INTRODUCTION

Throughout the 20th century, exodontia has classically been the backbone of equine oral surgery. There are a wide range of indications for tooth removal and most of these depend upon which tooth or teeth in the arcade are causing a problem. Some common indications for tooth removal are associated with one of the following:

1. Retained deciduous teeth
2. Interceptive orthodontics
3. Severe periodontal disease (diastema)
4. Highly mobile teeth
5. Supernumerary teeth
6. Dental impactions and displacements
7. Endodontic disease with secondary osteomyelitis
8. Surgical consideration in oral fractures
9. Severe disease or injury to the dental crown or root
10. Malocclusions
11. Disarming
12. Occlusal trauma
13. Neoplasia
14. Bitting discomfort
15. Sinus disease secondary to dental disease

The decision to extract a tooth should be a cooperative determination between the veterinarian and owner/trainer always looking out for the best interest of the horse. The veterinarian’s knowledge will guide the procedure.

Tooth removal should be a last resort after other methods to manage the diseased tooth or dental related problems, have failed. The specific tooth involved, dental disease process, age of animal and number of teeth dictates the surgical technique employed and instruments utilized. The extraction can be simple or very time consuming, frustrating, and fraught with operative and postoperative complications.

Routine dental corrective procedures should be performed prior to surgery. The equine dental surgeon must be well versed in the anatomy, physiology, embryological formation, and development of the hard and soft tissue of the equine masticatory system. The surgeon must be aware of age related changes
in teeth and the impact this has on dental wear and disease. Finally, there must be good surgical support for anesthesia as well as intraoperative imaging to guide the surgeon in his work.

The process of completely examining the masticatory system and careful surgical planning cannot be overemphasized. Preoperative examination and postoperative treatment are critical to a desirable long-term prognosis.

The earliest method to remove diseased cheek teeth in the horse was via the oral route. This method has been practiced by veterinary surgeons for centuries on severely diseased or loose teeth. Molar extraction forceps have been available for well over 100 years and until very recently have changed little in design. Along with the advent of equine general inhalation anesthesia which made working in the mouth around a mask or endotracheal tube difficult, this technique lost popularity. The late twentieth century veterinary literature has reserved oral tooth extraction to teeth that are loose or in old horses with short dental crowns.

**EXTRACTION PROCEDURE**

With improvement in sedatives and analgesics, standing surgical procedures have become more popular. The use of nasotracheal intubation and development of better quality screw type oral speculums have made oral access during general anesthesia practical. These factors have lead to the resurrection of oral cheek tooth extraction and the development of a wide range of better quality instruments to perform extractions.

Intraoral tooth extraction should be the primary method of tooth removal employed by the veterinary surgeon. Even though a retrograde approach to the sinus or periapical area may be necessary to reach an existing secondary condition, oral extraction should be attempted first. Proper extraction technique based on sound dental surgical principles minimizes postoperative discomfort and encourages rapid healing of associated soft tissues.

Oral extraction can be performed on any tooth but special consideration must be given to teeth with gross caries as those crowns may disintegrate during extraction. Diseased caudal maxillary teeth often are associated with secondary sinusitis and surgical drainage of the sinuses is required in this situation. The more caudally situated teeth are more difficult to access through the mouth making instrument placement and maneuvering more challenging. In aged animals with short reserved crowns or in the case of advanced periodontal disease that has resulted in loosening of the tooth, extraction may be carried out digitally. In young horses with apically disease teeth and long reserved crowns firmly attached in the alveolus, extraction will require more effort and expertise. Young animals with long reserved crowns may present an insurmountable challenge to oral extraction. It may be necessary in some juvenile horses to
remove permanent dentition prior to eruption, making an oral approach impossible.

Careful preoperative examination of the patient is important and all aspects of the approach to therapy should be planned before surgery is undertaken. Special consideration should be given to the age of the horse, type of dental pathology, position and number of root apices, and the structural integrity of the tooth crown. Radiographic and endoscopic examinations should be carried out pre- and postoperatively to support the clinical findings. When available, additional imaging techniques such as digital radiology, fluoroscopy, scintigraphy, computed tomography and MRI can be used to assist with the diagnosis.

