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A Punch Skin Grafting Technique in the Horse

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Summary

Wounds involving the lower limbs of horses often fail to respond to conventional methods of treatment. Treatment by skin grafting may be successful in such cases. The type of wound in which skin grafting is indicated, and the method of grafting are discussed.

Introduction

Proper wound management comprises a significant part of any equine practice. Lacerations involving the lower limbs are often complicated by the production of exuberant granulation tissue or the formation of dense keloid-like tissue with poor healing qualities. From mid-radius and tibia to the coronary band minimal soft tissue is present, and poor circulation in this region contributes to the easy formation of edema. The lower limbs are subject to increased exposure to contamination and infection, and often the injuries involve considerable tissue damage. These factors, along with excessive movement of the wounded area lead to the problem of delayed wound healing. Failure of conventional methods of treatment may result in the disfigurement or loss of an otherwise healthy and valuable animal.

Since primary closure is often unattainable, certain lacerations on the lower limbs must be allowed to heal by second intention. Many of these lesions readily lend themselves to skin grafting. Skin defects do not heal by the formation of new skin, but rather are dependent on wound contraction and epithelialization for closure. As the margin of epithelium advances its thickness decreases until only one cell thickness results. In large wounds, even coupled with wound contraction, coverage of the entire wound by epithelium may never occur. Even if epithelialization is completed, specialized structures such as glands and hair follicles are not regenerated, and the decreased thickness of the epithelial covering lends itself to repeated disruption. Skin grafting allows a uniform epithelial covering to develop in a shorter time than is possible on lesions allowed to heal by natural cicatrix formation. Grafting also promotes the recovery of wounds that may never heal without intervention, and the cosmetic appearance following healing is improved. 5

Various autogenous grafting techniques have been described for use in the equine, including punch, pinch, tunnel, split-thickness and full-thickness skin grafting. The punch grafting method is described here.

Surgical Technique

Pre-operative wound treatment is an important factor in the success of this procedure. The goal is to achieve a soft, pink, uniform bed of granulation tissue as the recipient site. A treatment regimen can be established for the owner as follows:

(1) Using 4x4" gauze pads and an iodine surgical soap, have the owner scrub the wound until all free devitalized tissue, purulent exudate, and other foreign material has been removed. "Handi-Wipes" cut to a 4x4" size can also be used for this purpose.

(2) Again using 4x4" pads, the area is scrubbed with hydrogen peroxide until the major chemical action is reduced. At this time, the wound surface should be slightly bleeding.

(3) Hydrotherapy consisting of a very light spray with a hose should be employed for 5-10 minutes.

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(4) After the hydrotherapy, have the owner apply an acceptable granulation tissue stimulant. Bandaging is not necessary. If flies are a problem, a preparation such as screw worm balm may be applied.

Initially this regimen should be repeated 3–6 times daily until a suitable bed of granulation tissue is present. The hydrogen peroxide treatment should be discontinued after the 4th or 5th day to prevent tissue death. Surgical removal of extensive devitalized tissue may be indicated in some cases. Usually the recipient site will be ready for the grafting procedure in 10 days to 3 weeks.

The equipment necessary for this technique is readily available to the practitioner. Included are: razor blades, thumb forceps, Metzenbaum scissors, suture materials, a saline bowl, sterile hypodermic needles, and at least 2 skin biopsy punches. A cutting board for the donor grafts can be made by covering a piece of particle board with aluminum foil and autoclaving. Bandaging materials are also needed. Prophylactic antibiotics should be administered 4 hours prior to surgery and continued for 5–7 days. Unless the animal is extremely intractable, the grafting procedure can be carried out with the horse standing under heavy sedation. The combination of xylazine\(^a\) (0.65–1.10 mg/kg) and morphine (0.15–0.25 mg/kg) administered intravenously has been used successfully for this procedure. This usually provides adequate sedation, however use of a nose twitch or additional doses of the xylazine-morphine\(^a\) combination may be indicated.

The recipient site is prepared as follows:

1. The treatment regimen as outlined for the owner is performed.
2. With a razor blade, remove the granulation tissue to a depth of approximately 2mm below the skin surface. Enough tissue should be excised so that a firm base is achieved. Extensive hemorrhage will occur following this procedure.
3. Using a 5mm dermal punch, plugs of granulation tissue are removed. These are spaced approximately 6mm from each other in every direction. The punch is placed on the surface of the granulation bed, and with slight pressure and a continuous rotating movement, plugs of tissue 2–4 mm in thickness are removed.
4. Extensive hemorrhage will occur from the punch sites, thus it is best to begin the procedure at the distal margin of the graft bed and work proximally. The hemorrhage can be controlled by applying a pressure bandage consisting of six 4x4" gauze pads secured with Elastikon\(^b\). This bandage is left in place while the donor grafts are harvested.

