Equine cheek tooth extraction: a surgical challenge

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Introduction

Dental disease in horses can be a common occurrence, and these abnormalities can contribute to significant systemic health problems. All horses should receive a thorough oral/dental examination on a regular basis, regardless of whether they are symptomatic or not. Routine examination is important in the early detection of abnormalities when the odds of successful resolution with treatment are most favorable. In the case where traditional treatment has failed to resolve dental disease or salvage a tooth, exodontia may be required. Exodontia, or dental extraction, is the most common oral surgical procedure in horses and a frequent requirement in equine practice. This discussion will focus on cheek teeth extraction since they require exodontic procedures much more frequently than incisors or canines in the horse.

Common indications for exodontia include, but are not limited to; retained deciduous teeth, apically infected teeth, severe periodontal disease, maleruption, impaction, supernumerary teeth, fractures, and loose or expired teeth in geriatric patients. Whenever feasible, intraoral extraction is the preferred approach for many reasons, the most important of which being lower complication rates seen with this approach. However, this may not be possible in all cases and other techniques may need to be employed. Owners should be well informed of the potential for complications associated with exodontia (e.g. fistula formation), or difficulties of resolving co-morbidities (e.g. sinusitis) associated with dental disease. An accurate diagnosis, appropriate patient preparation, skillful surgical technique, and early recognition and aggressive treatment of complications when they arise are vital components to successful exodontia in horses.

Examination and imaging

A thorough oral examination is the foundation for identifying dental pathologies, especially prior to contemplating oral surgical procedures. For further information on oral examination, see "Equine Dental Exam: Tools and Techniques for Success", R. Brad Tanner, 2019 JT Vaughan Conference Proceedings, in addition to other references listed in these proceedings.

Imaging is an important part of the evaluation of horses presenting with dental disease. Because of the relatively low density of bone in the skull and extensive paranasal sinus system in the horse, good quality radiographs of the equine skull are possible in the field with portable generators. However, the complexity of the skull can make radiographic interpretation difficult and radiographs can occasionally have low sensitivity for the identification of apical infection, especially early in the disease process. Some of the classic radiographic findings associated with dental disease are periapical/pulpar changes with infection (sclerosis, root blunting/clubbing,

halo formation, loss of lamina dura structure, periapical or intrapulpar gas), fractures, diastemata, neoplasia, hypercementosis, maleruption, and supranumerary dentition. Additionally, co-morbidities such as secondary bacterial sinusitis can be identified and evaluated with radiographs.

Computed tomography has rapidly become the imaging modality of choice for the evaluation of dental/sinus disease in horses at referral centers. It is particularly useful in the evaluation of the apicoalveolar aspect, as well as the reserve crown. Referral for advanced imaging should be considered in horses with clinical evidence of dental disease but equivocal radiographic studies. With the advent of standing CT systems, these diagnostics can be performed at a lower cost to the client and potential risks of anesthetic recovery avoided. CT studies also allow 3D reformatted renderings which can greatly facilitate diagnosis and presurgical planning.

Patient preparation

In most cases, horses are amenable to standing oral surgery given proper restraint, sedative combination, environment, use of regional anesthesia, and technique. General anesthesia should be used whenever there is concern that the horse's temperament will place it or personnel at risk of injury. Performing oral surgical procedures in the standing patient has many benefits in addition to avoidance of costs and potential risks of anesthesia. The horses head is in a position that allows access to both sides, better anatomic orientation for the surgeon, a more ergonomically comfortable working positon, lack of oral cavity obstruction from the endotracheal tube, and generally less hemorrhage is observed compared to when the horse is in a lateral positon. There are times however when the temperament of the patient or invasiveness of the procedure warrants general anesthesia. A minimum of equipment and facilities required for standing surgical procedures includes stocks, head support or stand, full mouth speculum, irrigator, dental picks/explorers, head lamp or other light source, and/or oral endoscope.

The horse is placed in stocks and sedated to begin the procedure. Sedation protocols for standing surgical procedures are numerous, however the author typically uses the α_2 agonist detomidine (0.01 mg/kg) in combination with butorphenol (0.01 mg/kg) and diazepam (0.01-0.02 mg/kg) as a single dose IV and repeated PRN. For standing sinoscopy, the author will typically administer an initial sedation dose of detomidine, butorphenol, and diazepam, and then initiate a detomidine CRI at 0.1 µg/kg/min. Dependent upon the tooth to be extracted, regional anesthesia is then performed. This is a critically important step as it significantly improves patient compliance which greatly facilities successful completion of the procedure, as well as provides post procedural analgesia. For further information on regional anesthesia techniques for oral surgery, see "Regional Analgesia: Every Nerve Block Needed for Dental Surgery", R. Brad Tanner, 2019 JT Vaughan Conference Proceedings, in addition to other references listed in these proceedings.

