How to Place Distal Lateral Radial Transphyseal Screws in a Standing Horse

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1. Introduction

Angular limb deformity (ADL), defined as an axial deformation of a limb in a sagittal plane, is common in foals and yearlings and is recognized to predispose lameness and affect performance. To enhance sale value and possibly potential performance, excellent conformation is needed.

Angular limb deformity can be presented as either varus or valgus deformity. Varus is defined as a medial deviation of the limb distal to the location of the deformity, whereas valgus is a lateral deviation of the limb distal to the location of the deformity, in a frontal plane. It can originate at different locations of the appendicular skeleton: cuboidal bones of the carpus and tarsus, epiphyses of the long bones, and occasionally in the diaphysis.

Many ALDs correct with conservative treatment, but surgical intervention is recommended in severe cases. A demand exists to correct these deviations early in development stage in order to improve cosmetic appeal and potential commercial value. A significant decrease in growth of the distal metacarpus/metatarsus and radial physis occurs after 10 weeks and 15 months, respectively. Distal radial epiphyseal closure occurs at a mean of 24.7 months.

Several surgical and nonsurgical techniques have been described in the literature. The first surgical angular limb deformity correction, with temporary transphyseal bridging using staples, was described in 1963. The majority of the surgical techniques described in the literature report the use of an implant to bridge the convex side or long side of an open physis, at the side of deviation of the affected limb. Transphyseal bridging with staples, single screws, and screws and wires have been used to retard growth of the physis in foals. Single transphyseal screw insertion was first described in 2004. Confirming our suspicions, based on our clinical experience, transphyseal screws have recently been shown to be superior to screw and wire, with fewer complications and faster results.

Transphyseal bridging with a single screw requires only a stab incision and minimal to no dissection of subcutaneous tissue. Hagyard Equine Medical Institute has been using predominantly single transphyseal screws for angular limb deformities since 2004. We have used this technique in the distal metacarpus, metatarsus, radius, and tibia.

In some cases, the risks of anesthesia, financial costs, or the lack of adequate surgical facilities may prevent timely surgical correction of carpal varus.
deformities. To avoid anesthetic and postoperative anesthetic complications, a standing distal radial transphyseal bridging procedure is a viable option. The purpose of this report is to describe the transphyseal bridging procedure, with a positional single 4.5-mm self-tapping screw, in the lateral aspect of the distal radial physis, in the standing horse.

2. Materials and Methods

Surgical candidates (8 Thoroughbred yearlings) were considered on the basis of clinical evidence of carpal varus deviation that had not corrected with conservative treatment. Visual appraisal alone was used as a standard means of assessment. Standing surgical placement of a lateral transphyseal screw was chosen, based on client’s preference.

Supplies and Equipment

The surgical armamentarium required for standing transphyseal screw placement and removal is the same as required for the procedure under general anesthesia. A small set (Mayo scissors, Brown Adson and Graefe fixation forceps, mosquito hemostatic tissue forceps, and needle holders) is usually required, in addition to the orthopedic armamentarium. To place a 4.5-mm positional self tapping screw, a hexagonal screw driver, 3.2-mm drill bit, soft tissue protector, and power drill is required. Appropriate surgical draping, a 15-T scalpel blade, a balanced electrolyte solution with or without antibiotics, appropriate suture, and bandaging materials should be also at hand.

Intraoperative radiographs are essential for successful screw implantation. It is not necessary for the screw removal procedure unless a broken screw is suspected. The procedure can be performed using appropriate restraint, sedation, and local anesthesia. Stocks are not used for this procedure in our practice.

Perioperative Preparation

Perioperative antimicrobials were administered in the form of procaine penicillin G,22,000 IU/kg intramuscularly and gentamicin sulfate 6.6 mg/kg, intramuscularly. The horses were sedated with detomidine hydrochloride,0.02 mg/kg and butorphanol tartrate0.02 mg/kg, intravenously. Only one dose of sedation is usually required for the duration of the surgical procedure. The skin was clipped, from mid-radius to proximal metacarpus, and aseptically prepared with iodine solution.3 Three to 5 mL of 2% mepivacaine hydrochloride, USP, was injected subcutaneously proximally to the incision site (Fig. 1). After two more scrubs after local anesthesia, the surgical site was prepared for surgery.

Surgical Procedure

The growth plate was assumed to the widest point of the distal radius. A large Ioban 2® was placed around the leg, from the most proximal aspect of the radius. Position of Ioban 2® was based on surgeons’ preference. A small (1 to 2 cm) skin incision was made 2 to 3 cm proximal to the growth plate, in between the lateral digital extensor tendon and the ulnaris lateralis muscle. The incision was then extended all the way through the periosteum. A 4.5-mm drill bit was then passed through the skin incision and positioned in the periosteal incision. A hole, 3 to 5 mm in depth, was drilled perpendicular to the long axis of the radius (Fig. 2). A 3.2-mm drill bit was passed through the drill guide, and the drill was then angled distally, at approximately 70° (Fig. 3). The tip of the drill bit was inserted about 10 to 20 mm distal to the physis. To ensure appropriate position of the hole, digital radiographs were taken while the drill was still in place. The size of the hole was measured, and a 4.5-mm, self-tapping cortical bone screw was placed with the use of the drill (Fig. 4). In most cases, a 56- to 60-mm, 4.5-mm cortical bone screw was used. The cortical screw was then lightly tightened by hand. Countersinking was not used in the procedure. Skin incisions were closed routinely.

