How to Prepare Equine Hoof Defects for Repair

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Hoof wall defects occur with some frequency in horses. Perhaps one of the most frequently used techniques is composite repair, which uses a combination of adhesives that are designed to bond with equine hoof wall material and reinforcing fibers to add strength to the final product. Strict attention to detail is essential to establish both a lasting bond and a repair capable of sustaining structural stresses. Authors’ addresses: Department of Large Animal Clinical Sciences, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, TX 77845 (Moyer, Honnas); and New Bolton Center, School of Veterinary Medicine, University of Pennsylvania, Kennett Square, PA 19348 (Sigafoos); e-mail: wmoyer@cvm.tamu.edu (Moyer). © 2006 AAEP.

1. Introduction
The need and/or desire to repair hoof wall defects, such as cracks, loss (intended or accidental), and separation, is commonplace. A multitude of techniques and repair materials have been used with varying degrees of success. A single category and commonly used repair technique is referred to as a composite repair. Most composite repairs use either acrylic hybrids or urethane derivative adhesives in combination with a variety of materials, such as carbon fibers, fiberglass, and others to re-enforce the final product. In the authors’ collective opinion, a major reason for defect repair failure using composite repairs materials, regardless of the technique chosen, is inadequate preparation of the defect and surrounding hoof wall and disregard for detail in handling the adhesives. Failures can include cracking and breaking of the materials, infection under the repair, loosening or loss of the repair patch, or a combination of problems. Proper preparation of the defect with attention to detail is a means of decreasing failure.

2. Materials and Methods
Hoof wall defects consist of cracks, wall separations, wall loss, or a combination of problems. The size, depth, length, and direction or directions of the defect vary with each horse. A portion of these problems are superficial, and these generally respond well with time and continued wall growth. Those that evoke pain, and thus lameness, are infected or bleeding, or are of such size, direction, or degree of separation to be likely to cause problems may require repair. Over the decades, a multitude of repair techniques and materials has been used. The selected technique may be as simple as a shoeing change and time or as complex as using available products (composites), sutures, or other stabilizing devices with a change in shoeing. Acrylic hybrids, and urethane-based materials, are commonly used adhesives. These products have been on the market for years, are reasonably simple to work with, and have excellent strength and adhesive properties. The ultimate repair or patch can, however, fail for a variety of reasons. The structural design may be insufficient to support the load and/or direc-
tion of load or the repair may have been accidentally and traumatically removed by an opposite foot, may have an underlying infection, or may simply fail to remain adhered to the repaired area. Our experience is such that we believe the most common cause of failure is that the patch fails to remain adhered. While sub-repair infections do occur, they are not common and almost always result from applying materials before the underlying tissues are healthy enough to accept them.

The intent of this paper is to outline suggested procedures that will lessen the likelihood of failure or infection. It is very important that attention be paid to detail throughout the process of preparing the foot and the materials and the aftercare. The suggested examination and process is approached as follows.

- Assess the balance and quality of foot or feet to determine if actions are required; in most cases they are required.
- Thoroughly examine the defect and determine the size and position. The defect should be carefully manipulated with hoof testers and probes to determine the presence or absence of pain, exudate, and/or bleeding.
- The extent of the defect can be very deceiving without further probing and/or radiography. It is seldom that the degree of underlying hoof wall material damage does not exceed the external visual appreciation. For example, a vertically oriented toe crack is invariably accompanied by extensive underlying wall separation and even cavitation.
- The defect usually can be effectively probed using a flexible plastic probe, because it is unlikely to break off. A small hoof knife, curette, or motorized burr can be used carefully to remove separated wall and debris, allowing better visualization, more complete exploration with the probe, and more complete assessment of the depth and direction of the defect. (Fig. 1).
- If the examiner detects excessive moisture and soft decaying horn material, bleeding, exposure of sensitive tissue, or evidence of infection, it is prudent to further expose the defect using a hoof knife, motorized burr, or curette in conjunction with repeated flushing with water to expose and explore the source. This is the time to inform the owner/trainer that the problems detected must be addressed before proceeding with a repair; that is, there should be no attempt to apply adhesive and seal the underlying damage. The examiner may choose to use a composite repair in combination with a built in means for flushing* or other means of protecting the underlying tissue. We suggest that, in most instances, a more conservative approach be taken until the underlying horn is of sufficient health and strength to accept a patch. This may consist of exposing the damaged tissue, providing daily application of a disinfectant, protecting the foot with a bandage, repeating examinations, and providing time for the tissues to regain enough strength to accommodate repair.
- The exposed and underlying horn tissue must be free of blood, moisture, and exudate and be sufficiently cornified, i.e. not soft and flexible, before beginning the repair. Most patches that lead to underlying infection and pain are the result of placing the repair over tissue that is not yet ready to accept the materials.
- Assuming that the above criteria have been met and the decision has been made to proceed with the patch, the following steps are very important, because failing to complete any one of these steps can lead to problems.

When all of the above have been completed, the examiner is satisfied with regard to the extent of the defect, and the owner/trainer has been informed and wishes to continue, the following represents the sequential steps to prepare the surface for the application of adhesives.

