Complications With Extractions

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1. Introduction

Complications involving cheek teeth extractions are prevalent. More than half of all cheek teeth extraction cases have a potential for complication.[1,2] Complications may involve surrounding bone, sinus, soft tissue (peridontium, vascular, nerves, etc), and teeth. The extraction process should never be viewed as a simple one-stop procedure. In contrast, an extraction should be a process that involves (1) presurgical/extraction evaluation, (2) treatment planning, (3) contingency treatment planning, (4) the extraction, and (5) postsurgical/extraction evaluation. To avoid or minimize complications, a systematic approach involving intraoral and radiographic examinations should always be instituted. Additional modalities for evaluation such as computed tomography, endoscopy, histopathology, cytology, and microbiology may be indicated before attempting an extraction procedure. Potential complications would include (but are not limited to) palatine artery laceration, iatrogenic mandible fracture, dilacerated roots, reactive cementum from chronic apical disease, alveolar bone sequestration, alveolar plug failure, oroantral fistula, iatrogenic dental fracture, retained or fractured roots, iatrogenic maxillary fracture, lingual laceration after a long-acting nerve block, collateral damage during the extraction process, and nonhealing mandibular fracture due to alveolar involvement and severe periodontal disease.

2. Materials and Methods

Oral and radiographic examination equipment/techniques required for the evaluation of extractions has been thoroughly reviewed previously.[3–12] Sedation protocols using constant rate infusion[13] along with regional nerve blocks[14,15] allow for most extraction procedures to be performed as a standing procedure.[16]

Palatine Artery Laceration

The greater palatine artery courses subgingival along the medial aspect of the maxillary cheek teeth at the edge of the hard palate within the palatine groove/process. It is a direct extension of the maxillary artery that passes through the palatine canal and extends rostral and joins its counterpart (right and left palatine artery) caudal to the incisors and enters the interincisive canal to form the incisive artery. The palatine groove does not completely enclose/protect the palatine artery. The artery is in close opposition to the alveolar bone of the maxillary cheek teeth. If extensive pathology is present along the medial/palatal alveolar wall, there is a risk of lacerating or tearing the artery when attempting an extraction. If a palatine artery laceration occurs, treatment involves direct pressure

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with surgical towels over a sustained period of time (20 to 30 minutes). Due to the location of the palatine artery within the palatine groove, surgical ligation is typically not possible.

Iatrogenic Mandible Fracture

The anatomical structure of a mandible consists of light alveolar and cancelous bone enveloped with a cortical plate on the medial and lateral aspect; most of the strength of the mandible is actually attributed to the large cheek teeth embedded within the bone. When planning treatment for the extraction of a mandibular cheek tooth, complete oral and radiographic evaluations are indicated for both mandibles. Strength for mastication during the postextraction healing period will be supported by the contralateral mandible. Evaluations for the (1) quality of bone, (2) pathology involving additional mandibular cheek teeth, and (3) missing mandibular cheek teeth are necessary to determine the strength of the mandibles during post extraction healing and mastication. Horses should be evaluated for chronic systemic diseases (such as Cushing's disease), periodontal disease, and so forth, which might affect the strength and quality of bone.

An evaluation of the extraction technique should be considered. If excessive force is needed with an intraoral or repulsion technique, severe damage and/or fracture of the surrounding bone is a possible complication. In contrast, a buccotomy and osteotomy technique may have less trauma involved with the extraction,[17,18] but if the bone is of poor quality/density, the excess removal of buccal bone may cause weakness in the overall strength of the mandible and a fracture could occur with the remaining lingual portion of the cortical bone.

Dilacerated Roots

A dilacerated root may occur with malformation, maleruption, trauma, crowding, or chronic apical disease. If a tooth is evaluated with a dilacerated root, a comprehensive treatment plan must be instituted with several options available, depending on the outcome. If standard intraoral techniques fail in the extraction process, alternative plans would include a root tip sectioning and/or a buccotomy with surgical extraction.[17,18] Excessive rotational oral extraction forces could lead to additional complications, including iatrogenic tooth fracture and devitalized alveolar bone (sequestra).

Reactive Cementum Due to Chronic Apical Disease

Unlike other species, the equine tooth reacts to insults and infection by trying to seal or wall off bacteria with a layer of cementum.[19] With chronic apical disease in cheek teeth there may be surges/flares of infection, followed with quiescent periods with cementum overgrowth. The abundant layers of cementum can create a moderate ankylosis that will inhibit or prohibit normal cheek tooth eruption. A tooth with excessive cemental buildup and/or ankylosis may need additional extraction techniques implemented if oral extraction fails. Careful oral and radiographic evaluations will help when developing an accurate treatment plan. Aggressive oral extraction forces could lead to other complications, such as iatrogenic fracture of tooth or bone, retained root tips, alveolar bone damage, sequestra formation, and so forth.

