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How to Apply and Reapply a Standing Bandage Cast for the Treatment of Severe Distal Limb Injury

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This paper presents a practical technique for cast application in standing horses for the management of severe lacerations involving or over joints. The described technique provides rigid support to the limb while allowing continued wound and joint access through reapplication of a bivalved cast shell over a new bandage. This system allows lacerations over and communicating with joints to be managed in the field with continued joint lavage, wound debridement, and delayed primary closure, while maintaining rigid support, which is critical in high-motion areas and traumatic joint luxations. Author’s address: Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, NY 14853; e-mail: ashleedvm@gmail.com. © 2011 AAEP.

1. Introduction

In addition to use in arthrodesis and fracture repair, casts are often required when treating wounds, joint luxations,1–3 and tendon lacerations.4 Standard casts, with only thin layers of cast padding under casting tape, are difficult to apply well in the standing patient, and even with careful and accurate application, they can lead to rapid development of severe cast rub sores. Consequently, standard casts are applied to anesthetized horses, and many clinicians prefer horses with casted limbs to remain hospitalized. This hospitalization is not financially possible for many cases.

Because of the bandage thickness, a bandage cast generally has a slower onset of cast rub sores and can be safely maintained outside of the hospital by an astute owner or caretaker. Additionally, because of bandage thickness, it is easier to detect when the bandage material has compressed or shifted within the cast, necessitating cast removal. When the cast is bivalved, it can be removed, the underlying bandage can be changed, and the same cast shell can be reapplied. This technique allows for continued semi-rigid support with continued access to the limb under the cast, which is not possible in a standard cast, where the need for continued support would require that another cast be made.

Equine clinicians commonly apply foot casts to the standing patient to treat heel bulb lacerations. Nearly as easily, half (up to the level of the carpo-metacarpal/tarsometatarsal joint) or full limb (up to the proximal radius/tibial plateau) bandage casts can be applied without general anesthesia. The biggest advantages of the bandage cast are as follows:

- increased room for error during application compared with a standard cast, allowing the clinician to easily and effectively apply it to the standing patient
- increased patient comfort because of normal weight-bearing conformation and increased cast padding with reasonable stability

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- improved long-term maintenance of a clean bandage and wound environment, reducing the frequency of required bandage changes
- continued access to the limb through bivalved cast removal for examination or treatment (joint lavage, wound debridement, delayed closure, etc.) while maintaining semi-rigid support between examinations with reapplication of the bivalved cast shell
- reduced risk and slower onset of cast rub sores caused by cast padding thickness and the ability to frequently change the underlying bandage
- increased padding thickness, which accommodates changes in limb swelling that are often inevitable with traumatic injury while maintaining some (reduced) rigidity

### 2. Materials

Bandage materials are as follows:

- non-adherent dressing
- stretchable gauze dressing
- sheet cotton (two sheets per layer for two layers)
- 6-in non-stretch gauze (three rolls)
- cohesive stretchable dressing

Other materials include the following:

- Gigli wire in flexible plastic tubing
- water-curable fiberglass cast tape rolls (3- to 5-in width)
- acrylic (polymethyl methacrylate)
- elastic tape
- porous non-elastic tape

### 3. Methods

**Wound Assessment and Care**

Before bandage cast application, the wounds must be addressed. This assessment includes wound duration, wound contamination, structures involved, and possibility of successful primary closure. Wound care may include systemic, regional limb perfusion and/or intrasynovial antibiotic administration, wound debridement, primary or delayed closure, and/or second-intention healing. When synovial structures, flexor tendons, collateral ligaments, or bone are involved, referral to a surgical facility is often indicated; however, these wounds can be managed in the field when referral is not elected.

