

accumulation of fluid within the wound and subsequent separation of the tissue layers. A thick bandage or a cast is usually required to protect the repair when a wound closed by delayed secondary intention is located on the limb.

This approach to wound closure is relegated to wounds that are first seen by the veterinarian more than 1 week after injury or that are heavily contaminated or infected when first examined. The former situation arises quite frequently because many horse owners attempt to manage their horse's wound prior to consulting a veterinarian.^{36–38} In the latter situation, the initial management consists of cleansing and debriding the wound and then dressing and bandaging it appropriately until healthy granulation tissue fills the wound. Various types of dressings or negative pressure therapy may be used to encourage fibroplasia (the reader is referred to Chapter 6 for more information regarding wound dressings and to Chapter 22 for more information regarding negative-pressure therapy).³⁹

Delaying closure until after the appearance of healthy granulation tissue works well for contaminated or infected heel bulb lacerations; as is the case with primary closure of wounds in this area, the repair should be protected by a foot cast. The reader is referred to Chapter 7 for more information regarding techniques of bandaging and casting. Delayed secondary closure may be more challenging if the wound is located over a cannon bone, because mobilizing the surrounding skin sufficiently to suture the wound is difficult, even after the granulation tissue has been resected. Thus, primary closure, delayed primary closure, and second-intention healing are the only practical approaches to managing wounds in the metacarpal/metatarsal area. Free skin grafting of acute wounds or those that have developed a healthy bed of granulation tissue is also a useful technique to manage wounds in the metacarpal/metatarsal area and should be considered to avoid the long healing times associated with second-intention healing of degloving wounds in this area (see Chapter 18 for more information regarding skin grafting).

Second-intention healing

Healing of wounds is nearly always faster and more cosmetic when the wound is primarily closed. Moreover, experimentally created cutaneous wounds of horses healed by second intention have been shown to withstand a maximum breaking load equivalent to only 60% of the breaking force of normal, intact skin.⁴⁰ Additionally, skin appendages are usually absent in epithelial scars, resulting in the absence of pigmentation and hair as well as deficient functions, such as the production of sweat or sebum.

Unfortunately, many accidental wounds in horses are not amenable to primary closure because of massive loss of tissue or contamination. Moreover, wounds that are sutured often partially or completely dehiscence. Indeed, a retrospective study of more than 500 horses with accidental skin wounds showed that primary closure was successful in only 26% of the horses and

41% of the ponies in which it was attempted.⁹ Additionally, some owners are unwilling or unable to cover the immediate costs associated with primary closure of their horse's wound. Consequently, many wounds managed by equine practitioners must heal by second intention.

Second-intention healing relies on the body's ability to decrease the wound's surface area by contraction and to cover the remaining area with newly formed epithelium. Second-intention healing is selected to manage wounds characterized by extensive trauma to and/or loss of tissue and those that are heavily contaminated. Wounds caused by pressure or entrapment (e.g., a limb that has been trapped by a rope) are frequently treated by second-intention healing or by delayed secondary closure because the health of the traumatized tissue often continues to deteriorate after the injury was incurred, thereby threatening the integrity of any sutured closure. Burn injuries are another example of wounds best managed by second-intention healing and are discussed in Chapter 20.

Tip

- Allowing a wound to heal by second intention, while less expensive at the onset, usually incurs an expense similar to that incurred by primary closure because of the costs associated with labor (veterinarian's honorarium for farm visits to monitor healing or trim EGT) and with bandaging materials.

When second-intention healing is selected, the wound must still be cleansed and debrided to remove necrotic debris and reduce the bacterial burden. Good ventral drainage must be ensured to avoid accumulation of exudate and proliferation of bacteria within deep pockets underlying the skin. The wound is then dressed and bandaged, as required. The reader is referred to Chapters 5 and 6 for more information regarding dressings and the techniques of bandaging. The frequency of bandage change is dictated by the nature of the underlying wound and the selected dressing; additional cleansing and debridement may be required at bandage changes. If the wound is not bandaged, the skin ventral/distal to the wound should be kept clean, and petrolatum jelly applied to the skin to prevent scalding from serum and/or exudate draining from the wound. After healthy granulation tissue has filled the wound, the frequency and intensity of general wound care can be decreased, and at this stage of healing, many clinicians opt to leave the wound uncovered, particularly if it is located on a limb, to reduce the likelihood of having to trim EGT.