A full set of dental extraction instruments includes:

1) Molar spreaders or separators with the proper size blade and angle of handle to fit between the mesial and distal margins of the tooth to be removed
2) A set of molar extraction forceps to fit the crown of the tooth being removed
3) Dental fulcrum
4) Molar cutter sized to fit tooth crown
5) Set of dental chisels
6) Set of dental elevators and curettes
7) General orthopedic instruments
8) Material to pack or cover dental socket, (iodoparform gauze, acrylic or base plate wax)

Intraoral tooth extraction is best performed on the standing horse although general anesthesia is necessary in a nervous or fractious animal. Sedative analgesics are administered and the horse’s head restrained in a steel frame dental halter or head stand. Regional anesthesia can be performed and is helpful in gaining patient cooperation. A full mouth speculum is needed to gain good access for working in the oral cavity. A headlight or fiberoptic light is essential for good visualization of instrument placement.

Teeth with split or damaged crowns can be loosened with an equine dental osteotome and forceps. A tooth with a healthy crown is loosened by placing a spreader between the mesial and distal interdental spaces of the involved tooth. Special care must be taken when working on the 07 and 10 teeth to spread first on the side with the most support to avoid loosening 06 or 11. The spreader blades are carefully placed between the teeth at the gingival margin and the handles closed, bringing the blades partially together. Just enough force should be placed on the spreader to slightly move the tooth. The blades are held in this position placing pressure on the periodontal ligaments, stretching them beyond the elastic limit over a 5 to 10 minute period. The spreader is removed and replaced on the opposite interdental space and the handles again closed, prying
the teeth apart. This process is repeated until the spreader blades are easily closed, both mesial and distal to the affected tooth. Next, the gingival mucosa is separated from the buccal and lingual edges of the tooth crown with a sharp dental elevator or osteotome. This will expose enough crown to allow forceps placement. It may be advantageous to remove a collar of alveolar plate on the buccal and/or lingual edge of the tooth crown to allow a more secure forceps placement. Care should be exercised when elevating on the palatial side of the upper teeth, not to damage the palatine artery.

The proper sized extraction forceps are placed on the tooth crown and secured with a length of rubber or elastic tied around the handles. The forceps are then rocked from side to side. The forceps handle should be moved over a very short range of motion to insure that the head of the forceps stay engaged on the tooth crown. This will hopefully avoid abrading or breaking the tooth. Torsion is placed on the tooth until it is felt to loosen in its socket. Undue haste or too great a force must be avoided and care must be taken to prevent crown damage from sudden movement of the horse’s head. When the tooth begins to loosen a sucking sound can be heard. Tooth looseness can be checked by removing the forceps and palpating the crown. Keep in mind that the tooth is like a post in a hole. A great deal of movement must be placed on the portion of the post above ground to be reflected in even a small amount of movement at the bottom of the post hole. In a young animal with the ratio of exposed crown to reserved crown and root, favoring the latter, more movement of the exposed crown is needed to result in any movement at the bottom of the alveolus. Conversely, an old horse with almost all of the crown being exposed, even a slight movement in the crown would put great pressure on the roots. The tooth is locked in place because of the irregular shape of the reserve crown and roots mirroring the shape of the alveolus. The thin alveolar plate is relatively easy to deform into the spongy surrounding bone. The combined process of disrupting the periodontal ligament and deforming the contour of the alveolus are essential to completely loosen the tooth.

Once the tooth is loose, the forceps should be repositioned to get a firm grip on the crown. A fulcrum or block is placed near the head of the forceps. Gradual firm traction will readily bring the tooth from its socket. The tooth should be examined to make sure it has been removed in its entirety and no root fragments or slivers of crown have been left in the socket. The alveolus should be examined and any bone or tooth fragments removed. Operative radiographs will confirm that the correct tooth has been removed and the alveolus has been left clean and intact. In the caudal recesses of the oral cavity in a young horse with a long reserve crown, the tooth may require sectioning with a molar cutter to allow it to be delivered into the oral cavity.