Alveolar Bone Sequestration

Alveolar bone sequestration is one of the most common extraction complications. Nonvital bone can develop from aggressive force applied to tooth and surrounding bone during an extraction process. This may occur during an oral extraction process when excessive deformation of the alveolar bone is created. Due to the instrumentation and techniques currently used with oral extractions, excessive rotational forces may be created with the long extraction forceps. In certain extractions that would be predisposed to excessive rotational forces, it may be better to consider a surgical extraction so that the amount of bone damage and sequestra can be minimized. There has been discussion of trying to develop a new type of oral extraction technique in which slow and steady vertical pressure can be maintained on the tooth.[20]

Extractions With Paranasal Sinus Involvement and Alveolar Plug Failure

Maxillary cheek teeth extractions that involve the paranasal sinus may be difficult to place and retain an alveolar plug after extraction. Based on the anatomy and limited access, a gingival flap closure technique of a cheek tooth extraction site has yet to be designed. Currently, closure of the alveolus is limited to the formation of an alveolar plug, utilizing materials such as vinyl polysiloxane, polymethyl methacrylate, gauze, dental wax, and so forth. When forming an alveolar plug, care should be taken to not allow the material to extend deep into the alveolus/sinus. In addition, the plug should be molded tightly against each neighboring cheek tooth and depressed slightly below the gingival to the level of the alveolar bone. Failure of the alveolar plug can occur in two directions; loss of the plug in the oral direction or loss of the plug into the paranasal sinus. With either type of plug failure, food material can migrate to the paranasal sinus. When addressing this type of plug failure, the sinusotomy site may need to be reopened and accessed for flushing/debridement of the sinuses and removal of the alveolar plug (if indicated).

Oroantral Fistula

An oroantral fistula is defined as a fistula that communicates between the oral cavity and a paranasal sinus cavity. When a fistula develops as a sequel to a maxillary tooth extraction, it typically is due to loss of vital bone structure surrounding the alveolus. Vital bone loss can occur with hard palate bone or

excessive alveolar bone. When the alveolar bone is sluggish to repair, rapid gingival overgrowth may develop into the sinus. Once the gingival mucosal overgrowth extends into the sinus, it is difficult for bone remodeling to completely repair and create a boney barrier between the oral cavity and sinus.

Prevention of excessive bone loss during an extraction process is the first line of defense against the formation of a fistula. This is accomplished through a well-managed treatment plan such as (1) correct placement of the repulsion instrument (and force), (2) staging multiple extractions that involve neighboring teeth, (3) sectioning large, malformed maxillary cheek teeth before extraction, and (4) removing all infected bone, sequestra, and tooth fragments from an extraction site.

Once a fistula has developed, aggressive debridement and curettage of the alveolus may be indicated. On occasion, it is necessary to create a sinusotomy to locally debride and remove infected nonvital bone from the sinus that is associated with the fistula. Due to the limited access and visual challenges, reparative gingival flap procedures have not been developed as in other species. A procedure describing the transposition of the labii superioris muscle for oromaxillary sinus fistulas has been described.[21,22] This procedure involves treating a fistula through the sinus by isolating and transecting the rostral tendon of the levator labii superioris muscle. The tendon and muscle is guided through the sinus, the oroantral fistula, into the oral cavity, and out through a buccotomy. Care should be taken to avoid damage to the dorsal buccal branch of the facial nerve and the parotid salivary duct.

Iatrogenic Dental Fracture

An iatrogenic dental fracture is a common sequel to a failed oral extraction procedure. Underlying conditions of the tooth that could lead to a fracture include ankylosis of the roots, resorption of the clinical/reserve crown, malformation of the tooth, dilacerated roots, and so forth. With oral and radiographic examination, a viable alternative extraction plan should be established before initiating an extraction procedure. During the oral extraction process, excessive rotational forces with a weakened clinical/reserve crown may lead to a dental fracture. If a dental fracture occurs, the alternative extraction procedure for the remaining reserve crown/root can be initiated.

Retained Root Tips/Fractured Roots

As a general dental principle applied to the horse, most fractured/retained root tips should be extracted. If there is radiographic evidence of a periodontal ligament outlining the root, then typically the root should be extracted. If the root tip does not have a definable periodontal ligament (in cases such as tooth resorption or ankylosis), oral and radiographic monitoring may be a viable alternate option. Middle-aged horses can be more problematic when dealing with a fractured and retained root tip. The root tips at this age tend to be long and thin, due to normal attrition of the clinical and reserve crown.

If a root tip is fractured and retained during an extraction process, the use of a right-angled elevator is indicated. The blade of the elevator is engaged with the tooth root. Slow and gentle pressure is applied to all aspects of the root (mesial, distal, buccal, and palatal/lingual). If the tooth root will not elevate and there is clinical disease associated with the tooth root, then complete excision/removal of the tooth root is indicated. This is accomplished by resecting bone over the tooth root (sinusotomy and/or buccal bone removal) followed with elevation or repulsion of the root fragment. If there is no clinical disease associated with the retained root tip and the root tip has an intact periodontal ligament, a treatment option would be to wait a short period of time (2 to 4 weeks) and try to reelevate the remaining tooth root. Active fibroblasts within an intact periodontal ligament are capable of creating eruptive forces.[23] Giving the tooth root a short period of time for partial eruption may make it easier to engage the elevator on the tooth and allow for complete extraction.