Wounds on the body left to heal by second intention often have acceptable cosmetic and functional outcomes, unless the wound was very large at the onset, necessitating healing, in large part, by epithelialization (Figure 8.8). Epithelial scars are thin and easily traumatized. Skin grafting may be useful to decrease epithelial scarring and should be considered in a wound healing by second intention as soon as the wound is covered by healthy granulation tissue (Figure 8.9); for more

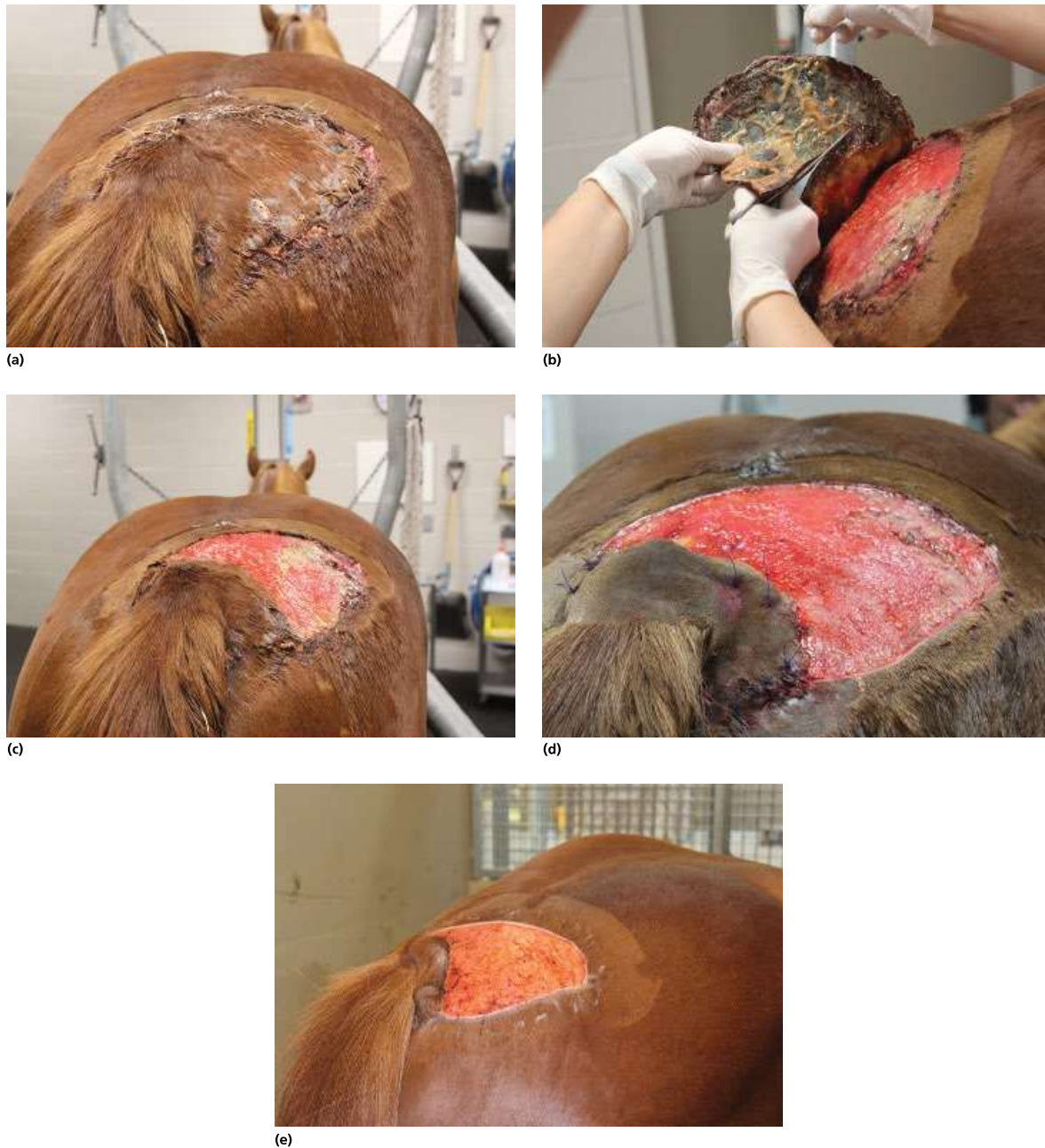


Figure 8.8 Injury at the tail head. (a) The large skin flap did not include any underlying muscle. The wound was closed primarily, in the field, by the referring veterinarian. Clipping of the hair initially proved difficult due to the attitude of the very young horse at the time of wounding. (b) The thinness and the orientation of the skin flap (the base was located caudally and the dominant blood supply arrived from the cranial extremity/apex of the flap), combined with inadequate ventral drainage, thereby trapping exudate, led to necrosis of the flap and the development of infection beneath it. Although it was ultimately lost, the flap served temporarily as a “biologic bandage.” The necrotic tissue was excised. (c) The area beneath the necrotic skin flap is covered by healthy granulation tissue. (d) The wound bed, after cleansing and debridement. A few sutures were placed to anchor the skin of the tail head to prevent it from retracting further. (e) The wound, left to heal by second intention, has contracted and has a pink epithelial rim approximately 1 week after cleansing and debridement.

