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ORTHOPEDIC SURGERY IN STANDING HORSES

Introduction:

Although it is feasible to perform many orthopedic procedures in the standing horse, consideration should always be given to the attendant benefits and risks of such an approach. Standing surgery has the primary benefits of eliminating the expenses of general anesthesia and the risks associated with recovery from recumbency. In addition, some procedures such as medial patellar desmotomy or lateral digital extensor tenectomy may be technically a bit easier with the horse bearing weight on the limb. In virtually every case, the surgeon's comfort is significantly diminished when doing surgery in the standing horse but with proper chemical and physical restraint as well as appropriate local anesthesia, there should be little serious risk to the surgeon. A major disadvantage of standing surgery is maintenance of a sterile surgical field; it can be difficult to drape the surgical area and prevent contamination if the patient moves. Visibility of anatomical structures is usually more difficult in the standing horse because of poorer illumination, inadequate retraction and problems with hemorrhage. In particular, some procedures in the distal limb will bleed more in the standing horse due to simple gravitational reasons. In summary, orthopedic procedures are generally more difficult to perform in the standing horse and the surgeon should be experienced and confident in doing the procedure in a recumbent patient before attempting it in the standing horse.

Specific Indications for Standing Orthopedic Surgery:

Stringhalt and upward fixation of the patella are well described and the surgical procedures used to treat them have remained essentially unchanged for decades. Use of lateral digital extensor tenotomy/tenectomy for stringhalt results in inconsistent long term improvement and is frequently unsuccessful in managing the more severely affected horses. Medial patellar desmotomy is still necessary to treat the severely "locked" upward fixation but evidence is strong that the procedure may lead to degenerative changes in the joint, specifically involving the distal pole of the patella. There are numerous good descriptions of these standing procedures in the literature as well as for distal splint bone amputation and palmar (plantar) digital neurectomy. Annular ligament desmotomy is indicated in horses with constriction of the flexor tendons over the palmar/plantar aspect of the fetlock. The constriction can be due to either

tendonitis and enlargement of the tendon(s) themselves or it can be associated with primary thickening of the annular ligament. Ultrasonography is the definitive diagnostic tool. The surgery is often indicated in the hind limb(s) of middle aged to older jumpers and dressage horses.

Osteostixis (transcortical drilling) is a common treatment for dorsal cortical fractures ("stress", "fatigue" or "saucer" fractures) of the third metacarpal bone in Thoroughbred racehorses. The rationale is the recruitment of healing elements from the medullary cavity into the fracture site as well as a possible induction of the proposed "regional acceleratory phenomenon" believed to operate in bone.^[5,6] In the author's opinion, osteostixis alone (without a bone screw) is adequate to treat most of these fractures. Many such fractures will heal with rest alone but mid diaphyseal cracks without evidence of endosteal involvement or periosteal response often are very slow to heal and are appropriate candidates for surgery. Horses with recurrence of dorsal cortical fractures also are good candidates for the procedure.

Sequestrectomy is often a simple procedure that can be done standing, even if it involves a bone more proximally located in the limb, head or axial skeleton. A good candidate for standing debridement is one in which the lesion is not adjacent to sensitive neurovascular structures and retraction and elevation of tissues is minimal. There is a potential advantage in standing debridement of very large sequestra from the appendicular skeleton because the risk of fracture during recovery is eliminated.

Deep digital flexor tenotomy for the treatment of laminitis is frequently done with the horse standing because of the poor overall condition of the patient or concomitant orthopedic problems. Although it can be done in either the mid-metacarpal region or the mid-pastern region in the standing horse, the mid-metacarpal approach is definitely easier. Inferior check desmotomy (transection of the accessory ligament of the deep digital flexor tendon) is usually done under general anesthesia for the treatment of flexural deformities. However, both inferior check desmotomy and deep digital flexor tenotomy can be done standing under ultrasonographic guidance, however.

Dorsal spinous process surgery (partial ostectomy or interspinous desmotomy) is technically a bit easier because of positioning in the standing horse.

Removal of orthopedic implants (screws, wires, plates) can often be done without general anesthesia. This is particularly advantageous when there is concern about recovering a horse following removal of the implants. An example would be a long condylar fracture of a cannon bone fracture repaired with multiple lag screws. Many horses with mid-diaphyseal transcortical screws will manifest pain when put back into heavy race training. Recovery from general anesthesia after removal of screws is risky because of the stress concentrating effect of the empty screw holes.