Iatrogenic Maxillary Fracture

Iatrogenic fracture of the rostral maxillae (usually bilateral) has been reported.[24] Adequate sedation and perineural anesthesia are necessary when performing standing extraction procedures. Excessive expansion force with a dental speculum should be avoided. As a horse feels pain or senses fear, the natural reaction is to close the mouth (and exit). Estimated normal masticatory forces have been reported to range between 875 and 1956 Newtons (196 to 439 lbs.).[25] With a fear response, wide-opened speculum, and excessive masticatory force, it is possible for the maxillae to fracture. If, during an extraction procedure, a horse starts to chew aggressively on the dental speculum, relax the speculum and reassess the perineural anesthesia and level of sedation.

Lingual Laceration After a Mandibular Nerve Block

Regional anesthesia is routinely used in conjunction with constant rate sedation for standing extraction procedures. The motor control of the tongue is through the intrinsic lingual muscle and extrinsic muscles which are innervated by the hypoglossal (cranial XII) nerve. The sensitivity to the rostral two-thirds of the tongue (touch, pain, heat, and taste) is controlled by the lingual (cranial V). The chorda tympani (cranial VII), glossopharyngeal nerve (cranial IX), and hypoglossal (cranial XII) control sensitivity to the caudal one-third of the tongue.[26,27]

The lingual nerve branches from the mandibular nerve. When performing a mandibular nerve block, the rostral two-thirds of the tongue will be without sensation. If the effect of the nerve block is still

present when the surgical procedure is completed, the horse could potentially self mutilate/lacerate its own tongue. This is particularly true if the nerve block is still present after recovery from the sedation.

The properties of a local anesthetic and the anticipated duration of an extraction process should be reviewed before selecting it for a nerve block. Important properties to consider would include the potency and duration of action.[28] Potency is rated with procaine as the standard (a unit of 1). All other local anesthetics are rated relative to procaine. Lidocaine has a potency of 2 (it is twice as potent as procaine). Bupivacaine has a potency of 8, which makes it 4 times more potent than lidocaine. So, if a standard volume for a mandibular nerve block with lidocaine is 10 mL, then this would be equivalent to 2.5 mL of bupivacaine. Duration of action can vary with local anesthetics from 1 hour to 6 hours. Procaine is the shortest duration at 1 hour, lidocaine and mepivacaine have a duration of ~2 hours, and bupivacaine will range between 4 and 6 hours.

Collateral Damage With the Extraction Process

Accurate assessment, location, and identification of the diseased tooth are critical when performing an extraction procedure. Intraoperative placement of markers can be used with radiology to guide surgical instruments being used for root tip resection, buccal bone removal, and repulsion procedures. Caution should be used to ensure that the radiographic beam is perpendicular to the marker or instrument when determining the exact location of the surgery. As an example, if the radiographic beam is obliqued from a slightly rostral position, the radiographic image of the marker (instrument) will be shifted caudal to the actual extraction site. The tendency will be to move the instrument rostral to make the radiographic image look correct, but in actuality the instrument will be placed over the distal aspect of the next tooth in a rostral direction. If this error is not recognized, collateral damage may occur to the neighboring tooth as the diseased tooth is approached incorrectly.

Nonhealing Mandible Fracture Due to Alveolar Involvement and Severe Periodontal Disease

The fracture of a mandible may involve the alveolus of a cheek tooth (or alveoli of cheek teeth). Accurate oral and radiographic examination is necessary for detailing the extent of the fracture. In severe cases, additional imaging with computed tomography may be necessary to gain an accurate 3-dimensional evaluation of the fracture and the involved cheek teeth. Care and judgment should be used when deciding if and when to extract a tooth that is involved with a fracture. With the initial evaluation, it is important to distinguish between an alveolar fracture and a combined alveolar and dental fracture. When a fracture involves the alveolus and/or tooth, critical oral and radiographic evaluation is necessary to determine when the presence of the tooth impedes or prevents repair of the fracture. A mandibular cheek tooth does give strength to the mandible (see previous section discussing iatrogenic mandible fracture). However, when severe periodontal disease develops,[29] the local infection will not allow the fracture to heal. At this stage, the affected tooth should be extracted. If several teeth are involved with the fracture site, a staging of extractions may become part of the treatment plan.

3. Summary

The equine extraction complications are varied and many. Over one-half of all cheek teeth extraction cases have a potential for complication. Additional modalities for evaluation such as computed tomography may be indicated before attempting an extraction procedure. Awareness of potential problems and constant patient monitoring (oral and radiographic evaluation) will help to eliminate or minimize the effects of a potential extraction complication.

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