After surgery, antimicrobial therapy was switched to a low dose of sulfamethoxazole/trimthoprim 15 mg/kg, PO, twice a day, for 5 to 7 days. Perioperative anti-inflammatory/analgesic therapy consisted of phenylbutazone® 2.2 mg/kg, q 24 h, PO, for 4 days.
Bandages, which consisted of sterile gauze and elastic bandage, were changed 5 to 7 days after surgery. The surgical site was wrapped for at least 10 to 14 days after surgery.

Stall rest for 5 to 7 days was recommended, followed by 14 days of limited turnout (4 to 6 hours per day). After 21 days, the amount of exercise can be progressively increased. Frequent evaluation was recommended after transphyseal screw placement. The frequency was determined on a case-by-case basis. The yearlings were evaluated at least every 7 to 14 days after surgery to ensure overcorrection did not occur.

Removal of the screw was performed with a similar preoperative technique. A small incision was made over the head of the screw, and a hexagonal screwdriver was used to remove the screw (Fig. 5). Skin incisions were left open to heal by second-intention healing.

3. Results

The placement of a transphyseal screw across the distal lateral aspect of the radius was easy and efficient to perform in the standing position. All yearlings stood adequately during the use of the combination of detomidine hydrochloride and butorphanol tartrate. Local anesthesia, using just 3 to 5 mL of carbocaine-V®, provided adequate anesthesia for the surgical procedure. No perineural anesthesia was required. All transphyseal screws placed standing were assessed using intraoperative radiographs. No complications were noted in the placement of the transphyseal screws standing.

Removal of the transphyseal screws resulted in no complications in this small group of horses.

4. Discussion

Angular limb deformities are a common orthopedic developmental disorder in Thoroughbreds. The first report of transphyseal bridging was published in 1963 by Heinze. Since then, several techniques have been developed: screws and wires, staples, and single-screw bridging. Most commonly, these procedures are performed under general anesthesia. A mortality rate of 1 horse per 158 cases is reported.
when anesthetic and surgical cases, such as a fractured limb in recovery and severe bleeding, are included.\textsuperscript{13} Besides the risk, it is directly translated into increased cost to the owner. As an alternative, we suggest performing the transphyseal screw implantation with the horse standing, under sedation, and with the use of local anesthetic. This technique minimizes the anesthesia-related risks, decreases the cost to the client, and makes the procedure more versatile. In some cases, the lack of an adequate surgical facility may dictate standing placement of a lateral transphyseal screw.

Patient selection is crucial to successfully place or remove single transphyseal screws. Visual appraisal alone was used as a standard means of assessment, as previously reported.\textsuperscript{6,9} The case selection was based on surgeon’s judgment. In our case load, the majority Thoroughbreds, standing procedures are reserved for yearlings. In our experience, foals and weanlings have had limited handling, and standing procedures can be a challenge. Medial physeal bridging is another limitation of the standing procedure, due to the lack of room and increased chance of complication such as infection or screw/drill bit breakage.

Different sizes of screws can be used for transphyseal bridging.\textsuperscript{14} The most common implant size used at Hagyard Equine Medical Institute, in single-screw transphyseal bridging of the distal radial physis, is the 4.5-mm self-tapping cortical screw.

Case selection is of paramount importance in avoiding complications. Though no complications were reported in this small group of horses, we believe that the potential for complications would be similar to those reported with placement under general anesthesia.\textsuperscript{10,14,15} In summary, standing physeal bridging by the use of a single screw is an alternative to surgically treat ALD.

References and Footnotes


\textsuperscript{a}Penflect\textsuperscript{®}, Butler Schein\textsuperscript{™} Animal Health, Dublin, OH 43017-7545.
\textsuperscript{b}Dormosedan\textsuperscript{®}, Orion Corporation, Espoo, Finland.
\textsuperscript{c}Torbugesic\textsuperscript{®}, Fort Dodge Animal Health, Fort Dodge, IA 50501.
\textsuperscript{d}Vetadine Topical Solution\textsuperscript{®}, Vedco, Inc, St. Joseph, MO 64507-7752.
\textsuperscript{e}Carbocaine-V\textsuperscript{®}, Pfizer, New York, NY 10017.
\textsuperscript{f}Butaject\textsuperscript{®}, Sparhawk Lab, Inc. Lenexa, KS 66215.
\textsuperscript{g}Elastikon\textsuperscript{®}, Johnson & Johnson, Skillman, NJ 08558-1303.