The cranial pectoral region is used as a donor site. The hair is clipped and the skin is prepared using a routine surgical scrub. The site is blocked using local anesthesia of 2% Lidocaine. A strip of skin in the shape of a rhomboid is removed using a single edged razor blade. The size of the strip is dependent on the area of the recipient site. Care must be taken not to cut the fascial sheath over the pectoral muscles, otherwise post-operative swelling and possible dehiscence of the suture line will result. During closure the skin strips are placed in a saline bowl. The skin incision is closed using nonabsorbable suture material in an interrupted vertical mattress suture pattern.

The skin strip is then placed hair side down on the foil-covered particle board. All subcutaneous fat and fascia must be removed to facilitate proper graft acceptance. A 7mm dermal punch is used to remove the donor grafts allowing for contraction which occurs before the grafts are placed in the recipient sites. The skin plugs can be placed on a saline soaked gauze 4x4" as they are removed. More donor grafts should be made than the number of recipient holes, as some grafts will be lost during the surgical placement.

The pressure bandage is removed from the recipient site, and the tissue is ready for grafting. Adequate hemorrhage control is necessary for the success of this procedure. The blood clots should be removed from the recipient holes, and the donor grafts put in place. The graft site is covered with a large sterile Tela\(^c\) pad, over which 6 gauze 4x4" are placed. The bandaging is completed using 4" Elastikon.\(^b\)

\(^a\)Rompun, Haver–Lockhart, Shawnee Mission, Kansas.  
\(^b\)Johnson & Johnson, New Brunswick, New Jersey.  
\(^c\)Johnson & Johnson, New Brunswick, New Jersey.
**Postoperative Period**

The bandage should be changed at 48-72 hours. A slight amount of exudation will be present. The graft area should be gently lavaged with a saline-neomycin solution and patted with wet gauze. The site is rebandaged and the treatment repeated every 48 hours for 3-4 bandage changes. After this time, the surgical site is no longer bandaged, and the owner maintains the saline lavage three times a day followed by the application of an antibiotic such as Hetacin-K\textsuperscript{4} mastitic ointment. Infection may sometimes be a complicating factor. This can usually be successfully controlled by the addition of soluble Furacin\textsuperscript{5} powder following the application of the Hetacin-K\textsuperscript{4} ointment. By three weeks post-grafting, the graft site need only be cleaned once a day. This is followed by the application of Moruguent\textsuperscript{6} to maintain the pliability of the graft site.

By one week post-surgery, many of the grafts will have sloughed the epidermal layers, which is demonstrated by loss of pigment. At 14 days, the grafts will appear as small gray islands in the granulation bed. By 6 weeks postoperatively, the graft plugs will be encircled by dark red rings. These represent a thin layer of epithelial tissue which is slowly spreading out to coalesce with neighboring grafts. By 6 weeks, pigmentation will begin, and the entire graft now has a grayish appearance. At 9 weeks, pigmentation is progressing from the edges as well, while contraction and shrinkage of the entire lesion continues.\textsuperscript{2} By 3 months post-surgery sparse hair growth should be noted.

**Case Reports**

**Case #1:** A 2 year old Appaloosa filly was found in a pasture with a severe laceration 38 cm long running diagonally across the anterior surface of the left hock. Two extensor tendons were severed, with a 10 cm piece missing from one of the tendons. The joint capsule was torn in 3 places. The wound was cleansed and debrided, and sutured in an attempt to achieve first intention healing. One week later the suture line had given way. The wound was cared for by the owner following the regimen outlined previously to promote filling of the defect by granulation tissue. Thirty-eight days following injury, the wound was ready for grafting. A total of 57 donor grafts were placed in the recipient bed. On the initial bandage change at 48 hours post-surgery, 3 grafts were lost. The same was true on the second bandage change. Six days post-surgery, the graft was progressing as expected; loss of epithelial caps from the donor grafts was evident. At 11 days postoperatively, all epithelial caps were gone. The hock had greatly decreased in size. By one month post-surgery, many of the grafts will have sloughed the epidermal layers, which is demonstrated by loss of pigment. At 14 days, the grafts will appear as small gray islands in the granulation bed. By 6 weeks postoperatively, the graft plugs will be encircled by dark red rings. These represent a thin layer of epithelial tissue which is slowly spreading out to coalesce with neighboring grafts. By 6 weeks, pigmentation will begin, and the entire graft now has a grayish appearance. At 9 weeks, pigmentation is progressing from the edges as well, while contraction and shrinkage of the entire lesion continues.\textsuperscript{2} By 3 months post-surgery sparse hair growth should be noted.