The mouth is rinsed and the speculum is placed. The horses head is placed in a dental ring type halter and supported overhead, or no halter is used and the head merely supported on a head stand. Some horses seem to prefer one over the other and the author will try another method if the initial one is met with resistance. Regardless of which technique is used, the horses head and neck should not be allowed to ventroflex or "bow" with excessive head

extension as this can create resistance if the horse has cervical facet disease, or cause cervical pain post-procedurally.

Surgical techniques

Extraction per os

The extraction procedure is initiated by correct identification of the tooth to be removed. Because the cheek teeth can often be difficult to distinguish from one another when the crowns are intact, especially those more caudally located, the wrong tooth could inadvertently be extracted if close attention is not paid. Additionally, the bulky nature of extraction forceps and the difficulty with accurate placement on the tooth to be extracted could lead to iatrogenic damage to adjacent dentition. Adequate lighting and visualization are crucial during these initial steps. Flat bladed elevators are used to separate the buccal and palatal/lingual gingiva from the affected crown. Absence of reaction to this procedure is evidence that the regional anesthesia technique is effective. Molar spreaders are then delicately placed within the interproximal spaces around the target tooth, and slow steady pressure applied to stress the periodontal tissues. The spreaders can be more difficult to position accurately in the more caudally located interproximal spaces (e.g. between Triadan 010s and 011s) due to the curve of Spee, and care must be taken to avoid crown fractures. Molar spreaders with increasing blade thickness are gradually applied in a stepwise fashion to fatigue the tissues.

Once the handles of the largest molar spreader can be completely closed, the appropriate size extraction forceps are placed on the tooth. A variety of different design, style, and size of molar extractors exist, and the one with the most appropriate fit on the tooth to be extracted should be selected. This is important so that the subsequent movements of the forceps results in efficient transfer of force to the tooth and its periodontal attachments. If the forceps do not have a self-locking handle mechanism, tape or strips of bicycle inner tube work well to secure the forcep handles closed onto the tooth during manipulations. Initially, small horizontal movement of the forcep handles result in rotational forces down the long axis of the tooth. This should be gradually increased as more movement is appreciated in the tooth. Once frothy hemorrhage is observed, torsional movements down the handles of the forceps can be applied to "rock" the tooth side to side within the arcade. Depending on a variety of factors, but namely the length of reserve crown present, the process can take time and multiple sessions may be required. Patience is paramount, and haste can result in a tooth fracture that can lead to the need for more invasive surgery, requiring more time on the surgeons part and a higher cost the client.

When a "squelching" sound can be heard, and the tooth is notably loose with finger pressure, a fulcrum is used under the forceps to elevate the tooth from the alveolus. Slow, steady pressure should be applied to the forcep handles to leverage the tooth along its path of eruption. The position of the tooth in the arcade, along with its length may require manipulations to free it from the alveolus once it has been elevated. In rare cases, it may require sectioning with molar cutters or obstetrical wire. Care must be taken to avoid the apical portion of the tooth falling back into the alveolus as it can be difficult to retrieve after sectioning. The tooth is then closely inspected to ensure it is complete on no root remnants are remaining in the alveolus. Curettage may be required to remove remaining fragments or pieces of alveolus that may have become disrupted. Radiographs can confirm complete tooth removal if uncertainty remains after further examination.

Repulsion

Forceful repulsion of equine cheek teeth using large diameter dental punches and a bone mallet has fortunately been replaced by techniques that have much lower associated morbidity. Complications associated with the traditional procedure included fractures and sequestration of maxillary or mandibular bone, destruction of the alveolar bone plate, damage to adjacent dental structures, and oral-sinus, oral-nasal, or oral-cutaneous fistula. However, the technique is still useful for removal of dental remnants in select cases. The utilization of radiography for triangulation and use of small gauge Steinman pins results in a minimally invasive approach and greatly reduces the morbidity associated with traditional repulsion techniques.

Buccotomy

The buccotomy approach for cheek tooth extraction is technically challenging, requires general anesthesia, and complications such as incisional dehiscence and injury to the buccal nerve branches, linguofacial artery, vein, and nerve, or parotid salivary duct can occur. It is only used in special circumstances and therefore for the purposes of this discussion and sake of brevity, this technique of extraction will not be covered.

