Removal of Maxillary Tooth Fragments and Root Remnants in Standing Horses

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Take Home Message

Small maxillary tooth root remnants and comminuted maxillary tooth fragments can be removed safely, quickly, and inexpensively from the alveolus of sedated, standing horses, thereby avoiding the risks and costs associated with general anesthesia. The technique requires minimal specialized instrumentation but does rely on careful radiographic guidance to ensure accurate instrument placement.

Introduction

The traditional method of extracting equine cheek teeth has been repulsion of the diseased tooth performed with the horse anesthetized.[1] This procedure carries with it high costs and the risks associated with general anesthesia, as well as a high incidence of postoperative complications.[1-6] Other techniques for surgical extraction of molars and premolars from anesthetized horses include buccotomy extraction and vertical alveolar osteotomy.[3] Recent efforts to develop and improve techniques for oral extraction of diseased teeth in the standing horse have resulted in reduced post operative complications, compared to conventional methods of repulsion.[1-6] Extracting intact equine cheek teeth, however, can be difficult, regardless of the technique used (i.e., repulsion, lateral buccotomy, or oral extraction),[1-3,5,6] and the difficulties are magnified dramatically when teeth are fractured or severely comminuted, or when only small pieces of the reserve crown or apical fragments remain within the alveolus.

The cheek teeth become fragmented as a result of iatrogenic trauma during dental repulsion, or from disease.[1,5,7] When dental fragments cannot be extracted orally, the invasive surgical techniques typically used to remove the fragments disrupt the alveolus substantially. The resulting large oro-sinus fistula is often slow to heal, and the period required for complete post-operative recovery is typically prolonged. There is clearly a need for minimally invasive techniques designed to remove fragmented cheek teeth, and this report describes one such protocol. In addition, the improved sedation techniques that have facilitated the revival of standing tooth extraction in equine practice[1] can also be

used to remove cheek tooth fragments with the horse standing, as outlined in this report. The objectives of the study reported here are to describe a minimally invasive technique developed to repel fragments of maxillary cheek teeth, and to report results from a series of cases in which this technique was used successfully.

Materials and Methods

Medical records of horses that had cheek tooth fragments removed during the time period from January 1st 2003 through December 31st 2005 were reviewed and tabulated. All horses undergoing standing repulsion of dental fragments using a minimally invasive repulsion technique with appropriate radiographic control were included in the study.

Necessary Equipment (this technique requires little specialized equipment).

1. Full-mouth speculum
2. Two, 20-inch, 90°, stainless steel dental picks[a]
3. Radiopaque skin marker
4. Standard radiographic equipment
5. Standard surgical equipment (including blade handle and mosquito forceps)
6. Michele trephine[b] (0.79-cm outer diameter, 15.9-cm long shaft)
7. Steinmann pins[c] of various diameters (3.2mm x 228mm, 4.0mm x 228mm, 6.3mm x 228mm) with the trochar tip ground off at one end
8. Hand-held chuck or a Vice-Grip® locking wrench[d]
9. Bone mallet

Surgical Technique

Horses were positioned in stocks and sedated with a combination of xylazine[e] (0.2-0.4 mg/kg, IV) and detomidine HCl[f] (0.01-0.02 mg/kg, IV) followed by butorphanol[g] (0.01 mg/kg, IV) or morphine (0.05-0.1 mg/kg, IV). Additional doses of these agents were added as needed to achieve adequate sedation and analgesia. A full-mouth speculum was then inserted, and the head was suspended using a pulley system to provide restraint and comfortable positioning for the patient and personnel.

The incision site directly over the affected alveolus was identified using two, mirror image, 20-inch, 90° dental picks (Fig. 1). The point of one pick was placed intra-orally in the affected alveolus, and the other pick was held parallel to the intra-orally placed pick over the maxilla to mark the rostral-to-caudal location of the affected tooth. A radio-opaque skin marker (either a skin staple or a piece of lead shot held in place with tape) was then applied to the selected area. Marker placement was based on the rostral-to-caudal position of the dental pick, as well as palpable landmarks indicating the dorsal-to-ventral position estimated to be most appropriate for a trephine hole. The site selected for the trephine opening avoided damage to the nasolacrimal duct and the lacrimal canal while still providing an optimal angle for repulsion.[3] Palpable facial structures used to identify proper sites for trephination to access maxillary cheek teeth included the facial crest, the medial canthus of the eye, and the infraorbital foramen.[3]