Lower cheek tooth sockets that are chronically infected from oral debris may need to be drained ventrally. This can be done with a ¼ inch Steinmann pin or ½ inch trephine hole made in the ventral lateral aspect of the mandible below the
affected alveolus. To protect the open alveolus, place several 4 x 4 gauze sponges tied in the center to a length of ¼ inch umbilical tape. The tape ends are passed into the empty alveolus through the oral cavity and out the drainage hole. The gauze roll is wedged firmly into the space between the opposing teeth and secured in the socket with umbilical tape tied around another roll of gauze on the outside of the skin incision. The ends of the tape should be kept long enough to allow it to be replaced without having to thread another piece of tape each time the packing is changed. The gauze should be changed daily and the wound irrigated until the periphery of the dental socket is covered with healthy granulation tissue (five to ten days).

The alveolus should be protected from oral contamination with a patch or plug of acrylic dental base plate wax or polymethylmethacrylate (PMMA). Dental base plate wax is a satisfactory product for this purpose. The entire plug should be about 1/4 the length of the reserve crown of the removed tooth to allow room for the development of granulation tissue in the dental socket. The plug should extend only slightly above the top of the gingiva so that it is not involved in chewing. After the wax is in place, its surface is molded carefully with a finger to build a slight flange over the gingival line to seal the alveolus. A similarly fashioned plug made from dental acrylic or bone cement has been found to be more successful in sealing the alveoli and preventing postoperative complications. Bone cement (PMMA) can be combined with radio-opaque contrast media or antibiotics if needed.

MINIMIZING COMPLICATIONS OF TOOTH EXTRACTION

The removal of a tooth or a number of teeth from a horse should not be approached casually. Reports on the incidence of complications that accompany cheek tooth removal range from a low level of 4 per cent for simple oral extractions in the older horse to as high as 47 per cent for repulsion of maxillary cheek teeth. Other studies have shown a 22 to 40 per cent rate of complications from traditional tooth repulsion. Complications can be divided into categories beginning with problems associated with restraint, general anesthesia, and long-term hospital care. Problems associated with the extraction itself include hemorrhage, removal of the wrong tooth, damage to structures adjacent to the tooth being removed (i.e. palatine artery, sinuses, infraorbital nerve, alveolar bone, jaw bone, adjacent teeth, nasolacrimal duct, parotid salivary duct and facial nerve).

Complications associated with wound healing can include wound dehiscence or persistent draining due to fistula formation, resulting from incomplete tooth removal, bone sequestrum, damage to alveolar plate of adjacent tooth, infected dental socket, packing breakdown, mucous membrane healing prior to wound granulation or a foreign body in the healing wound. Long-term complications can be associated with a misdiagnosis of the initial problem that can result in removal of a wrong or inappropriate tooth, leaving behind a tumor, infected sinus with
inspissated pus or diseased tooth. Additionally, long-term consequences can occur with abnormal wear of opposing teeth and rostral or caudal drift of adjacent teeth that, over time, can lead to diastema, periodontal pockets and further dental disease.

Careful and complete examination of the equine patient will allow an accurate diagnosis of the dental problem and any associated medical conditions that could cause problems during restraint and anesthesia. A full series of radiographs should be performed on horses with mandibular or maxillary swellings or paranasal sinus disease. When available, scintigraphy, digital radiography, computerized tomography and MRI can be used to assist with diagnosis. Surgery should be planned with facilities and equipment adequate to support the patient. Prolonged periods of keeping the mouth open with a speculum or rough use of a speculum can also lead to postoperative pain and damage to muscles or to the temporomandibular joint. Special considerations need to be given to upper airway maintenance and lower airway protection from oral fluids and debris. Nasotracheal intubation or a tracheotomy tube may be necessary. Reports in the literature quote the average hospital stay after tooth repulsion to be 2 to 61 days (median 22 days) for maxillary teeth and 3 to 35 days (median 8 days) following mandibular tooth repulsion. Every effort should be made to minimize the patient's postoperative stay thus reducing the chance of acquiring a nosocomial infection and shortening the ultimate recovery phase.

During the surgical procedure, hemorrhage is a concern from the very nature of the surgery. The nasal turbinates, oral mucosa and sinuses are very vascular. It has been recommended that packing the nasal passages or sinuses is the most important factor in preventing postoperative blood loss. Infusion of balanced electrolyte solutions, hypertonic saline solutions and administration of dobutamine may be needed to maintain adequate blood pressure after severe blood loss. The decision to perform a whole blood transfusion should be made on the basis of mucous membrane color, capillary refill time, oxygen saturation, packed cell volume hemoglobin concentration and arterial blood pressure.

