Symbiosis

www.symbiosisonlinepublishing.com
ISSN Online: 2381-2907

Case Report | SOJ Veterinary Sciences | Open Access

Retained Roots After Tooth Fracture and Replantation in a Horse

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Received: 07 March, 2019; Accepted: 11 March, 2019; Published: 21 March, 2019

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Abstract

A 6 years old horse sustained a traumatic mandibular fracture and damage to 3 incisors surgical repositioning resulted in successful heeling. The horse was followed over a 9 year period with radiographs taken every 2nd year.

Resorption of the apices of two of the affected teeth (401 and 402) occurred but was complete 1 year after the trauma. A retained loose root-fragment (from 403) was totally resorped after 7 years. After 2 years and until last examination, the dentin was blood-stained at the occlusal surface of 401 and 402. There was no dental treatment of the incisors during the 9 years of observation.

The horse was used for dressage, jumping and riding without any complaints during the entire study.

Key words: Equine incisor fracture, Equine retained root, replacement resorption in Equine teeth. Replantation Equine dentistry

Introduction

The general goal for treatment of retained tooth root fragments is to remove them. However, sometimes the position of the fractured root is such that removal is technically difficult and the chances of damage to adjacent tissues can outweigh the benefit of removing the fragmented root [1].

In humans, the treatment of horizontal positioned, impacted third mandibular molars has been managed by coronectomy and the rest of the root remained untreated. Only in very few cases of reaction in the soft tissue e.g. inflammation or if the socket failed to heal, will the patient be treated by complete root removal [2, 3]. Even in horses partial crown removal has an excellent prognosis [4].

Among humans a study [5] showed that out of 2000 patients referred for removal of a retained root fragment only 16.2 % were associated with symptoms or pathology. Treatment was reserved for patients with clinical symptoms related to their retained root fragment.

Eruption of the permanent canine teeth in dogs and cats does not replace the primary teeth, but the permanent canine teeth will erupt lingual to the primary mandibular canine teeth. The primary teeth will undergo resorption starting on the lingual part of the teeth in the sub gingival area, eventually fracture transversally. The retained part of the root will normally undergo resorption very rapidly, so that the permanent teeth can move into its normal position. This resorption and fracture process very seldom results in any clinical problem. The dead root fragment in normal developmental evolution can easily be resorped normally without problem.

Case report

A 6 year old horse, gelding, was brought in to the Teaching Hospital for Large Animal at the University of Copenhagen with a history of fractured mandible.

Examination of the horse at presentation in the Clinic the horse showed that the 3 right mandibular incisors (401, 402 and 403) were ventrally displaced. On radiographs mandibular fracture was displaced by approximately 1 cm, and there was a fracture of 403 about 1 cm from the apex (see fig 1 and 2). All radiographic pictures are taken according to "open mouth technique" [6].

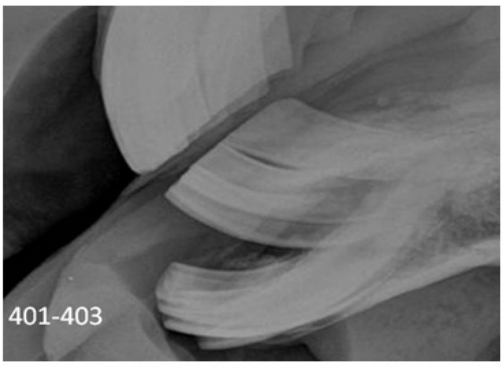

Figure 1: This radiograph was taken Jan.10, 2009 showing the ventrally displaced mandibular fragment which includes incisor teeth 401 – 403

Figure 2: This radiograph was taken Jan. 10, 2009 showing a fracture and dislocation of 403. Note the apical part of 403 (arrow) is located within the alveolar bone, but the remainder of the tooth (arrow) is dislocated. 401 and 402 are dislocation but not fractured.

The horse was anaesthetized and the mandibular fracture was reduced and stabilized with steel wire around the incisors fixed to the right mandibular premolar teeth (fig 3) using an established technique [7]. The horse was discharged from the Hospital after 3 days, and the owners were instructed to allow liquid food only for the following week. The wound healed uneventfully and the horse returned to the clinic for a routine checks after 1 month (fig 3), 3 months post operatively (fig 4). At the 3 month check, the mandibular fracture had healed and the steel-wires were removed.

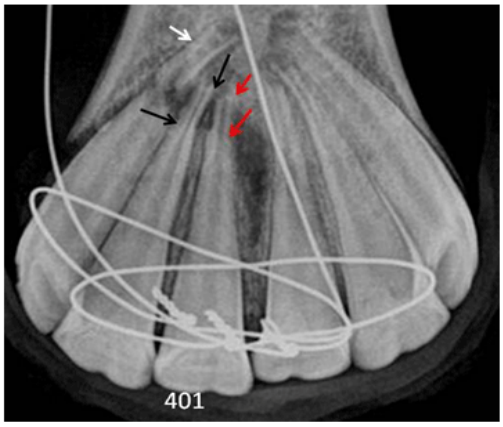

Figure 3: This radiograph was taken Feb. 5, 2009 showing the fixation wire around 5 incisors. The fixation to the premolars in not included in the image. The fracture fragment of 403 is observed unchanged (white arrow). The apical parts of 401 and 402 are slightly thinner (between the black and red arrows). Incisors alignment appears satisfactory.