Reduction and repair of rostral mandibular and incisive bone fractures with simple interdental wiring techniques can be done standing in most horses. If the repair involves wiring around the premolars, general anesthesia is preferred.

Arthroscopy has almost completely replaced traditional arthrotomy for joint surgery. Some arthroscopic procedures can be safely performed standing despite the delicate nature of the instrumentation. The simplest indication of arthroscopy in the standing horse would be for lavage of a septic joint. The instrumentation and fluid delivery systems are well suited provided that the involved joint can be safely entered and operated upon with the horse standing. Removal of osteochondral fragments is also practical for some specific injuries such as simple chip fractures of the dorsal aspect of the proximal phalanx.

Preparation of a patient for standing surgery:

The horse should be carefully groomed or bathed to remove gross debris, bedding and hair. Typically, the clipping, primary scrub and local anesthesia are performed under xylazine sedation (0.4-0.5 mg/kg IV). Detomidine (1.5-2.2 mg/100 kg IV) is then administered immediately prior to surgery (usually about 15 minutes after the xylazine was given).

Non-sterile drapes should be used to cover the horse's body and neck because minimal headshaking or body movement will result in a surprising amount of "fallout". The non-sterile drapes should be taped in place so that sterile drapes can be clamped to them. Drapes or clean bandage material should be taped securely to the limb proximal to the site of the surgery. It is highly preferable to operate with the horse restrained in stocks, and with its head controlled by an experienced handler. If head ties are used, they should be easily releasable. The completeness of the surgeon's attire depends on the nature of the surgery. For clean procedures, it is helpful to wear a long sterile gown so that the surgeon can kneel on the sterile floor drape. Carpet layer's knee pads are strongly recommended for the surgeon's comfort if the surgery is being performed on the distal limb. Draping

of the surgical site must include a generous impervious covering of the foot and floor surrounding the foot. Adhesive drapes are particularly useful in standing surgery because they tend to minimally obscure the surgical site and are more easily kept in place on the limb. Obviously, towel clamps are not useful to hold drapes in place anywhere away from the anesthetized portion of the body.

Local anesthesia for standing limb surgery must be complete enough to insure the safety of the patient and the surgeon. If possible, however, anesthesia should be minimal enough to preserve some sensation to the limb that might help minimize stumbling under the effects of the sedatives. It also is sometimes helpful if the horse can feel part of its limb so that the limb can be more easily repositioned by the surgeon during the procedure. The best example of this is joint surgery which is easily performed by firmly distending the joint with 2% mepivacaine or lidocaine. The skin is anesthetized by local subcutaneous infiltration of anesthetic either directly at the site of the portals or in a hemircumferential subcutaneous ring proximal to the joint margin.

Condylar fractures and sagittal P1 fracture lag screw fixation:

Simple lag screw fixation of non-displaced condylar fractures and simple sagittal P1 fractures has become more popular over the last 10 years or so. The development of standing internal fixation was originally prompted by the specific risks of anesthetic recovery known to be greater in medial condylar fractures. As surgeons gained more confidence doing standing internal fixation on those "high risk recovery" cases, many have chosen to do more common non-displaced lateral condylar fractures and sagittal P1 fractures without general anesthesia. There are, as always, risk:reward considerations.

The major "risks" of standing internal fixation are:

- 1 Inherently inferior asepsis. The procedure can certainly be done very cleanly (acceptably) but it is impossible to be AS clean as a well run general anesthetic procedure.
- 2 Horse motion leading to instrument breakage. This is uncommon if good surgical techniques (frequent cleaning of bits, sharp bits/taps, complete local analgesia and appropriate sedation) are followed.
- 3 It is uncomfortable for the surgeon. Flooring installers' knee pads are strongly recommended.

The major benefits:

- 1 Avoiding the risk of recovery from general anesthesia.
- 2 It is easier to maintain topographical orientation, i.e. place screws parallel to the joint and directly lateral to medial.
- 3 (perhaps...) lessens the overall costs to the client. It does lessen costs to the hospital but there is some question whether or not it should cost the client less!

