How to Perform Pinch/Punch Grafts for the Treatment of Granulating Wounds in the Horse

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Punch and pinch skin grafts can be performed readily on the standing horse in the field using basic equipment. Practitioners should utilize these successful grafting techniques to routinely treat granulating equine wounds in order to reduce healing time and create a cosmetic and functional scar. Authors’ addresses: Department of Large Animal Clinical Sciences, Virginia–Maryland Regional College of Veterinary Medicine, Phase II, Duck Pond Drive, Blacksburg, VA 24061 (Dahlgren); and Veterinary Teaching Hospital, College of Veterinary Medicine, Iowa State University, Ames, IA 50011 (Booth, Reinertson); e-mail: lad11@vt.edu (Dahlgren). © 2006 AAEP.

1. Introduction
Degloving wounds are a common problem in equine practice. Wounds on the distal limb can be especially troublesome to achieve a satisfactory outcome. Skin grafts are indicated when the wound exceeds the capacity healing by contraction and epithelialization and/or surgical closure. Wounds most commonly in need of grafting are large wounds on the body and any wounds including and distal to the carpus and tarsus. Grafting a granulating wound is often a highly cost effective means of treatment. The cost of performing the procedure is often paid for in the time and money saved in bandaging and wound care to the completion of wound healing. Without grafting, many wounds take a longer time to heal, require increased investment in bandage material, and necessitate prolonged periods of stall confinement.

Skin grafts are classified as either pedicle grafts or free grafts depending on whether a connection to the donor site is maintained. Free grafts must establish a new vascular connection in the recipient wound bed to survive, and are used most commonly in equine practice because of the inelastic nature of equine skin, and the lack of movable skin adjacent to extremity wounds. Most skin grafts applied to wounds in the horse are autografts (grafts transferred from one site to another on the same horse). A third useful method of categorizing skin grafts is based on the thickness of the graft. Full thickness grafts include the epidermis and the entire dermis, whereas split thickness grafts are composed of epidermis and only a portion of the dermis. Full thickness grafts tend to be more durable and cosmetic, but have a decreased rate of graft acceptance. Split thickness grafts sacrifice durability and cosmetic outcome in favor of a higher rate of graft survival. The selection of the type of graft best suited to an individual case is based on the size and location of the wound, the desired cosmetic outcome, the financial constraints of the owner, equipment available, and the expertise of the individual practitioner.
Pinch and punch grafts are specific examples of island grafts (or seed grafts), which are small pieces of full or split thickness skin that are placed into a granulating wound bed. Pinch and punch grafts are technically easy to perform in the standing horse and provide a cost effective means of wound management for a large percentage of common equine wounds. The grafting procedure itself may be performed under moderate sedation. The steps involved in performing these grafting procedures are outlined along with a discussion of the pros and cons of each technique and examples of wounds that are well-suited to this approach.

2. Technique

Preparation of the Wound Bed

A healthy recipient bed that is free of infection and devitalized tissue, and has a good vascular supply is critical to a successful outcome in any skin grafting procedure. One rule of thumb is that if a granulating wound is healthy enough to have a margin of new epithelium, then it is healthy enough for grafting. It should be noted that if one portion of a wound is ready for grafting and another is not, that the use of island grafts allows the flexibility to graft only a selected portion of a wound without sacrificing a successful outcome. This can be advantageous in speeding the healing process by reducing the affected surface area and performing staged grafting procedures.

In preparation for grafting, it is desirable to excise the granulating wound bed to, or just below, the level of the surrounding skin using a scalpel blade or a single edge razor blade. Excision of granulation tissue should be performed from the ventral portion of the wound to the most proximal to avoid obscured vision from blood as trimming progresses. As granulation tissue lacks a nerve supply, trimming can be readily performed in the standing horse, often times without sedation. The epithelial margin should be avoided as the horse will respond to excision of this sensitive tissue. Trimming the granulation bed should be performed days to several weeks prior to grafting depending on the health of the granulation bed. A fully granulated wound may require a single trim 24 to 48 hours prior to grafting, whereas a less mature wound may require several rounds of trimming to achieve a smooth, level wound bed without crevices and pits. Trimming an older, more chronic granulating wound will encourage the development of a younger, vascular bed of granulation tissue consistent with a successful outcome. Chronic wounds may require 3–4 days to form a healthy granulation bed following trimming. Because of the marked vascularity of granulation tissue, a heavy bandage is applied following trimming to control hemorrhage. The bandage is routinely replaced after 24 hours and a clean bandage applied for 24–48 hours prior to grafting. Utilization of an antibacterial cream or ointment such as triple antibiotic ointment or silver sulfadiazine cream can help reduce the bacterial count on the surface of the wound. The goal is a healthy, red, young granulation bed that bleeds readily when wiped, produces minimal discharge, and has a smooth contour. A major advantage of island grafts is that they are more forgiving than other types of grafts with respect to preparation of the wound bed. The brief time spent preparing the wound bed will, however, pay off big dividends in the rate of graft acceptance.

