Degloving Injuries in Horses: Initial Treatment

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Horses are prone to injury due to contact with various objects and structures (e.g., fences, stalls, wires). Many of these injuries are degloving injuries, which often damage a large area of skin and the underlying tissue and muscle, usually without extensive damage to joints, bones, or organs.

Possible treatments, including medications, are being explored for beneficial effects. Therapies involving growth factors, platelet-rich plasma, and shock waves have recently been examined, so clinicians should continually review the current literature regarding new treatment options.1,2

Distal Limb Injuries

Degloving injuries usually occur on the distal limbs, exposing bone or tendon. The skin is removed in a proximal to distal direction, leaving a distally based skin flap. Because the blood supply to the limbs flows in a proximal to distal direction, distally based skin flaps lose blood at the proximal aspect. Wounds with a substantial circumference may interfere with the superficial blood supply to the skin. Primary debridement and repair are strongly recommended to reduce the area that will require healing by second intention. Keys to successful repair include providing adequate drainage and relieving tension in the skin.

When assessing a distal limb injury, it is important to recognize the involved structures and predict the course of healing. The choice of treatment can depend on determining whether the blood supply has been interrupted, whether movement will interfere with healing, and what resources will be available to assist with healing. It is important to realize that although degloving injuries can appear extensive, they usually heal well with sufficient treatment and time.

Degloving injuries are more common on hindlimbs than forelimbs. These hindlimb injuries usually are dorsal and involve the extensor tendons. These injuries do not require apposition to underlying structures for the patient to regain full function.3,4 However, the fetlock may need initial support in extension until the patient adjusts its gait or the tendon heals to underlying tissue. If the patient knuckles dorsally at the fetlock, the repair can abruptly separate at the edges of the skin. Support can be provided with a cast or splint (incorporated into a bandage) on the plantar aspect of the limb from the point of the hock to the foot. After fibrosis of the wound, a few horses with complete disruption of extensor tendons develop a stringhalt-like gait.

Systemic medications should be given before addressing the wound. Tetanus prophylaxis should be administered. If deep tissues such as tendon or bone are exposed, antimicrobials (intravenous, intramuscular, or regional) can be administered. Bacterial or fungal cultures are not normally indicated. The need for antimicrobials depends on the wound and the deeper structures that are involved. If no synovial structures are involved and adequate drainage can be provided, administration of systemic antimicrobials may not be necessary, but treatment depends on the clinician’s assessment of the wound. If administration of antimicrobials is warranted, broad-spectrum agents should be used and can be given systemically or regionally through regional limb perfusions. Pain and antiinflammatory medications are always indicated for initial wound management. Phenylbutazone (2 to 4 mg/kg) is often given intravenously or orally.

Once the wound has been assessed, it should be anesthetized locally, cleaned, and debrided. Local anesthesia can be provided through regional nerve blocks proximal to the laceration or a ring block immediately proximal to the laceration. A ring block can be applied subcutaneously and is quick and practical. If regional nerve blocks are performed, the location of the laceration dictates which nerves should be blocked. Intravenous chemical restraint, such as either romifidine with butorphanol or detomidine with butorphanol, should be used. During work on the hindlimbs, butorphanol should be included to provide some analgesia and increased safety if xylazine is used for sedation because xylazine alone may be associated with hyperreactivity in the hindlimbs. Romifidine is preferred by some clinicians because it may cause less ataxia than xylazine and detomidine at similar sedation levels for hindlimb procedures. Many wounds can be treated using standing sedation and nerve blocks, which can prevent disruption of the repair during recovery from general anesthesia. With standing sedation, safe wound debridement and repair depends on the patient’s attitude and the number of staff members who can help provide restraint. If safety of the veterinarian and patient cannot be ensured, general anesthesia can be administered intravenously at the farm or an equine hospital.
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The injury should always be examined in detail to ensure that synovial cavities or flexor tendons are not involved; involvement of these structures requires referral to an equine hospital for treatment beyond superficial wound care. After water-soluble jelly or moist gauze is placed in the wound to prevent further contamination, the hair around the wound edge can be clipped (FIGURE 1). The wound should be lavaged with sterile isotonic fluid such as saline or lactated Ringer solution. Substances that can be toxic to tissues (e.g., nitrofurazone, undiluted povidone-iodine) are not recommended. The addition of antibiotics or antiseptics to fluid therapy is not strongly recommended because the efficacy of these additions is doubtful.\(^5,6\) Any additives should be extremely dilute because concentrated solutions have been shown to be toxic to cells.\(^5,7\) Excessive pressure may drive contaminants into deeper tissue. Lavage using a 60-mL syringe and an 18-gauge needle achieves ideal pressure but is time-consuming; constant lavage through an 18-gauge needle attached to a fluid set and a 1-L bag of fluids is appropriate, and the bag can be easily held by an untrained assistant. Use of a dental water jet has also been described for providing pulsatile lavage.\(^8\)