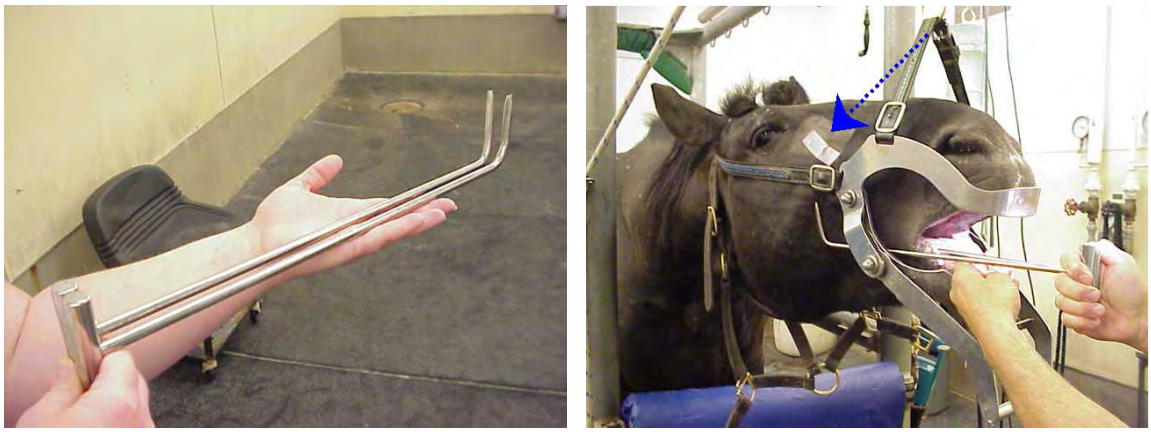

Figure 1. Two, 90° dental picks are used for initial localization. One pick is aligned intra-orally with the affected tooth, the second pick is held in parallel over the maxilla, and the location marked with a radio-opaque marker (blue arrow).

After the proposed site for trephination was marked, the mouth speculum was removed, and a dorso 30-60° lateral — ventrolateral radiograph highlighting the affected arcade was taken to confirm the location of the skin marker relative to the dental fragment to be removed (Fig. 2).[8,9] The appropriate angle depended on which tooth was involved and the width of the horse's head; a narrow head and more rostral teeth required a steeper angle of obliquity.[9] In addition, it was essential that the primary beam was exactly perpendicular to the centering point in the rostrocaudal plane because minor deviation from perpendicular produced marked distortion of the image.[9] It was, however, difficult to detect slight rostral-to-caudal obliquity on coned-down views. To prevent misinterpretation of marker position due to inadvertent obliquity, on the most recent cases the authors used a hand-made metallic post-and-ring positioning device placed on the cheek over the opposite arcade at the level of the involved cheek tooth (Fig. 3). If alignment was appropriate, with no rostral-caudal obliquity, the ring was superimposed around the skin marker on the radiograph. If the ring did not line up with the skin marker, another radiograph was taken to eliminate obliquity before the position of the skin marker was assessed.

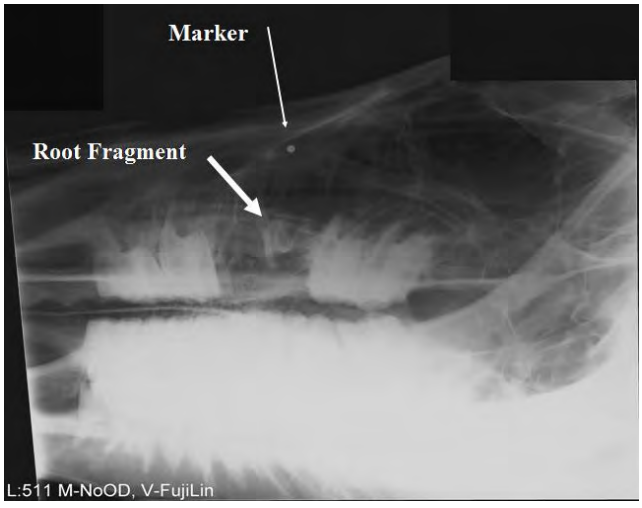

Figure 2. Oblique radiographs are taken highlighting the roots of the affected dental arcade and confirming the location of the skin marker above the dental fragment. In this case, a root fragment of 109 (right upper 1st molar) is present.