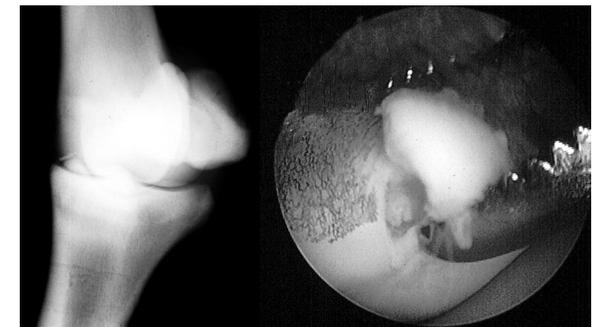
It is technically much easier to drill from the lateral side of the limb I personally would prefer to repair both medial and lateral condylar fractures from the lateral side. There is no compelling reason to attach the "small piece" to the "big piece" IF the strength of the small piece is adequate. The quality of bone in the MC3/MT3 condyle is so good that engaging 25mm of bone already exceeds the strength of the 4.5mm screw.

Implant removal:

The key to removing screws, wires or plates with the horse standing is accurate localization of the implants. In the standing horse, intraoperative radiography is cumbersome and time consuming so pre-operative planning is essential. As discussed above, stainless steel skin staples placed aseptically after skin preparation but before the surgery begins are a very useful means to localize the implant. Radiographs should be taken in two planes to confirm the precise position of the screw head prior to making the incision. Placing a "grid" of staples over the area will minimize the number of necessary radiographs. When the screw head is localized, the scalpel should be inserted directly towards it; any lateral dissection makes a "miss" more likely. When the screw head is located, the screw driver head can be inserted in most cases for easy removal. If the screw driver head does not seat fully, the hexagonal head recess should be cleaned with the corner of a 3-4 mm osteotome or a 2 mm K-wire. Attempting to remove a screw with the screwdriver only partially inserted often leads to stripping of its head. The surgeon should check his/her screwdriver to be sure it still has sharp edges. This is a piece of equipment that will wear out and occasionally needs replacement. All of the above precautions are particularly important with 3.5 mm screws because the heads are shallower and much more prone to be stripped. The surgeon should also have osteotomes/chisels and a mallet available in case there is bone covering a portion of the screw head. Bone plates can sometimes be removed by making small incisions over the screws and pulling the plate though an



Positioning of the surgeon and horse (left) for removal of a typical proximal dorsomedial chip fracture of the left front proximal phalanx (below).



incision at one end. In some cases, this is not possible because of bone growing over the plate edges. Wires are generally easy to remove as long as the twist is parallel with the direction from which it is being pulled. If the operator is comfortable with the technology, ultrasonography can also be used intraoperatively to localize metal implants.

Arthroscopy in the standing horse:

Standing arthroscopic surgery may seem a bit ridiculous considering the delicacy and expense of the instruments. However, some arthroscopic surgical procedures are so rapidly performed that the amount of time spent inducing, positioning and recovering a horse from general anesthesia seems disproportionate. In addition, there is, even under the best of circumstances, an element of risk to the patient for general anesthesia both during the procedure and during recovery from anesthesia. These risks include postoperative pneumonia and traumatic injuries during recovery, both of which may occur in young and healthy athletic horses. It is important to emphasize, however, that these risks are still quite low and certainly don't demand an alternative approach to surgery. An alternative such as a standing approach should not be done unless the procedure can be done equally well or if the alternative approach affords some other specific advantage.

The best indication for standing arthroscopic surgery is the removal of chip fractures from the proximal dorsal aspect of the proximal phalanx, probably the single most common chip fracture in Thoroughbred racehorses. The arthroscopic portals are straightforward, intra-articular dissection is minimal and the procedure can easily be done without manipulation of the joint. In fact, the standing weightbearing posture of the horse actually makes the dorsal joint pouch more readily accessible.

It is imperative that the surgeon has an honest appraisal of his/her abilities as an arthroscopist. If he/she cannot consistently complete a routine chip fracture removal in less than 10 minutes without a tourniquet, standing removal probably should not be attempted. This approach should not be attempted in the absence of a lightweight video setup.