Preparation of the Donor Site

In general, the donor site for pinch and punch grafts should be in an inconspicuous location where the small scar that is created is cosmetically acceptable. Preferable locations for graft harvest in the standing horse include the pectoral region, the lateral aspect of the neck under the mane, the lateral abdomen, and the lumbar region. The location should be carefully selected to match the hair color and texture of the recipient site, have unidirectional hair growth, and be of an appropriate thickness and flexibility to match the type of graft to be harvested. The more flexible skin of the pectoral region and neck are well suited to the harvest of pinch grafts, whereas a stiffer skin such as that harvested from the lumbar region works well for the punch grafts. The hair at the recipient site is clipped with a #40 blade, aseptically prepared and desensitized with local anesthetic. Care should be taken to rinse the donor site thoroughly with sterile physiologic saline to remove harmful residues from detergents or isopropyl alcohol. Clipping is recommended over shaving the skin so that the direction of hair growth is preserved. Although grafts may be harvested prior to preparation of the recipient site, the amount of time should be minimized to maintain the health of the grafts. Grafts should be stored on or wrapped in a saline-soaked gauze sponge to keep them moist.

Punch grafts are full thickness grafts harvested using a 6mm skin biopsy punch in a routine fashion (Fig. 1). New, sharp punches are recommended for graft harvest. The punch is rotated until the entire thickness of the skin is penetrated, the edge of the graft is gently lifted out of the donor site using a Brown-Adson thumb forceps, and a #15 scalpel blade or Metzenbaum scissors is used to cut the graft free in the deep dermis and fat near the junction of the subcutaneous tissue. The subcutaneous tissue may alternatively be sharply excised following removal. Removal of fat is critical to revascularization. Organizing the grafts on the moistened gauze sponge so that the hair is oriented in the same direction is helpful. If available, an assistant can be preparing the recipient site at the same time that the grafts are being harvested. The donor sites should be harvested in a symmetric pattern approximately 1 cm apart to improve the cosmetic appearance and may be left open or sutured using 2/0 or 3/0 absorbable monofilament suture in a simple inter-
rupted, cruciate, or horizontal mattress pattern or skin staples.

Pinch grafts are partial thickness grafts harvested by sharp excision of a tented portion of skin (Fig. 2). The result is a circle of skin approximately 3 mm in diameter that is thicker in the middle and thinner at either edge. The skin is tented using a fine tissue forcep or a hypodermic needle with a bent point and the elevated skin is excised using a scalpel blade. Grafts are stored on a saline-soaked gauze sponge as for the punch grafts prior to implantation. The donor site may be left open or sutured as with punch grafts.

Preparation of the Recipient Site

For punch grafts, matching circular holes are made in the recipient bed using a 4 mm skin biopsy punch. Recipient holes should start at the ventral aspect of the wound bed and be spaced approximately 1 cm apart and 1 cm from the wound margins. The smaller diameter of the recipient holes and the slight contraction of the donor grafts allow the 6 mm donor grafts to fit in the 4 mm recipient holes snugly to improve graft retention. As the recipient holes are created in the granulation bed, the holes are plugged with cotton tip swabs to provide hemostasis (Fig. 3). The wooden sticks are broken off of the cotton swabs to reduce their length. The donor grafts are placed using fine tissue forceps, removing the cotton swabs one at a time, and taking care to achieve proper alignment of hair growth.

The recipient sites for the pinch grafts are prepared by making shallow pocket-like slits in the granulation tissue that allow the grafts to slide down into the pocket (Fig. 4). Parallel rows of pockets are made at 1 cm intervals using a #15 scalpel blade to a depth of 1–2 cm and at an acute angle with the opening pointing up. Implantation should begin at the most distal portion of the wound as described for punch grafts to avoid obscuring the surgical field with blood as the grafting progresses. The flattened graft is placed proximal to the opening of the pocket (with the hair properly oriented) and slid into the pocket using a hypodermic needle or closed tissue forcep. Recipient holes can be made prior to graft harvest.
to allow time for hemostasis within the pockets prior to implantation.