Highly contaminated tissue can be sharply excised. Large blood vessels can be ligated. The ends of extensor tendons can be debrided by simple excision of a small portion of the free end. If periosteum is missing or bone is scored, the area can be gently debrided with a curette or bone rasp. The edges of the skin can be freshened by sharp removal of a thin edge. Obviously dead skin should be removed; otherwise, as much skin as possible should be left intact and removed later, if necessary.

Even when skin is expected to die, it can be sutured to provide a biologic bandage until it has died. Suturing decreases the tendency of the flap to contract. By the time that nonviable skin is ready to slough or be removed, granulation tissue may be present under the skin. If tendon or bone is exposed, protecting it with skin until granulation tissue forms can help keep it clean and moist. However, the client should be informed that the repair will appear to fail. The edges of the skin should be apposed in a tension-relieving pattern using large-gauge, monofilament, non-absorbable suture (0, 1, or 2, depending on the patient’s size and the thickness of the skin). Various techniques can be used to relieve tension in the skin. Adequately relieving tension during wound closure greatly increases the chance of successful closure. Alternating tension-relieving patterns with a simple interrupted pattern or short runs of a simple continuous pattern reduces the amount of suture in the wound while relieving tension in the skin. A tension-relieving pattern can be chosen based on personal preference. Stents can be incorporated to help distribute pressure and prevent the suture from cutting through the skin. Stents can be cut to size from rubber tubing, Penrose drains, or extension sets. One tension-relieving technique is to mesh the skin using full-thickness stab incisions in staggered rows parallel to the edges of the skin (FIGURE 2).

This allows expansion of the skin, relief of tension, and good drainage of these often-contaminated wounds. In addition, meshing of the skin can prevent formation of a large subcutaneous hematoma or seroma that could mechanically separate the skin from underlying tissue. Theoretically, it would be preferred to mesh the skin on either side of the wound to avoid causing further vascular compromise to the skin flap in the wound. However, this is often not possible, and meshing of the skin flap represents a viable and practical alternative, accomplishing many goals simultaneously. If a large subcutaneous dead space is present, a Penrose or closed suction drain should be placed unless the skin is meshed.

Portions of devitalized extensor tendons may become chronically infected and behave similar to bony sequestra, preventing complete healing, causing persistent drainage, and resulting in unhealthy granulation tissue. Therefore, exposed edges of extensor tendon should be debrided during initial treatment. Exposure of bone—especially disruption of periosteum or scoring of bone—by a degloving injury should also be considered a risk for development of a sequestrum. Disruption of the blood supply as well as infection must be present for a sequestrum to develop. Clinical signs of a sequestrum can appear 4 to 8 weeks after injury; the client should be informed of this at the initial examination. To help prevent sequestrum development, damaged bone or tendon ends should be debrided at initial treatment.

Bandaging or casting is important during initial treatment, but bandaging may be overused thereafter. Casts or cast bandages can enhance initial healing by (1) decreasing motion in areas where there is tension on the wound edges or (2) being used instead...
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**Proximal Limb Injuries**