**Case #2:** A 15 year old Arabian-Quarter Horse mare was admitted to the hospital late one evening, having been found on a road several miles from its pasture. Contusions and lacerations were present on all four legs, the most severe involving the proximal anterior aspect of the left front leg and the anterior lateral aspect of the left hock. The laceration on the left front leg cut deeply into the extensor carpi radialis muscle. It was sutured with the knowledge that large sections of skin in the area would probably slough, but an attempt was made to use the skin as biological bandage. The sutures held 10 days postoperatively. By 17 days following injury, the wound on the left rear leg contained several deep craters of necrotic tissue. At 4 weeks post-injury, these craters had coalesced to form one large lesion extending to the proximal cannon bone. Very little granulation tissue was present in the lesion on the front leg, and the underlying muscle tissue was visible. The aforementioned treatment regimen was followed by the owner, and by the 37th day post-injury the lesion on the front leg was ready for grafting. The wound on the rear leg was not grafted until 58 days post-injury, at which time 50 donor plugs were used for the grafting procedure. Three months following initial injury both graft sites were progressing satisfactorily.

**Case #3:** A 13 year old paint mare suffered an injury to the right hock after running through a board fence. A rough-edged tear was present on the anterior surface of the hock, approximately 13x23 cm extending down to the joint capsule. The wound was bandaged and attended to by the veterinarian for 2 weeks after injury, at which time the owner was advised to follow the treatment regimen outlined previously. Fifty-eight days after injury a granulation bed was present; suitable for grafting. The healing process was

\begin{footnotes}
\item Bristol Laboratories, Syracuse, New York.
\item Nordon Laboratories, Lincoln, Nebraska.
\item Beecham Massengill, Bristol, Tenn.
\end{footnotes}

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Figure 1: Case #1—one month following injury.

Figure 2: Case #1—five months post-grafting.

Figure 3: Case #2—ten days following injury.

Figure 4: Case #2—six months post-grafting.
uneventful. At 88 days postoperatively, pigmentation was present in the areas of the donor grafts as well as progressing from the edges of the lesion. Sparse hair growth was noted on the surface of the graft bed.

Discussion
Initially, the only source of nutrients for the donor grafts is diffusion via plasma from the underlying granulation bed. Thus establishment of a fibrin seal between the graft and the recipient site as soon as possible is most important to the success of the grafting procedure. Three major factors can act as deterrents to the success of the graft: (1) improper removal of subcutaneous fat and fascia, thus preventing direct contact between the graft dermis and the granulation tissue. (2) inadequate hemostasis, causing the grafts to be displaced from the recipient sites. (3) movements of the grafts relative to the graft bed, thus constantly breaking down the fibrin seal as it is formed. If the grafting procedure is followed as outlined previously, these factors are minimized and a successful graft should result.

The treatment selected for management of a particular wound depends upon several factors; the value of the animal, its use, and its temperament; the nature of the wound and its location; geographic location; facilities available; client demands; and the veterinarian's preference. A decision to graft a lesion should be made after considering the following factors: (1) the value of the animal (2) the cosmetic effect desired (3) location, age, and size of the wound.8

A number of autogenous skin grafting techniques have been used in the equine with varying degrees of success. There are several advantages offered by the punch grafting technique. The donor site can be sutured and will heal by first intention. This is the only suturing required with this procedure. All fat and subcutaneous tissue can be removed with the donor skin in one piece. The use of the dermal punch provides donor grafts of a uniform size. Since the grafts are embedded in the granulation tissue, this type of graft is not affected to a great extent by a small amount of movement.2 Thus the punch technique is very useful for wounds involving joint surfaces.

In the horse, autogenous skin transplantation is the most effective method for resurfacing skin defects and promoting wound healing after conventional treatment has failed. The technique presented in this paper has produced results highly satisfactory to both the horse owner and the attending veterinarian.

References
6. Donawick, W. J.: Skin Grafting in the Horse. Univ. of Penn., New Bolton Center, Kennett Square, Penn.

ERRATUM:
The ISU Veterinarian would like to apologize for the mistaken identity of James Herriot. His real name should be James Alfred White, not Hite as noted on page 46 of volume 42, no. 1.