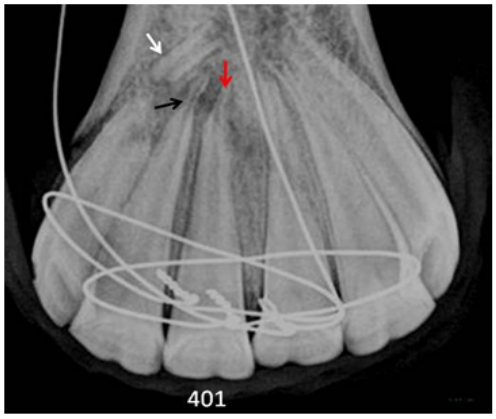

Figure 4: This radiograph was taken April 4, 2009 showing a marked thinning of the apical parts of 401 and 402 (red and black arrows) as a sign of external replacement resorption. The apical fragment of 403 is slightly increased in opacity (white arrow). After this radiograph was taken, the fixation-wires were removed.

Recheck was performed at the owner's premises every 2nd year with the final check 9 years after the acute fracture (figs 5, 6, 7, 8, 9). It was observed, that the free fracture-element of apex of 403 persisted for 6 years whereas the resorption of the non-fractured apex of 401 and 402 was completed after13 months. After 2 years black colored dentin area was observed in the occlusal surface of 401 and 402. This persisted during the rest of the follow up period (7 years) (fig 10, 11 and 12). In the latest final follow up visits, photographs of the occlusal surface of the mandible were taken (Fig 10, 11, 12). These showed normal alignment of the mandibular incisors arcade.

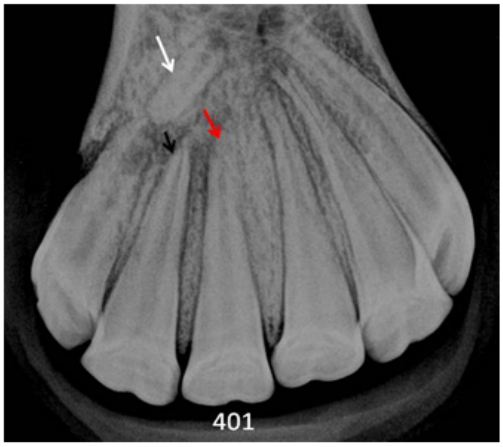

Figure 5: This radiograph was taken Feb. 10. 2010 showing the apical parts of 401 and 402 have now been resorped (red and black arrows) and the apical fragment of 403 is nearly homogenous in opacity. On the radiograph the fragment (white arrow) is projected axially due to oblique projection.

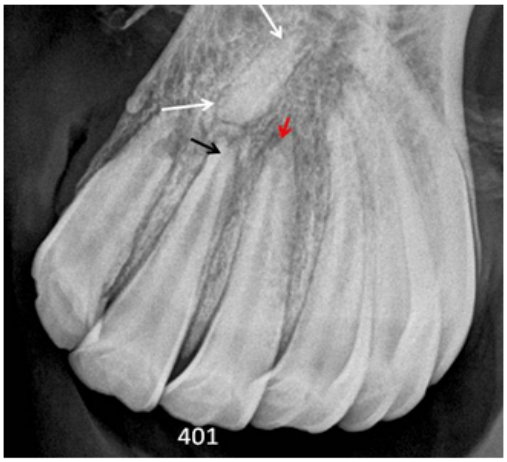

Figure 6: This radiograph is taken Feb. 8. 2012 showing rounded apices of 401 and 402 (red and black arrows). On the radiograph the fragment of 403 is projected axially due to oblique projection (between the 2 white arrows), is now very homogeneous in opacity, has unshaped edges and is significantly larger in transverse diameter due to cementosis in the periodontal ligament.

Figure 7: This radiograph was taken Jan. 14. 2014 showing very blurred contours of the fragment, again projected over 402 (between 2 white arrows).

Figure 8: This radiograph was taken Jan. 29. 2016 showing very regular trabecular bone pattern in the area proximal to 401,402,403. The free fragment has now been resorped totally.

Figure 9: This radiograph was taken Feb. 14. 2018 showing shorter right incisors (401, 402,403) compared to those on the left (301,302,303).

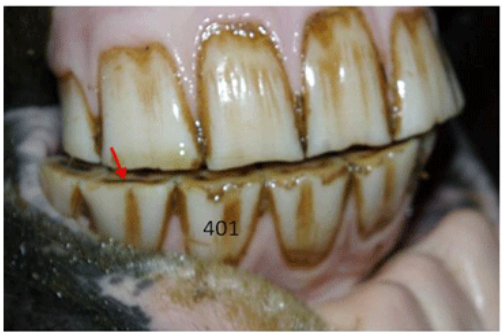

Figure 10: This photographic was taken Feb. 8. 2012 showing normal occlusal surface. Blood stained black areas in the dentine can be seen in 401 and 402. Normal mandibular and maxillary arcades.