Careful surgical planning and review of anatomy can reduce the chance of damaging structures that should be protected during surgery. The parotid salivary duct, palatine artery, nasolacrimal duct and facial nerves are structures to be considered when surgery is anticipated.

Judicious use of intraoperative radiographs or fluoroscopy are indicated to avoid operative problems such as removal of the wrong tooth or damage to structures adjacent to the tooth being removed. These would include the palatine artery, mesial or distal alveolar bone and adjacent teeth. Additional radiographs taken after tooth removal are useful in confirming that the proper tooth was removed and the alveolus is clear of unattached pieces of bone, slivers of crown enamel, root fragments or cementomas.
Many factors can contribute to delayed healing of the dental socket. In the normal course, the vacant alveolus fills with a sterile hematoma. This blood clot, protected from oral contamination, is the framework for a vascularized bed of granulation tissue that migrates inward from the outside margins of the wound, filling the void left by the removed dental crown and roots. The mucosa of the oral cavity, paranasal sinus, nasal passage or skin adjacent to the wound migrates over the bed of granulation tissue and, along with wound contraction, covers the alveolus with a layer of epithelium to complete socket healing.

Many factors can delay or completely interrupt this healing process, causing long-term problems for the horse, and in some cases the need for further corrective surgery. Persistent sinus tract formation is a common complaint following tooth removal. A sinus is a tubular ulcer that refuses to heal owing to the presence of a foreign body or dead tissue. A draining sinus is lined by granulation tissue and will heal rapidly once the offending material is removed. Sources of sinus formation can be pieces of avascular bone, dental fragments, dental packing materials, feed or debris from the oral cavity, avascular or infected nodules of cementum or any foreign body in the depth of the healing wound. Characteristically, a sinus will discharge purulent material, then appear to heal. However, the infection or irritation persists and the sinus tract reforms periodically. Transient response is often seen following systemic antibiotic therapy.

The successful treatment of a sinus tract involves removing the cause of the irritation to allow the tract to heal spontaneously. The source of the sinus should be identified with plain and/or contrast radiographs and a complete examination of the involved area should be performed. Generally, it can be determined where the source of the sinus is located and this area should be approached surgically via the most suitable route. Placement of drainage tubes or antibiotic impregnated beads of methylmethacrylate and protection of the surgical area from oral contamination can speed healing. Plugging the dental socket with bone cement has been shown to be superior in protecting the alveolus.

A fistula is a similar non-healing wound connecting skin with a mucosal surface or one mucosal surface to another. In a fistula, the tract can be lined with either granulation tissue, scar tissue or epithelium that has grown along it from either or both ends. Dental fistulae can form connecting the oral mucosa to the skin (orocutaneous), to the paranasal sinus (oroantral) or to the nasal mucosa (oronasal). The treatment of fistulae is usually complex and detailed anatomical reconstruction may be required. The epithelial tube lining a fistula, must be completely removed to allow the defect to fill with granulation tissue. Cutaneous fistulae have been known to form over the paranasal sinuses after they have been opened by trephination or a sinus flap. Fistulae between the nasal passages and paranasal sinuses are not usually a concern and can be useful in some situations to allow better ventral drainage of the paranasal sinuses.
Horses presented for tooth removal should first and foremost have a complete dental examination. Presurgical examination procedures will depend on the horse’s age and general health and the requirements of the anesthesiologist. Radiographic evaluation of the head is usually indicated and is the only way to visualize the crowns, roots and support structures of the involved tooth. Radiographs and other imaging techniques help with planning the approach to the tooth and can reduce the risk of complications. Exodontia should not be performed unless it has been determined beyond a doubt which tooth or teeth are problematic and all methods of corrective medical, periodontic or endodontic therapy has been exhausted to arrest the disease process and preserve the tooth.

Detailed descriptions for management of surgical and post surgical complications can be found in the literature. The objective to exodontia should be to carefully plan and execute the extraction and protect the dental socket, thereby minimizing complications.

REFERENCES AND SUGGESTED READINGS


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