How to Apply a Hindlimb Phalangeal Cast in the Standing Patient and Minimize Complications

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1. Introduction

Phalangeal casts, also referred to as foot casts, slipper casts, and distal-limb casts, are widely used in equine practice. Properly applied foot casts decrease mobility of the hoof capsule and distal and proximal interphalangeal joints. This makes the foot cast an effective tool for the treatment of multiple distal-limb maladies, such as heel-bulb and pastern lacerations,1–4 hoof-wall avulsion injuries,3 distal-phalanx fractures,5 and collateral-ligament injuries. Advantages of foot casts over traditional bandaging include increased immobilization, increased durability, and decreased expense and treatment time when faced with multiple bandage changes.1–3

One of the challenges of foot casting is achieving a proper hoof-pastern axis post-application.2 Failure to do so can result in pressure necrosis that necessitates premature cast removal. Many practitioners prefer to apply foot casts under general anesthesia because of safety concerns and/or ease of application.2 The authors have observed numerous instances in which improper hoof-pastern axis resulted from either hypoextension or hyperextension of the distal limb during cast application in the recumbent patient. Although initial treatment of an extensive injury may necessitate general anesthesia, the authors recommend applying the foot cast in the standing patient.

Proper hoof-pastern axis can be achieved by allowing full weight bearing of the casted limb before curing of the cast material.1 This can be easily and safely achieved in the forelimb with an assistant suspending the limb off the ground during the entire application of the cast material; however, it is the authors’ experience that this procedure cannot be safely or effectively repeated in the hindlimb. Applying a hindlimb foot cast with the limb elevated during the entire application typically results in a poorly fitting cast, which increases the risk of cast complications. The goal of this paper is to describe a safe and effective method of applying a hindlimb foot cast in the standing horse.
2. Materials and Methods

Pre-Casting Considerations

There are many indications for the application of a foot cast. It is beyond the scope of this paper to address the pre-casting considerations for all of the injuries that would benefit from a foot cast. Two of the most common indications for a foot cast are heel-bulb and pastern lacerations, and it is important to remind the reader of the numerous structures in this region of the limb whose involvement can worsen the prognosis.1,6 The distal interphalangeal joint, proximal interphalangeal joint, deep digital flexor tendon and associated tendon sheath, and collateral cartilages are often involved in some of the most superficial lacerations. The involvement (or lack thereof) of these structures should be assessed and treated, if indicated, before cast placement. Wound location, plain and contrast radiography, arthrocentesis, and ultrasonography can be used to assess the involvement of these structures.6–8 If synovial involvement is suspected, arthrocentesis should be performed at a remote site and the synovial structure distended with a sterile polyionic solution while the laceration is monitored closely for fluid egress.1,6,8

If any of the above structures are involved, cast application should be delayed, and additional treatment should commence. Treatment generally consists of systemic antibiotics, non-steroidal anti-inflammatory drugs, and frequent joint/tendon sheath lavage.7,8 Antibiotic therapy should be based on culture and sensitivity whenever possible. Arthroscopic debridement of involved joints or tendon sheaths may be indicated in advanced cases. The authors strongly recommend the use of regional limb antibiotic perfusions in those cases involving synovial sepsis.9 Wounds may be closed by primary closure, delayed primary closure, or left to heal by second intention depending on the nature of the wound (Fig. 1).7,8

Patient Preparation

If the horse is shod, the shoe on the affected limb should be removed before cast application. The foot should be trimmed to achieve balance, and excessive frog and sole should be removed. Debris should be removed from the collateral and central sulci, and the entire distal limb should be as clean and dry as possible. Any wounds present should be dressed and bandaged. It is important that any bandage present under the cast be as thin as possible. Thicker bandages will compress over time and result in decreased immobilization. This could lead to increased cast movement and subsequent pressure necrosis. The authors prefer dressing any wounds with a non-adherent dressing, a soft-cling gauze, b and a minimal amount of elastic bandage material c (Fig. 2).

The ideal foot cast should terminate at the proximal aspect of the first phalanx. A length of 7.6 cm (3 in) stockinette d approximately twice as long as the distance from the toe to the fetlock should be measured and cut. The stockinette should be rolled from each end toward the middle. Rolling one-half outward and one-half inward will facilitate placement (Fig. 3). The outward one-half should be rolled onto the clean, dry limb starting from the foot. Next, twist the stockinette at the foot and roll the inward one-half onto and up the limb. Both layers of stockinette should be free of wrinkles or other irregularities. A length of 7 mm (0.25 in) orthopedic casting felt e identical to the circumference of the patient’s pastern should be cut. The felt should be ~5 cm wide and tightly secured with no overlap around the proximal pastern using a piece of white tape.

Application

At this point, the authors will routinely sedate the patient using a combination of detomidine HCl f (0.007–0.01 mg/kg, IV) and butorphanol tartrate g (0.007–0.02 mg/kg, IV). Doses vary depending on
the temperament of the horse. Some horses require no sedation or only minimal restraint (i.e., nose twitch) to effectively apply the cast. The patient should then be positioned with the toe of the affected limb resting on a board. The affected hindlimb should be in a neutral position with as much of the foot as possible hanging off the back of the board (Fig. 4). It is important that the solar surface of the foot remains parallel with the ground and that the toe does not become elevated off of the board during the positioning. The authors routinely use a standard 2 × 4 inch piece of lumber, but boards of other dimensions will suffice provided that they allow for proper positioning and cast application. The authors have found that placing the contralateral hindlimb on a board of similar thickness will facilitate proper weight bearing and positioning of the affected limb. Proper placement of the affected limb on the board is crucial, because it allows the majority of the cast to be applied with the limb in full weight bearing.