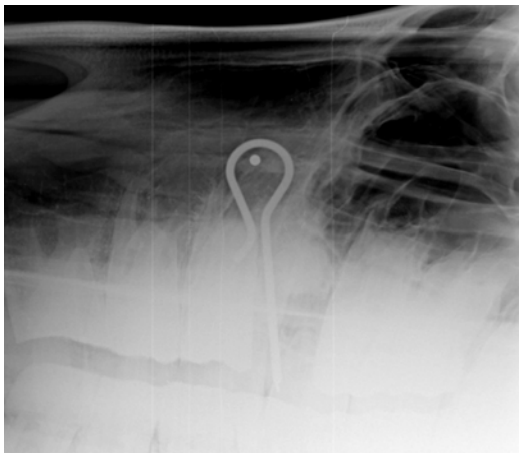

Figure 3. To eliminate misinterpretation of the skin-marker position due to inadvertent rostral-to-caudal obliquity in the radiographic image, a dual marker technique can be used as illustrated in this figure and described in the text.

Figure 4. Once the appropriate position for the trephine hole is confirmed radiographically, the surgical site is prepared for aseptic surgery.

After an appropriate position dorsal to the dental fragment was located, the full-mouth speculum was replaced, and the surgical site was prepared for aseptic surgery (Fig. 4). An incision approximately 1.5 cm long was made through the skin, subcutaneous tissues, and periosteum. A trephine hole was created in the bone in this location using a 5/16" Michele trephine. A Steinmann pin was then introduced through this hole and advanced toward the tooth fragment. Placing one hand inside the mouth to feel the location of the fragment facilitated proper pin placement, but pin position was always confirmed radiographically using the oblique view that highlighted the apices of the teeth in the affected dental arcade (Fig. 5).

Due to overlap of the maxillary and mandibular arcades, as well as the long Steinmann pin protruding from the sinus, determining proper axial alignment of the pin using radiographic control was often difficult. Having one hand in the mouth during fragment removal, therefore, was necessary to prevent penetration of the palate or the buccal alveolar plate caused by excessive axial or abaxial angulation of the Steinmann pin. With the Steinmann pin positioned directly above the dental fragment, an attempt was made to push the piece out with the pin. The pin was maneuvered using either a hand chuck (Fig. 7), or a Vice-Grip® locking wrench. (The locking wrench was easier to apply and allowed more rapid repositioning of the Steinmann pin if it became immoveable in the bone.) With one hand inside the mouth, it was usually possible to feel the fragment as it was pushed toward the oral aspect of the alveolus. If the fragment was small, this pushing maneuver was all that was necessary to dislodge the fragment into the oral cavity. With larger fragments, however, substantial periodontal ligament attachments typically resisted fragment removal, necessitating more force to dislodge the fragment. When more force was required to repel the fragment, a gloved assistant struck the pin with a small bone mallet.

Figure 5. A Steinmann pin is placed into the trephine hole to repel the tooth fragment.

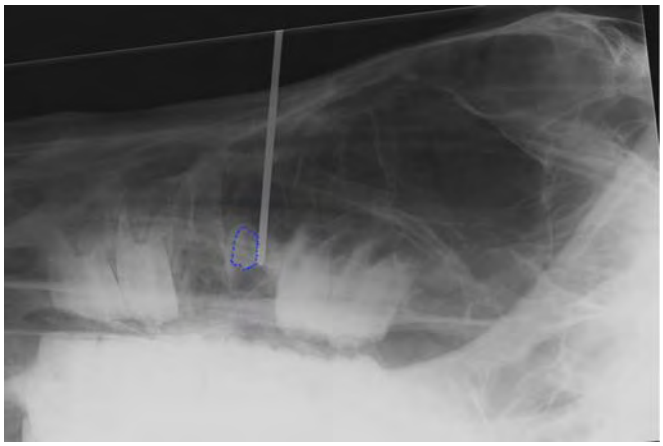

Figure 6. Radiograph taken to ensure that the Steinmann pin is located over the dental fragment. In this case, the pin is caudal to a root fragment of 109 (outlined in blue), and needs to be repositioned slightly to permit satisfactory repulsion.

After the fragment was removed, the alveolus was examined by palpation through the oral cavity, visually, and with radiographic imaging to confirm successful removal of all dental fragments. The ipsilateral paranasal sinuses of horses affected with paranasal empyema were lavaged. In most cases, a temporary plug of dental impression material was placed in the alveolus to prevent the alveolus from packing with feed. No plug was placed in older horses with sockets that were too shallow to retain the impression material, or when there was already extensive granulation tissue filling the alveolus. The

Fig 7. It is important to place one hand inside the mouth to monitor pin position and progress in repelling the fragment. Sometimes, a small bone mallet is required to remove large fragments that have extensive periodontal attachments.

skin overlying the trephine hole was closed with skin staples or non-absorbable suture material placed in a simple interrupted suture pattern. If long-term sinus lavage was indicated, a catheter for lavage was placed in the chonchofrontal sinus. Broad-spectrum antibiotics and non-steroidal anti-inflammatory drugs were routinely administered before and after surgery; the dose and duration of administration of these mediations were determined by the severity of the associated paranasal sinusitis.