Support provided by a bandage cast may be used for soft-tissue laceration in high-motion areas, collateral ligament, or tendon injury. After the need for semi-rigid support is established, the care required and expected duration of casting should be discussed with the owner. For example, in a heavily contaminated wound with significant soft-tissue swelling, the owner should expect that the bandage cast will need to be bivalved and changed regularly with careful monitoring and wound care, which will be time consuming. Similarly, when using a bandage cast for support to an open joint, the owner should be prepared for additional joint lavages and wound care that may require several veterinary visits, especially when the wound is left open to heal by second intention. With severe swelling, a second cast shell may also be required as the swelling resolves. In contrast, after successful primary closure of a minimally swollen laceration over the dorsum of the fetlock, the owner can expect that bandage cast removal may occur in 3 wk, with minimal daily care. In any case, the owner should be prepared for careful cast monitoring and instructed to schedule immediate follow-up exams if and when abnormalities develop.

**Bandage Cast Indications**

Bandage cast indications include the following:

- open joint laceration
- joint luxation (open or closed) (Fig. 1)
- laceration in a high-motion area (i.e., dorsum of the metacarpophalangeal joint)
- tendon injury

**Bivalved Bandage Cast Indications**

Bivalved bandage cast indications are the scenarios listed above where the wounds are expected to be especially exudative or continued care is required (i.e., repeat joint lavage, wound debridement, or delayed primary closure).

**Standing Cast Application**

**Casting**

The horseshoe is often removed, and the foot should be trimmed and cleaned. Because the cast is for short-term support and will be changed more frequently than a traditional cast, a fully extended, weight-bearing posture can be used. Maintenance of the hoof–pastern axis in the casted limb obviates the need for additional pads to increase limb length on the contralateral foot. Therefore, the contralateral limb can be left barefoot, be left in the pre-existing shoe, or have added support materials to recruit the palmar sole and frog for weight-bearing support if severe unilateral lameness is expected.

The horse should be adequately sedated so that it will remain quiet throughout cast application and cast curing, because movement can result in stretched, wrinkled, and misfitted casts and increased risk of cast complications. It is important to keep in mind that some horses can be startled by the sudden inability to flex the hindlimb when casting hindlimbs and may react adversely with rapid and extreme abduction and attempted hyperflexion of the casted limb.

In standard cast application, a double layer of stockinette is rolled onto the limb to create a uniform, non-shifting, comfortable padding that will allow cast material adherence, while protecting the hair and skin from adhering to the casting tape. In a bandage cast, it is not required. Similarly, an encircling ring of 1- to 2-in-wide strips of orthopedic...
felt is not required at the proximal aspect of a bandage cast. As in a standard cast, wounds should be covered with a thin, non-adherent dressing, avoiding wrinkles and folds of material.

When the cast shell is to be bivalved for reapplication, the initial bandage must be easily reproducible for the cast shell to be accurately reapplied without gaps or overriding between the two halves (Fig. 2). Although pound (roll) cotton may be used, sheet cottons are easier to reproducibly apply and are less likely to continue to compress and/or shift after cast application. A typical bandage cast will have a two-sheet combination of folded sheet cotton secured with non-stretchable, 6-in gauze (brown gauze) followed by a second two-sheet combination. The second set of sheet cottons are firmly secured with both brown gauze and flexible cohesive wrap, including the bulbs of the heel and caudal sole. The tight gauze should not extend beyond the cotton padding proximally. The completed bandage should be approxi-
mately 1-in thick, nearly non-compressible, and uniform in thickness down its length. If wires are elected to bivalve the cast for cast removal, they should be included at this stage along the medial and lateral aspect of the limb. Wires should be 40 cm longer than the expected length of the cast, allowing 20 cm of free wire at both the proximal and distal ends. Spraying the wires with...
lubricant, and placing them in flexible tubing (e.g., IV drip set tubing) before application of the cast will facilitate their use during cast removal. The tubing should extend just beyond the ends of the cast, leaving approximately 20 cm free wire to be coiled and secured to the cured cast with porous tape. Fiberglass casting tape application follows as for a standard cast with a few exceptions.