Minimally invasive transbuccal approach

Minimally invasive transbuccal screw extraction (MITSE) is an alternative technique that can be used to remove dental structures that cannot be successfully extracted via a traditional oral approach. Typically the approach has low morbidity which compares favorably to more invasive techniques such as buccotomy of repulsion approaches. Common reasons for selection or conversion to this approach is lack of clinical crown, intraoperative fracture of clinical crown, or inadequate extraction forcep purchase on the crown.

A specialized instrument set for MITSE exists (MTE set; pegasos4D, Denzlingen, Germany), however some surgeons have constructed custom instrumentation to perform the technique with good results. The procedure is most frequently used for the extraction of maxillary cheek teeth but can also be used for mandibular cheek teeth. It is completed with the horse standing with sedation and local anesthesia, but has also been used under general anesthesia in horses with temperament that was not conducive to standing procedures. The standing MITSE procedure is the author's technique of choice when traditional oral extraction has failed or is not possible.

Postoperative care

Following dental extraction, the alveolus should be irrigated and dry surgical sponges rolled and inserted into the defect while packing materials are prepared. A variety of materials are available, and gauze, dental wax, plaster of Paris, dental acrylic, or polysiloxane dental putty have been successfully used. Regardless of the material used, there are some important aspects to consider when packing an alveolus.

- The pack should sufficiently seal the opening to the alveolus to prevent entrance of feed material into the defect.
- The pack should not fill more than 1/3 of the alveolus which will prevent granulation tissue formation and healing of the defect

- If dental acrylic is used, the pack should be irrigated while polymerizing in place to avoid thermal damage to surrounding dental tissues
- The pack should be molded around adjacent crowns to aid retention, be below the occlusal surface, and not have excessively large "wings" on the lingual or palatal sides that could allow the horse to dislodge it with the tongue.

The horse should be examined again 2-3 weeks postoperatively to remove the pack and inspect the alveolus for proper healing.

Complications

One of the most common, and challenging to treat, complications of maxillary cheek teeth disease in horses is secondary bacterial sinusitis. The horse has an extensive paranasal sinus system made up from six pairs of sinuses: the dorsal, middle, and ventral conchal sinuses; the sphenopalatine sinus; the frontal sinus; and the maxillary sinus. The nasal passages and sinuses are separated sagittally into right and left sides by the nasal septum and vomer bone. All sinuses communicate with each other directly or indirectly, and with the nasal passage through the nasomaxillary opening from the maxillary sinus into the middle nasal meatus. The frontal and maxillary sinuses are considered the most clinically significant, most commonly due to disease of the apices of the caudal cheek teeth (maxillary 08s-11s). The most common clinical signs associated with sinonasal disease in horses are unilateral nasal discharge, facial swelling or deformity, and reduced nasal airflow. Additionally, horses may present with external draining tracts, epiphora, exopthalmos, or abnormal respiratory noise. Horses with sinusitis secondary to dental disease commonly have nasal discharge that is extremely malodorous.

Resolution of secondary sinusitis involves the treatment or removal of the underlying cause. With dental disease, this usually requires the extraction of the affected tooth/teeth. Depending on the age of the horse, infections of the apical portions of the caudal four maxillary cheek teeth (08-11s) will typically drain into the sinus. The teeth most commonly involved are the maxillary 09s, followed by the 08s. Apical infections of the rostral maxillary teeth result in facial swelling and ultimately draining tracts to the skin or into the nasal passage.

As sinusitis persists, the nasal mucosa becomes thickened and inflamed and can result in occlusion of the nasomaxillary opening. Chronicity of infection can lead to inspissation of material which commonly accumulates in the ventral conchal sinus. A soft tissue density dorsal to the caudal cheek teeth on radiographs may indicate inspissated material in the ventral conchal sinus, an area that can be difficult to access surgically.

Surgery of the paranasal sinuses

Surgical approach to the paranasal sinuses can be performed via trephination, bone flap techniques, or sinoscopy. The method of access is selected based upon the condition being treated. Additionally, it is important to consider the age of the horse when selecting an approach as in young horses the reserve crown of the maxillary cheek teeth fill the maxillary sinus and make access via a maxillary bone flap technique more limited. Brief descriptions of these techniques are discussed below. A blood donor is cross matched and stalled on site should the need for transfusion arise during or shortly following surgery as profuse hemorrhage is possible

with sinus procedures in horses. Broad spectrum antibiotics and anti-inflammatories are administered preoperatively and continued postoperatively as necessary.