Degloving injuries regularly occur on the front of the shoulders and chest. These high-motion areas are prone to dead-space accumulations and loss of serum or blood. Therefore, owners should be informed that although repairs of high-motion areas are prone to repeated failure, healing is commonly successful. In the initial healing period, exercise restriction is important regardless of the method of repair. Reducing tension in the skin and providing adequate drainage are crucial to successful wound repair. Achieving these goals with any degloving injury can reduce the healing time and enhance the quality of the repair compared with healing by second intention, which may require more time for full return to function. The use of vacuum-assisted healing for large areas of degloving is a potential advancement in managing these wounds, but achieving a seal with this method can be difficult in high-motion areas of the body. In these areas, tension-relieving suture patterns with or without stents are recommended and placing drains or creating mesh incisions is crucial to avoid formation of seromas. Walking or tacking suture patterns can be used to reduce dead space and relieve tension, but excessive amounts of suture should be avoided if a wound is severely contaminated. Adequate drainage is important not only for successful repair but also for preventing infection inside the wound and down the fascial planes into the mediastinum. Systemic antimicrobials are indicated if contamination is severe.

**Conclusion**

Degloving injuries in horses remove large flaps of skin and underlying tissue, usually on the distal limbs, ventral abdomen, or chest wall; if necessary, a rapid-acting intravenous anesthetic can be used to facilitate closure. It is difficult to return the skin to its original position without excessive tension even if no skin has been lost. Ventral wounds are prone to formation of seromas or hematomas after repair, possibly compromising the viability of the repair by separating the skin from underlying tissue and increasing tension in the skin. Use of an abdominal bandage can help prevent this but may hold purulent discharge against the skin. If used, abdominal bandages must be changed daily to prevent maceration of the skin due to excessive moisture. All of these factors can make repair difficult. Therefore, providing ventral drainage and relieving tension on the skin are very important.

Several techniques can help manage abdominal degloving injuries. Once the skin and tissue have been cleaned and debrided, the skin flap can be extensively meshed using a #10 scalpel blade. This can greatly expand the skin flap and provide adequate drainage along the entire wound. An alternative method is to use a walking suture pattern to attach the skin flap to the underlying tissue along the length of the skin flap, gradually moving the edge of the skin flap toward the intact edge of skin. Drains should be placed at various intervals to allow drainage from a contaminated wound, and tacking sutures can help resolve dead space. Other methods can be used if they reduce tension on the skin and encourage drainage. The patient's movement should be restricted to help prevent dehiscence during healing.

**Other Degloving Injuries**

While many degloving injuries occur on the distal limbs, other areas of the body can be affected. The difference in healing between wounds on the distal limbs, proximal limbs, and body is well established. Because of basic physiologic differences in wound healing, wounds on the body and proximal limbs of horses are better able to contract and heal without excessive granulation tissue. The front of the chest and the shoulders of horses are prone to degloving injuries. Large degloving injuries of the ventral or lateral abdomen can occur when horses fall or try to jump an obstacle.

When assessing proximally located wounds, it is important to determine whether underlying structures (e.g., joints, peritoneal cavity, brachial plexus, mediastinum) have been affected and to administer broad-spectrum systemic antimicrobials (in most cases) to prevent infection of important underlying structures. Although degloving injuries are treated in a similar fashion regardless of their location, there are some important differences when proximally located wounds are treated. Large wounds on the abdomen and chest wall can involve muscle, resulting in substantial loss of serum; therefore, affected patients should be monitored for protein loss. In addition, chest and abdominal wounds may cause substantial pain and discomfort, requiring aggressive pain management.

**Abdominal Injuries**

The anatomy of the blood supply to proximally located skin flaps may be more complex and, therefore, less well understood. Degloving injuries of the abdomen usually occur in a cranial to caudal direction, possibly interfering with the blood supply, which flows in a cranial to caudal direction. If a degloved subcutaneous layer maintains its blood supply, the chance of maintaining the health of the skin flap greatly improves. As with distal limb injuries, suturing a skin flap that is likely to die can have value. Large skin flaps from the ventral abdomen must be assessed for viability and contamination. Adequate tissue debridement and suturing can be difficult with the patient standing if the skin flap is directly ventral; if necessary, a rapid-acting intravenous anesthetic can be administered to help prevent dehiscence during healing.

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shoulders. Healing can occur without primary repair, but healing time can be reduced and cosmesis can be enhanced through primary repair of the skin flap. These benefits can be obtained even if the entire skin flap does not survive. Reducing tension in the skin and ensuring adequate drainage are the keys to successful repair of degloving injuries.

References