A foot block (Fig. 2) is used to allow complete enclosure of the foot within a well-laminated, solid half- or full-limb cast. Proper lamination of the cast material enclosing the foot to the remainder of the cast is critically important to allow for continued use of a bi-valved bandage cast. A foot block consists of a 1-in wide by 2-in tall by 6-in long wooden block attached to a large flat piece of plywood for stabilization. The contralateral foot is placed on a block of similar cumulative height. The limb to be cast is then placed flat on the foot block, leaving as much toe as possible extending forward of the sole contacting the block while maintaining the normal hoof–pastern axis. The foot block suspends the toe and heel, allowing maintenance of a weight-bearing position during cast application, including nearly circumferential inclusion of the hoof margins with fiberglass tape. Extra layers of casting tape are used to wrap across and under the toe region. These extra layers are especially important in the hindlimbs, where extra force will be applied when the horse flexes the hock and stifle. After the cast has cured, the limb can be extended forward for a hindlimb or picked up for a forelimb, off the foot block, for complete enclosure of the foot and acrylic application. Dependent on the degree of cast curing, the complete foot enclosure may not laminate properly to the cast. The application of elastic tape over the newly applied layers and the cured layers will minimize this problem, which will become apparent after the cast has been bivalved.

Before starting fiberglass cast tape application, the clinician should double check limb positioning and adequate sedation of the patient. The casting material is then removed from its foil package, immersed in tepid water (20–25°C, specific temperature for each manufacturer available in the package insert), and applied evenly over the limb. Only one roll should be opened at a time, because ambient humidity can initiate tape curing. Application can begin either over the foot or at the proximal end. At least 1–2 cm underlying bandage should be left uncovered by casting tape proximally to prevent skin abrasions from hardened cast material during limb flexion. Because of the underlying bandage thickness, each casting tape layer should be applied with firm, even tension. With each new roll, application should begin at the same level that the previous roll was ended. All rolls, except at the foot, should be applied in the same direction around the limb. Each layer should be applied quickly and carefully and overlapped by 50% to ensure even pressure and maximal bonding between cast tape layers. The foot, excluding the bars of the hoof in contact with the foot block, should be included and covered with each successive layer up and down the limb. Five to six layers (one layer is a single pass up or down the limb with 50% overlap) are sufficient to provide rigid support. In very large horses or areas expected to undergo increased bending, such as the dorsal hock in a hindlimb full-limb cast, the cast can be fortified with additional layers. Smoothing and rubbing of the applied cast material between layers and after completion while curing will help maximize bonding lamination between layers.

Hoof acrylic (polymethyl methacrylate) should be placed on the solar surface of the cast to protect against excessive wear, especially at the toe. The mixed methacrylate should set to a putty-like consistency before being spread onto the sole with a tongue depressor. Many horses are more comfortable and develop fewer and less-frequent cast sores if the solar surface is slightly rounded, allowing foot breakover to occur more easily. Rounding of the solar surface can be performed with the acrylic. Elastic tape should be placed over the acrylic after it has hardened to increase traction.

After the cast has cured, elastic tape should be placed at the proximal aspect of the limb, spanning from the skin of the exposed limb to the cast itself, to seal the cast from environmental contamination. This tape should be changed daily for routine cast monitoring. Applying a semi-permanent ring of elastic tape 1 cm proximal to the cast serves as a point of attachment for the elastic tape that is changed daily, thereby minimizing skin irritation.

At the completion of cast application, an additional 20 min curing time should be allowed before asking the standing horse to move.

Cast Care and Monitoring
Stall confinement is absolutely required during casting. Systemic health and signs of cast complications should be assessed at least two times daily, keeping in mind that cast rub sores are the most common complication. This assessment includes thorough examination, cast examination, cast palpation, and observation of the horse at a walk in a straight line for at least 5–7 steps. The horse should always be turned away from the casted limb to prevent pivoting on the injured limb. The tape at the top of the cast should be changed daily, allowing a more thorough examination of the proximal region of the limb and cast.