information regarding free skin grafting, the reader is referred to Chapter 18. Wounds in the axilla or groin often heal well by second intention, due to good ventral drainage and a generous blood supply to the region, whereas primary closure of wounds in these areas often fails due to excessive motion that, in the horse, is quasi-impossible to limit.

When possible, some form of immobilization (i.e., a thick bandage, splint, or cast) should be provided to support second-intention healing of a wound located in an area of high motion, such as the carpus or the tarsus. Immobilization limits the damage suffered by the early repair tissue during extension and flexion of the limb. Wounds on the distal aspect of the limb

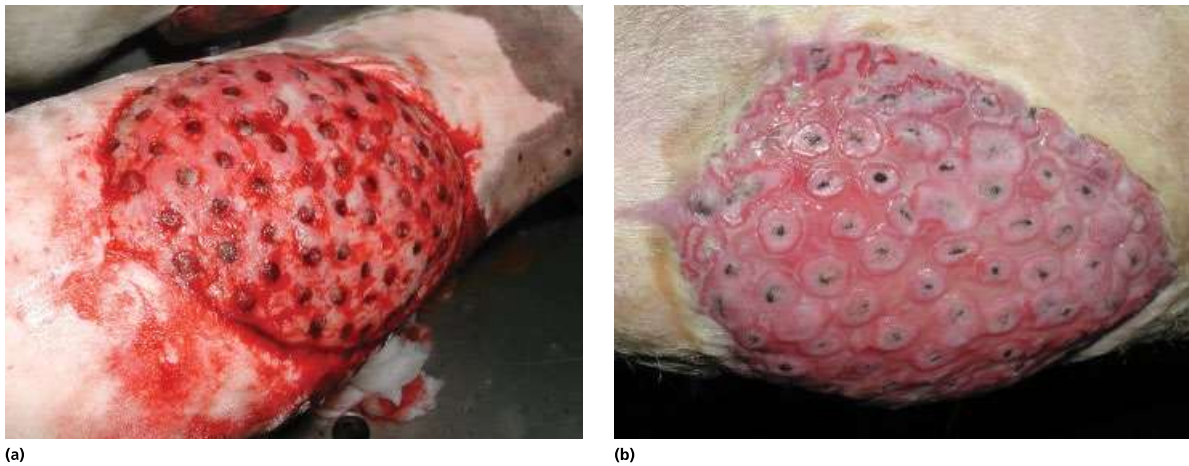


Figure 8.9 This wound, located on the dorsal surface of the metatarsus in a draft horse, was initially left to heal by second intention until healthy granulation tissue filled the wound. (a) After this had occurred, skin grafting was considered because contraction and epithelialization appeared unlikely to result in rapid and complete healing of the wound. The wound was implanted with island grafts, rather than being covered with a sheet graft, because of the owner's financial constraints. (b) 10 days after island grafting. Tufts of hair surrounded by raised new epithelium are observed. In some areas, there is evidence of coalescence between the new epithelial islands. Approximately 80% of the punch grafts ultimately survived, which is the expected percent of graft "take" for island grafting. Courtesy of Dr. Christophe Celeste.

heal poorly by second intention; healing is prolonged, and EGT frequently forms.^{9,41}

Conclusion

Selecting the most suitable approach to wound closure should be based on clinical assessment and experience, as well as a sound knowledge of the physiologic processes of wound repair. The aim is to provide pain relief and comfort and to return the horse, as quickly as possible, to its previous function, while achieving the best possible cosmetic outcome by minimizing scarring.

Assuming that primary closure is always the best method to achieve this goal is tempting. In some instances, however, primary closure invites wound dehiscence through infection. Tissues may be sutured when they are in a state amenable to healing, that is to say, with scant bioburden, good blood supply, and minimal edema/cellulitis in the surrounding skin. The choice of "if" and "when" to close the wound must be adapted to each wound and circumstance.

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