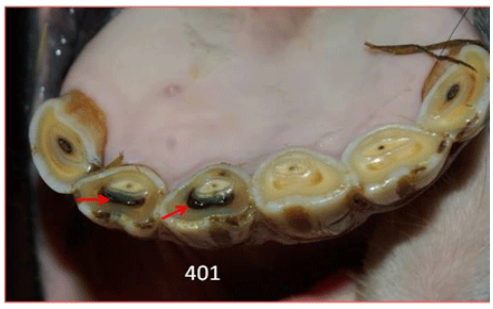

Figure 11: This photographic picture was taken Jan. 29. 2016 showing normal occlusal surface, but the black stained dentine is observed 401 and 402 (red arrows).

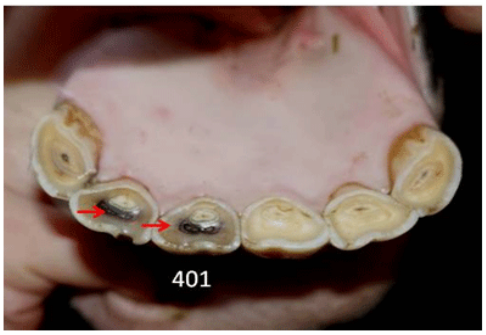

Figure 12: This photographic picture was taken Feb. 14. 2018 showing the normal wearing of all the mandibular incisors. The miscolored dentin (red arrows) in 401 and 402 is the same as seen 2 years earlier (see Fig 11).

The length of the mandibular incisors at the fracture site (401 to 403) was gradually reduced, but the pulp diameters seem to be of the same size as the noninvolved incisors. It is probable that vascularisation to the roots was restored. The alveolar bone adjacent to the affected incisors was replaced with normal trabucular bone tissue. (fig 7 and 8 compared with fig 3) after the resorption of the apical end of the teeth.

Discussion

Studies of human injuries, avulsion and severely intruded single root incisors show that only between 36 and 54 % of the periodontal ligament remained on the damaged teeth [8]. The importance of intact periodontal ligament for survival of reimplanted teeth has been shown [9].

The reason for the rapid resorption of the apical part of 401 and 402 is the lack of nutrition through the periodontal ligament (PDL) which is seen on fig 3, 4 and 5. The fractured apex of 403 stayed in place and therefore the PDL was not destroyed and so this "intact" part of the root remained vital for several years. It was resorped totally after 7 years (fig 9) without any infection or discomfort for the horse. In man this resorption is followed by replantation in 42.3 % of the teeth within the first year after replantation [9]. Another study [10] showed resorption of replanted roots occurred in 51 % of teeth and inflammatory root resorption 23 %, even if the replanted teeth were treated with disinfection material (tetracycline) before the replantation.

The intact PDL is very important for survival of the root [12] which also is observed in this case. The fractured apical fragment of 403 persisted for 7 years and very slowly resorped during the last 4 years. At the beginning the fragment was filled with dentin in the original pulp and surrounded by cement as may be seen in similar human cases [13]. Therefore the fragment was observed to be more and more opaque on the radiographs and eventually showed irregular borders. In the following years total resorption occurred (fig 7 and 8) with the roots replaced with normal structured trabecular bone that merges with the surroundings.

Among humans [1, 5] retained roots after tooth extraction is a very small problem and when they do occur they are often considered to be incidental findings. Therefore it is recommended to carefully consider the extraction of minor toot root fragments [1]. The present study supports this idea of allowing retained tooth root fragments to be resorped naturally in horses with acute injuries to healthy incisor teeth. In cases with diseased teeth the problems are not the same. In cases with pathology related to fractured teeth the remnants should be removed [14, 15].

In the horse described in this report, the pulp was ruptured and blood was partly resorped during the revascularization which appeared in connection with the fracture heeling. However, some black miscoloring in the new dentin formed gradually and became visible when the occlusion surface weared down. The black color could be observed after 2 years (fig 10) and persisted during the rest of the observation period (7 years) (fig 9 and 10).

Some studies [11] showed that some teeth have continued root formation in the periapical tissue, which was explained by the mesenchymal stem cells in the apical papilla of permanent immature teeth. These cells are the source of odontoblasts and can develop root dentin. The conclusion was therefore, if infection can be prevented tooth root healing can occur - even grove in some instances. It is still not yet clear if the odontclasts responsible for the physiological resorption of the roots are the same as those responsible for bone resorption [15].

The horse in this report was used for dressage and jumping riding without any complaints during the entire period of study (9 years). There had been no teeth anomaly after the fracture incidence, and after 2 years the alignment and the occusal surface were normal. There were no clinical findings related to the fracture except for the black colored dentin in 401 and 402

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