Post-Operative Wound Management
Following placement of the grafts, a bandage is applied to protect the freshly grafted wound, apply pressure to control hemorrhage and maintain graft position, and maintain a moist environment conducive to epithelialization. The type of bandage applied depends on the extent and location of the wound. A minimal bandage is often adequate for pinch grafts. Punch grafts require the pressure of a soft padded bandage to control hemorrhage and keep them in position. The wound should be covered with a non-adherent dressing that has been coated with antibiotic ointment or cream. It is helpful to secure the initial layer of dressing in place using elastic adhesive tape to avoid slippage and movement that will disrupt the grafts. Finally a routine standing bandage is applied over the dressing. For wounds over the hock and carpus that can be difficult to maintain in a stack wrap, the entire dressing may be covered with elastic adhesive tape to protect the grafts but allow joint mobility. The bandage should be changed daily or every second day initially to monitor graft acceptance and clean the surface of the wound. Sedation is advisable at

Fig. 3. Steps involved in preparing the recipient site for punch grafting. (A) Healthy granulating bed that is smooth and slightly raised. (B) Creating the recipient holes using a 4 mm skin biopsy punch starting at the ventral aspect of the wound. (C) Recipient holes plugged with cotton tipped swabs to control hemorrhage. (D) Placing the punch grafts into the recipient bed and removing cotton swabs one at a time. (E) Nearly completed grafting. (F) Non-adherent bandage held in place with elastic adherent tape.

Fig. 4. Steps involved in preparing the recipient site for pinch grafting. (A) Creating a pocket in the granulation bed that opens dorsally using a scalpel blade. (B) Sliding a graft into a pocket. (C) Partially completed graft procedure showing evenly spaced pinch grafts placed in pockets.
the time of initial bandage changes, even in tractable horses, to avoid inadvertent graft removal should the horse move unexpectedly while the bandage is being removed. Over time, the bandaging interval can be increased to every 3 or 4 days if the wound is not producing a large volume of exudate. Caution should be used when removing the bandage so as not to dislodge the grafts or pull any out that may be stuck to the dressing. Gentle spray with sterile saline and patience while the bandage is soaked off will help avoid inadvertently removing grafts. A bandage should be maintained for 3–4 weeks or until the wound has completely epithelialized.

3. Results and Discussion
Initially, during the adherence phase, grafts are held in place by fibrin that is exuded from the recipient site and receive temporary nutrition via plasmatic imbibition (passive diffusion from surrounding fluid). Revascularization of the grafts begins 24–48 hours after grafting and eventually the host vessels anastomose with vessels from the graft to supply nutrition (inosculation). In addition, blood supply to the graft is established by capillary buds from the recipient site invading the graft (revascularization). By 3–4 days, fibroblasts have begun to invade the graft and form adhesions between the graft and recipient site, and by 9–10 days grafts are firmly attached via fibrous adhesions and functional vessels crossing the graft-host interface. Pinch grafts initially appear as dark spots within the granulation bed approximately 1–2 weeks following grafting as the granulation tissue overlying the grafts sloughs. By 3–4 weeks following pinch or punch grafting, a ring of pink epithelium can be detected around the grafts, and by 42–56 days hair will begin to grown from the grafts. In general, a 50-75% survival rate can be expected with either punch or pinch grafting, which is generally more than adequate to achieve success. Grafting a granulating wound will usually stimulate epithelialization along the wound margins as well as wound contraction which both contribute to the successful resolution of the wound.

The decision whether to use pinch or punch grafts is based on the location of the wound, the expertise and preference of the practitioner, desired cosmetics, and the nature of the granulation bed. Both techniques are relatively inexpensive, and can be performed in the standing sedated horse with basic instruments, minimal technical expertise, and a less than ideal granulation bed. Pinch grafts are easily applied and are an excellent choice in a high motion area such as the dorsal aspect of the carpus or the hock, where flexion of the joint might tend to “pop” punch grafts out of the recipient site. The major disadvantages of pinch grafts are a poor cosmetic end result, leaving a cobblestone appearance with tufts of long hair sprouting from the grafts. The skin tends to be very fragile and prone to cracking and bleeding with movement. These disadvantages stem from the partial thickness nature of the grafts. Punch grafts provide a more cosmetic and durable end result because they are full thickness and therefore transplant the hair follicles and other adnexal structures. Punch grafts can be placed in a thinner layer of granulation tissue than can pinch grafts.

In summary, pinch and punch grafts should be considered at a relatively early stage in the wound healing process rather than as a last resort. Meticulous preparation of the wound bed and attention to aftercare will result in a rewarding outcome with minimal investment of time and money. Practitioners are encouraged to consider the use of these simple techniques as treatment for one of the most common problems in equine practice, granulating wounds.