Signs of possible cast complications include the following:

- increased rectal temperature
- increased heart rate
- swelling of the limb proximal to the cast
- visible sores or exudate at the proximal aspect of the cast
- increased lameness
- increased focal heat detected manually or using a thermographic camera
- moisture through the cast (Fig. 3)
Fig. 3. Photographs of the left hindlimb of a 2-yr-old Paint gelding. The horse was presented for an acute laceration of the left hind pastern and lateral heel bulb transecting the deep digital flexor tendon midpastern and communicating with the coffin joint and digital tendon sheath. The wound was treated with needle lavage of the synovial structures (coffin joint and digital tendon sheath), wound debridement with primary closure, and bandage cast application under general anesthesia. The horse remained hospitalized with daily regional limb perfusion and systemic antibiotics. (A and B) One week later, there was increased lameness and discharge striking through the cast. The horse was anesthetized (because of temperament), and the cast was removed. (C and D) There were partial-thickness rub sores at the plantar sesamoids. The bivalved bandage cast was replaced for recovery, after which a fishtail trailer shoe was applied and the dorsal one-half of the splint was used combined with a heavy bandage. (D and E) The sutures were removed, and the horse was discharged 2 wk after presentation for continued use of the splint, bandage, and shoe for support. One month after discharge, the dorsal cast half-cracked, and a new splint was made. Three months after discharge, a flat, extended heel shoe was applied. The horse resumed his previous level of activity with a mild and acceptable lameness (light, occasional pleasure riding).
odors from the cast
- cracks or bends in the cast
- wearing through the sole of the cast

If any of these signs are detected, the cast should be removed immediately, because seemingly mild signs of cast complications can progress to life-threatening complications very quickly. Even with the best monitoring, cast sores also may cause no to minimal appreciable clinical signs but are discovered during a routine cast and bandage change.

The horse’s systemic status should be carefully monitored, including appetite, manure production, weight, and skin health. The other limbs, especially the contralateral limb, should be carefully monitored for signs of support limb laminitis, including increased digital pulses, increased heat within the hoof capsule, decreased willingness to turn in the stall, increased time spent in recumbency, and increased weight-bearing in the cast limb.

The casted patient requires special stall care. To encourage the horse to lie down, deep, comfortable, clean bedding, banked extra deep along the back wall of the stall, and a quiet barn with reduced light at night should be used. Many horses will be more comfortable with their feed and water elevated, especially when wearing forelimb casts.

**Cast Removal With Reapplication**

A bandage cast can be left in place for up to 3 wk provided that bandage compression and cast loosening are not detected and the wound is not expected to be especially exudative. In cases where there is significant soft-tissue swelling at the time of bandage cast application, the cast should be changed much sooner. Dependent on the initial swelling, a new cast shell may be required as swelling resolves. If additional debridement, joint lavage, or wound assessment is required, the cast should be bivalved, and the bandage should be changed earlier.

For cast removal and reapplication of the cast shell (Fig. 4), the cast should be bivalved in the frontal plane to form dorsal and palmar/plantar shells. Although the two halves can be completely separated by a cut across the solar surface of the foot connecting the medial and lateral cuts, reapplication is easier, more accurate, and more secure when the foot region is left as a hinge. Reapplication in this manner is facilitated by placing the cast initially on a bare and well-trimmed foot. The bandage can then be changed, mimicking the initial bandage applied before casting, and the cast shell is reapplied and secured with two to three layers of porous, non-elastic tape. It cannot be stressed enough that the reproducibility of the initial bandage is the most important factor in successful reapplication of the cast shell, without gaps or overriding edges. With perfect reappositi-
Fig. 4. Photographic sequence of reapplication of a bandage cast after a new bandage has been applied. (A) A double-layer sheet cotton is secured tightly and evenly with brown gauze. (B) The bivalved cast shell is placed over the bandage, and the cut edges of the cast shell are opposed. (D) Two-inch-wide, non-elastic porous tape is used to secure the cast in place while achieving greater apposition of the cut cast edges. A large gap will result when the underlying bandage is too thick, and overriding of the cast edges will result when the underlying bandage is too thin. Neither condition is acceptable for maximal stability of the reapplied bandage cast.
References and Footnotes


*Vetrap, 3M Corporate Headquarters, St. Paul, MN 55144-1000.

*WD-40; WD-40 Customer Relations, San Diego, CA 92138-0607.