases.

Conservative management was not an option for these horses because the development of both adjacent teeth resulted in a localized swelling and abnormal riding behavior due to interference with the horse's bridle. The specific position and shape of the tooth precluded the use of molar spreaders or extraction forceps to complete a simple oral extraction procedure in the first case (Tremaine, 2004). The rostral position of the tooth allowed the use of the screw extraction technique (Stoll, 2007; Langeneckert et al., 2015) without the need to work transbuccally. Preoperative analysis of CT images allowed precise measurement of screw insertion depth to avoid inadvertent damage of the hard palate, which resulted in a straightforward extraction of the tooth.

The observed root resorption and hypoattenuation within pulp canal 2 seen on CT images of element 106 in the first case were attributed to the displacement of this tooth caused by abnormal forces executed by the presence of a supernumerary tooth. In human dentistry, it has been suggested that root resorption can be the result of heavy occlusal forces and/or malpositioning (Hemley, 1941; Ando et al., 1967). Another possible explanation could be an iatrogenic pulp insult due to excessive floating causing thermal pulpar damage with consequent later pulp exposure (Spierings et al., 1985; Zach and Cohen, 1965; O'leary et al., 2013).

Root resorption secondary to orthodontic treatment is well known (Ketcham, 1929; Newman, 1975; Hollender et al., 1980; Mirabella and Artun, 1995). Although element 106b was not subjected to an orthodontic treatment, it did undergo orthodontic forces due to the presence of 106p, which was considered etiological for the encountered apical changes. The hypoattenuation within pulp canal 2 most likely demonstrated the presence of a compromised pulp due to changes in the vascular supply. Six months after the initial presentation, this resulted in communication of this pulp canal with the oral environment, which necessitated an orthograde endodontic treatment.

The literature about the use of orthodontic appliances in horses to align individual malpositioned teeth is very limited (Fletcher, 2008; Galloway, 2008). Functional orthodontic correction of overjet or overbite in foals has been well described although this technique addresses growth retardation of the jaw bone rather than focusing on individual tooth position (Klugh, 2004; Easley and Schumacher, 2011; Easley et al., 2016). Unlike in equine dentistry, orthodontic principles are routinely used in humans and have also been reported in dogs and cats (Reitan, 1967; Ross, 1986; Emily, 1992; Surgeon, 2005; Nanci, 2013; Polkowska et al., 2014; Lothamer and Soukup, 2016; Magkavali-Trikka et al., 2018). It is generally known that the position of teeth and its supporting tissues can be easily modified by orthodontic therapy. The general principle is to exert controlled forces to induce tooth movement, which is based on the adaptive changes in surrounding bone and periodontal tissues (Roberts, 2012). For the first case, postulated orthodontic treatment included the insertion of two miniscrews in the bony hard palate, serving as anchoring points for the attachment of an elastic band encircling the crown of Triadan 106b at a level just above the gum line. This appliance should be able to induce a translational repositioning of the tooth. Six months follow-up CT images of the horse showed that good quality bone had developed at the extraction site, which would have allowed proper miniscrew placement. However, sufficient spontaneous tooth repositioning had occurred by that time, which resolved the original discomfort during ridden exercise and excluded the necessity to continue with the planned treatment.

CT analysis at six months postoperatively in the first case also showed the tooth to have repositioned by a palatally directed tipping displacement of the crown with associated buccal tipping of the roots causing local cortical bone remodeling and a residual, small, external deformation. Considering the starting position of this tooth, the observed positional changes could not be attributed to its eruption pattern but external forces applied to the clinical crown should have contributed substantially. Forces exerted by the cheek are known to be counterbalanced by tongue pressure, which creates an equilibrium that influences tooth position in humans (Weinstein et al., 1963; Weinstein, 1967; Proffit, 1978). Disruption of this equilibrium can contribute to asymmetry in the dental arch in certain cases (Takada et al., 2011). Applying a moderate, continuous load is more efficient to cause orthodontic tooth movement than high loads of short duration (Roberts, 2012). Thus, in the present case report, cheek muscular activity might have been responsible for exerting continuous limited pressure on the tooth's clinical crown, contributing to the observed positional changes in time. Although a diastema persisted between Triadan 106 and 107, this problem was manageable with conservative measures and owner compliance. The authors hypothesize that the radiographic changes observed after 18 months at the level of 106 (irregular outlined periodontal space) can be explained due to the tilted position of the tooth and the high rate of remodeling of the periodontium and surrounding bone due to the orthodontic movement

(Reitkin, 1967). Changes that occur in the periodontium due to orthodontic forces are unknown in equids and care must be taken to interpret these findings. Regular and thorough dental checkups remain essential in this case to verify normal attrition and vitality of the tooth.

The use of dental casts in the present cases was complementary to the CT images to study the possibilities of orthodontic treatment strategies. Illustrations of the use of dental casts of equine tooth pathology can be found in text books (Becker, 1962; Galloway and Galloway, 2011). Deep sedation is a prerequisite to ensure that the equine patient accepts the application of a custom-made tray filled with dental impression material. Even minor chewing movements while the product sets, decreases the quality of the dental cast.

Treatment choice of a supernumerary tooth case is based on the individual dental situation and associated secondary clinical signs. The present case report illustrates the possibility of spontaneous repositioning of a malpositioned maxillary premolar due to an adjacent supernumerary tooth.

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