Sinoscopy, trephination, and bone flap techniques are tolerated surprisingly well when performed standing in horses with appropriate sedation and local anesthesia. Many diagnostic and therapeutic sinus procedures can be safely performed in the standing patient. Hemorrhage during the procedures is greatly reduced when compared to similar procedures in the laterally recumbent horse. Additionally, the expense and risks of general anesthesia can be avoided.

Trephination

This technique is minimally invasive and therefore has less morbidity associated with the approach, however, access to the sinuses is limited for anything other than sinoscopy, biopsy procedures, and lavage of the sinuses depending on the size of the trephine opening. Trephination openings using Michele or Galt trephines can be created from ¼" to 1" in diameter. Locations for trephination are 3 cm dorsal to the facial crest and 3 cm caudal to the infraorbital foramen to approach the rostral maxillary sinus, 3 cm rostral and 3 cm ventral to the medial canthus for the caudal maxillary sinus, or 3 cm axial and 3 cm caudal to the medial canthus for the frontal sinus. The periosteum is preserved during the approach and the circular piece of bone is discarded. The approach is closed routinely in three layers beginning with the periosteum to encourage adequate healing of the bone.

Maxillary flap technique

The maxillary bone flap provides access to conditions affecting the rostral and caudal maxillary sinuses with limited access to the frontal sinus. This approach is not as useful in young horses due to the presence of the reserve crown that can obscure access and visualization. The borders of the maxillary bone flap are as follows: the rostral margin is a line drawn from the rostral aspect of the facial crest to the infraorbital foramen; the dorsal margin is a line from the infraorbital foramen to the medial canthus; the caudal margin is a line from the medial canthus to the caudal aspect of the facial crest; and the ventral margin is the facial crest.1 Once the landmarks are identified and the site is prepared, the skin incisions are made along the three borders (rostral, ventral or lateral, and caudal) down through the periosteum which is subsequently elevated. An oscillating bone saw or osteotome and mallet are used to create the bone cuts. The cuts through the bone are ideally beveled such that when the flap is replaced it overlaps and therefore is more secure. The flap is slowly elevated so that the bone fractures along the fourth (dorsal or medial) border. Small cuts can be made at the corners to facilitate this border fracturing in a straight line. Once the procedure is complete the paranasal sinuses may be packed if necessary to control continued postoperative hemorrhage using stallion packing passed up through the nasal passage and layered in an accordion fashion within the sinus. The end is sutured in the nostril with heavy suture. The flap is replaced and the periosteum is closed with absorbable suture. The subcutaneous tissue and skin are closed routinely. The packing is removed 48-72 hours later and the sinus is usually lavaged. Complications include excessive hemorrhage, cellulitis, sinocutaneous fistula formation, or bone sequestration of the flap.

Frontonasal flap technique

The frontonasal bone flap provides good access to the caudal maxillary and frontal sinuses as well as the ventral conchal sinus. For the surgical approach, the caudal margin is a perpendicular line from dorsal midline to a point midway between the supraorbital foramen and

the medial canthus; the lateral margin begins at the caudal margin 2 to 2.5 cm medial to the medial canthus and extends to a point approximately two-thirds the distance from the medial canthus to the infraorbital foramen; and the rostral margin is a perpendicular line from dorsal midline to the rostral extension of the lateral margin. Postoperatively, cases are managed similar to that described for the maxillary flap procedure.

Sinoscopy

Direct visualization of the paranasal sinuses can be achieved via sinoscopy using either a rigid arthroscope or a flexible endoscope. The advantage of the arthroscope is the procedure can be performed through a small opening into the sinus, but the disadvantage is the limited field of view. The use of a flexible endoscope allows a more thorough exploration of the sinuses however it requires a larger opening into the sinus. Both procedures can routinely be performed in the standing patient with sedation and local anesthetic techniques. Additional portals or openings can be created for probes, biopsy instruments, or grasping forceps. Portals can be closed primarily or left open for subsequent flushing or other treatment and heal by second intention. Complications are usually related to localized cellulitis around the portal.

Summary

Horses are adept at hiding dental abnormalities until they become advanced. These abnormalities can contribute to significant systemic health problems over time. Regular oral examination should be performed on all horses at least annually. Thorough routine examination is important for the early detection of abnormalities so they can be addressed to avoid secondary complications. When the determination that cheek tooth extraction is required, it should be completed through the oral route whenever feasible. Oral extractions take patience and require more time, but can significantly reduce the number of postoperative complications which have a high incidence with more invasive dental surgical procedures. Minimally invasive procedures such as MITSE technique for extractions and sinoscopy for treatment of sinusitis can greatly reduce patient morbidity and improve outcomes, and can be performed in the standing patient avoiding the risks and expense of general anesthesia.

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