Local anesthesia for standing arthroscopy must be complete enough to insure the safety of the patient and the surgeon. If possible, however, anesthesia should be minimal enough to preserve some sensation to the limb that might help minimize stumbling under the effects of the sedatives. I believe that it is better if the horse can feel part of its distal limb

so that the limb can be more easily and safely repositioned by the surgeon or assistants during the procedure. I therefore prefer to do standing fetlock arthroscopy without a palmar/plantar ring block.

Horses are not given antimicrobials either parenterally or locally. All horses are given intravenous phenylbutazone (2.2 mg/kg) at the time of surgery.

Procedure:

The horse should be carefully groomed or bathed to remove gross debris, bedding and hair. Typically, the clipping, primary scrub and local anesthesia are performed under xylazine sedation (0.4-0.5 mg/kg IV). The fetlock is tautly distended with intra-articular 2% mepivacaine. This usually requires ~25 ml of anesthetic. The distention clearly outlines the proximal margins of the joint. A subcutaneous dorsal half ring block is then performed just proximal to the joint capsule to desensitize the skin. Using a 1 1/2 inch 22 gauge needle, this usually can be done with 2 "sticks". This technique has the advantages of being technically very simple and rapid to perform, consistent in its effects and distends the joint pouch in preparation for placement of the arthroscope cannula.

The horse is then moved to stocks and detomidine (1.5-2.2 mg/100 kg IV) is administered immediately prior to surgery (usually about ~10 minutes after the xylazine was given). It is highly preferable to operate with the horse restrained in stocks, and with its head controlled by an experienced handler. If head ties are used, they should be easily releasable. Final skin preparation is done while the surgeon scrubs.

It is helpful to wear a long sterile gown so that the surgeon can kneel with the sterile gown on the sterile floor drape. Carpet layer's kneepads are strongly recommended for the surgeon's comfort. Although we originally placed non-sterile body drapes on our patients, we now have further simplified the draping. I use a single paper drape spread out on the floor that is clamped to itself (NOT THE HORSE!) behind the pastern. An adhesive transparent drape is then applied circumferentially proximal to the surgical site to drape off the carpus and distal antebrachium. Finally, a plastic split sheet with adhesive edges is placed under the fetlock and the adhesive strips stuck to the palmar aspect of the limb and the adhesive drape proximally. The plastic drape is spread out on the floor surrounding the operated limb.

Basic arthroscopic technique is no different from that used under general anesthesia. The surgeon must work on his/her knees and pay close attention to asepsis due to the awkward position. A powerful fluid delivery system is essential because hemorrhage can be a major problem with the horse standing. I prefer the nitrogen-powered disposable Arthro-Flo® system (Daval) without the regulator sold for human use. In the dorsal aspect of the fetlock, the scope portal is usually proximal so that the camera and scope can be comfortably directed distally to view the lesion. The sharp trocar is not used in the dorsal fetlock; I prefer to leave the fluids running at full pressure while a stab incision is made with a #11 blade. The dorsal fetlock is easy to examine with the horse bearing weight on the limb because that position maximizes the joint pouch. If the palmar fetlock must be examined, an assistant can hold the limb up in palmar flexion but this is not recommended if anything more than a brief examination is anticipated. Always check for skin anesthesia with a hemostat or towel clamp prior to making the skin incision; a tranquilized horse can move very quickly and create a disturbingly large incision when the scalpel is applied. Instrument portals are made according to the location of the lesion(s). It is nearly always feasible to debride medial and lateral dorsal proximal P1 fractures through a single instrument portal. If both medial and lateral lesions are identified after placing the arthroscope, the instrument portal should be positioned more axially so that the sagittal ridge isn't in the way reaching across the joint.

Although the most suitable indication for standing arthroscopic surgery is a simple proximal dorsal P1 chip fracture, simple chip fractures of the distal dorsolateral radius and proximal intermediate carpal bone can be readily removed in a standing horse. There is adequate space in the antebrachiocarpal joint to maneuver the scope and the instruments along the dorsal rim with the horse bearing weight. The author has also done standing arthroscopic procedures on palmar metacarpophalangeal, middle carpal, tarsocrural, femoropatellar and distal interphalangeal joints. It is improbable that standing arthroscopy will ever be the preferred technique for most procedures although it is practical and successful for certain indications.