Results

We used this technique to remove dental fragments from 19 maxillary teeth of 18 horses. Horses ranged in age from 7 to 22 years, with a mean and median age of 13 years. Mares, geldings, and stallions of a variety of breeds were represented; mares (n=8) and Warm Blood horses (n=6) were most commonly affected.

Dental tissues removed included single root fragment (n=10 horses), a complete apical section with a portion of the reserve crown (n=1), dental fragments resulting from dental fracture caused by disease or iatrogenic vertical fractures of the tooth (n=5), and comminuted fractures of the entire tooth in which extraction was precluded by the fracture configuration or extent of dental decay (n =3).

Fragments were relatively evenly distributed between the right (n=12) and left (n=7) maxillary arcades. The technique was used to remove fragments from the following maxillary cheek teeth: Triadan 108 (n=1), 109 (n=8), 110 (n=3), 209 (n=6), and 210 (n=1). The right and left maxillary first molars (109 and 209) were the teeth most commonly involved.

Several horses experienced mild, intra-operative hemorrhage, and several experienced mild to moderate post-operative swelling at the surgical incision site, but no horse suffered a significant post-extraction complication related to the use of this technique.

Discussion

This report describes a surgical technique developed to remove retained dental fragments from fractured maxillary cheek teeth 08 to 010 with the horse standing. The procedure is simple to perform and requires only minimal specialized equipment; diligent radiographic control is necessary, however, to avoid damaging adjacent normal teeth or other structures.[3,6] The use of digital or computed radiographic techniques or fluoroscopy may help minimize delays necessitated by standard radiographic processing, but is certainly not essential for successful completion of this procedure. The procedure has proven to be valuable for treatment of horses that have suffered fracture of a tooth either from disease or during attempts at extraction or repulsion.

Only horses that had fragments of cheek teeth whose apex extended into the maxillary sinuses were included in this report, but similar principles can be applied to localize and remove tooth fragments of the mandibular cheek teeth and those maxillary cheek teeth that lie rostral to the paranasal sinuses. We have not used the technique, to date, to

remove fragments of either the 111 or 211 teeth because we were not presented with horses that had retained fragments of these teeth. We anticipate difficulty in aligning the Steinmann pin over the roots of these teeth through the overlying frontal sinus.[10] The long distance between the proposed trephine hole and the apex of 111 and 211, and the fact that the infraorbital canal overlies the apex of 111 and 211 are likely to make accurate positioning of a Steinmann pin to remove fragment of these teeth quite difficult.

In this report, the described procedure was used exclusively to repel fragmented teeth and retained dental fragments. We have, however, used the described technique to facilitate minimally invasive standing removal of intact maxillary cheek teeth. Removal of an entire tooth typically requires the use of a larger trephine hole and dental punch, as well as large or specialized mallets (slide hammer, dead blow mallet). Similarly, the described technique can be performed to remove dental fragments and fractured teeth with the horse anesthetized, if the horse is not amenable to having the procedures performed while standing. This approach has also been used in two horses to remove small, retained fragments of polymethylmethacrylate bone cement that had broken off of alveolar packs. In one horse, the procedure was used to remove a small cementoma identified at the apex of the root of an extracted tooth.

The technique described in this report can be used safely and effectively to repel fragments of maxillary cheek teeth with the horse standing. Careful radiographic control and adequate sedation are essential for success, but the technique is straightforward and easy to perform. This approach precludes the need for general anesthesia in many horses, and the small size of the Steinmann pins used to repel the fragments minimizes damage to the alveolus during fragment removal, thereby substantially reducing the time needed for the alveolus to heal by granulation and epithelialization. We anticipate that this procedure will be associated with a much lower incidence of long- and short-term, post-operative complications than that reported following traditional tooth repulsion techniques in horses.[1-6]

References and Footnotes

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a. Custom dental picks, Horsepower, Inc., Antioch, CA 94509.
b. Michele Trephine, Miltex, Inc., York, PA 17402.
c. Steinman Intramedullary Pins, Imex™ Veterinary, Inc., Longview, TX 75603.
d. Vice-Grip®, Irwin Industrial Tools, Wilmington, OH 45177.
e. AnaSed®, Lloyd Laboratories, Inc., Shenandoah, IA 51601.
f. Dormosedan®, Pfizer Animal Health, Exton, PA 19341.
g. Torbugesic®, Fort Dodge Animal Health, Fort Dodge, IA 50501.