Gloves should be worn when handling the cast material. Latex exam gloves are adequate, but nitrile gloves result in less adherence between the gloves and cast material. Cast material should not be opened until ready to apply. Most cast materials are activated by submersion in warm water for 10–15 s. Excess water should be shaken off before application. Increased water temperature typically results in more rapid cast setting. The water temperature, immersion time, and other specific handling characteristics are unique to each product, so manufacturer guidelines should be followed.

Three rolls of 7.6 cm (3 in) fiberglass casting tape is sufficient casting material for most adult horses. The first two rolls are applied with the patient standing on the board and should encompass all of the foot except for the toe. It should extend proximally to encompass the proximal pastern (Fig. 5). The proximal aspect of the cast should overlap only one-half the width of the orthopedic casting felt. The first roll of casting tape should be applied firmly without any wrinkles or folds. Tension can gradually be increased with subsequent rolls. Each spiral wrap should overlap the previous one by ~50%, resulting in even pressure throughout the cast.

The third roll of casting tape should incorporate the toe and should be applied with an assistant extending the limb cranially off of the board (Fig. 6). A figure-eight pattern may be used to adequately cover the toe and ground surface of the foot. After the toe has been sufficiently covered with casting tape, the foot should be placed back on the board, and the remainder of the third roll of casting tape should be applied proximally. The stockinette should be folded distally and incorporated in the last few layers of casting tape.
The cast should cure with the patient fully weight bearing and the casted limb in a neutral position (Fig. 7). After the cast is cured, hoof acrylic is applied to the toe and ground surface of the cast to increase durability. The hoof acrylic should be mixed in disposable paper cups. It can be spread on the cast using a tongue depressor or fashioned into a ball and flattened using a sheet of plastic (plastic wrap or palpation sleeves work well). Wetting hands will facilitate the application of the acrylic (Fig. 8). The final step in the cast application is to loosely apply elastic bandage material to the top of the cast (Fig. 9). This acts as a seal and prevents the introduction of bedding, dirt, and debris between the cast and the limb.

3. Results and Discussion

The authors have used the above technique to successfully apply dozens of hindlimb foot casts in the standing patient. Although the original injury will dictate the length of time needed in the cast, most patients will wear the cast for 3–5 wk before removal. A new cast can be applied if further treatment is necessary.

Whenever possible, the casted patient should be confined to a clean, dry stall. Confinement minimizes movement, which will help decrease the risk of cast sores and reduce cast wear. Removal of the cast should be considered if there is an increase in rectal temperature or heart rate, lameness or reluctance to bear weight on the casted limb, discharge above or through the cast, palpable heat through the cast, swelling above the cast, cracks in the cast material, or visible sores. A foul odor alone with absence of other danger signs is not enough to warrant foot-cast removal.

The cast is typically removed with the aid of a cast saw and cast spreaders. In the absence of a cast saw, a farrier’s rasp or other file may be used to cut through the cast material. When using a saw, care should be taken to avoid lacerating the skin or scoring the hoof wall. If a cast saw is known to be unavailable at the time of casting, obstetrical (Gigli)
wire can be incorporated on both the medial and lateral aspects of the limb between the stockinette and the casting material.\cite{2,3}

Foot casts can be used to treat a wide variety of distal limb injuries, and they offer many advantages to routine bandaging. The foot cast provides increased immobilization of the interphalangeal joints and hoof capsule, relieves tension surrounding any sutures that may be present, decreases development of exuberant granulation tissue, provides a moist environment for re-epithelialization, and eliminates the time and expense involved with frequent bandage changes.\cite{1,2,7,8,10} Compared with traditional bandaging, foot casts can significantly decrease the convalescent period of horses with heel-bulb lacerations.\cite{1} Foot-casting complications can be minimized by achieving a natural hoof-pastern axis in a properly applied, well-conforming cast. This ideal cast can be safely applied to the weight-bearing hindlimb using the technique described in this paper. It is the authors’ opinion that placing a foot cast in this manner results in less casting complications than applying a foot cast in the recumbent patient.

References and Footnotes


aTelfa, Kendall-Tyco Healthcare Group, Mansfield, MA 02048.
bConform, Kendall-Tyco Healthcare Group, Mansfield, MA 02048.
cElastikon, Johnson and Johnson, New Brunswick, NJ 08933.
dStockinette, 3M Health Care, St. Paul, MN 55144.
eOrthopaedic Felt 0.25, Victor Medical Company, Irvine, CA 92630.
fDormosedan, Orion Corp., Espoo, Finland.
gTorbugesic, Fort Dodge Animal Health, Fort Dodge, IA 50501.
iVetcast Plus, 3M Animal Care, Minneapolis, MN 55415.
jTechnovit, Jorgensen Laboratories Inc., Loveland, CO 80538.