- The ideal situation, depending on the clinician's skill and experience level, is to work jointly with a farrier.
- Select an environment that will enhance success, if at all possible. The ideal environment is a dust-free, low noise/activity, and well-lighted enclosure. The floor surface should be totally dry and provide good traction. There should be a flat, clean surface on which to prepare the adhesives and other materials. A
good horse handler, which can be difficult to find, should be available.

- Be equipped with the following: (1) shoeing apron, which is a necessity; (2) a farrier’s hoof rest (Fig. 1), which can be very helpful, especially if the examiner is not used to being under horses routinely; (3) shoeing rasp; (4) shoe pull offs; (5) nippers, ideally, but not necessarily, the specially made concave nipping heads to remove wall; (6) more than one sharp hoof knife with looped blades being preferred; (7) portable motorized equipment with various size burrs, drum sanders, small drill bits, which are 3/32 in or smaller; (8) curettes in sizes 2 and 3; (9) acetone, if using the acrylic hybrids; (10) small steel or brass brushes; (11) heat gun or hair dryer; and (12) any other materials necessary to complete the repair.

- Carefully remove the shoe or shoes on the involved foot or feet, trim as needed, and thoroughly clean the foot or feet, as any foreign material will interfere with the ability of materials to adhere. In most instances, some degree of imbalance or impaired hoof wall quality exists, and this should be addressed as a very important component of the total picture and thus is best managed with a team approach with both a veterinarian and a farrier.

- Remove any separated, loose, or less than normal hoof wall material, which can be accomplished with a motorized burr (Fig. 1) and/or bone curette. A commonly encountered error is leaving a shelf of thin, poor quality horn in place in the hopes that it will remain attached. Be aware that the depth of involvement or the degree of separation may well be more than anticipated, but it is important to remove any and all damaged, weak, or separated hoof wall. We repeat—do not use separated hoof wall in the hopes that it will remain attached.

- In the event that sensitive tissue is entered, bleeding (Fig. 2) is encountered, or evidence of underlying infection exists, these conditions must be treated and hoof tissues allowed to heal and cornify before proceeding with the repair, unless one is experienced and wishes to create a drainage portal or medicated packing device. In most instances, it is best to delay the procedure and work on horn material that is ready for repair. Assuming the wall material and underlying tissues are ready and healthy enough to accept the repair, proceed to the next step.

- Prepare the edges of the surface in an effort to insure adhesion and provide mechanical anchoring sites (Fig. 3).

The creation of anchoring sites may consist of drilling small holes, using fiber or suture that is compatible with the repair materials or steel wire, notching the edges, and providing a slight undercut of the edge. Determining which of these methods to use will depend on a multitude of factors, which are beyond the scope of this paper.

- Sanding (Fig. 3) the external wall surrounding the defect helps to expose presumably healthy, strong hoof wall, to remove materials that may interfere with the adhesion, and to increase greatly the contact surface area on which the adhesive materials can bond. Sanding can be accomplished with various grades of sand paper or a drum sander and motorized burr.

- The use of acetone (when using acrylic hybrid products) or soap and water (when using urethane products) is useful to remove naturally occurring wax-like and oil materials, products applied topically to the hoof wall, and any FIG. 2. Removal of all unattached hoof wall, exposure of sensitive laminae, and subsequent bleeding.

FIG. 3. A way of creating “dovetail” notches that can serve to anchor the adhesive. Note also the thorough sanding surrounding the defect to help insure bonding with the adhesive.
other foreign material that is adhered to the hoof wall. The use of acetone as a drying agent is contra-indicated when using urethane products. After the cleaning procedure, it is essential to dry the area thoroughly with either a heat gun or hair dryer.

Successful bonding of the adhesive, with or without the addition of fiber materials, such as fiber glass and carbon fibers, is dependent on the following.

- Strictly follow the directions for the selected adhesive product, including directions for mixing, if required, the adhesive. Determining the ambient temperature range for proper setting and bonding of the materials is essential. We are unaware of any commonly used adhesives that do not come with directions.
- Attempt to keep the patient quiet and reasonably still, because motion can easily disrupt early bonding. Protect the patch from foreign materials, which entails covering the patch while it is setting up.

Ideal aftercare will vary somewhat with the original problem, the environment in which the patient exists, and the clinician’s ability to achieve client compliance. Most repairs will at some point need a shoe, which may be just a manufactured “keg” shoe or a handmade shoe tailored to the needs of a given foot. The selection of the shoe is best determined jointly by the veterinarian and the farrier. We prefer to keep the horse out of any significant physical activity for the first 24 h.

3. Results

In the authors’ experience, the hoof wall defect failures, both those caused by the authors and those referred, commonly encountered were a loss of bonding between the chosen materials and the underlying hoof wall material. Most of the failures encountered occurred shortly after application, usually within the first 2 wk and sometimes within days of application. Most failures begin with noticeable peeling at the margins of the patch followed by loosening of the attachments and ultimately complete loss of the patch. These occurrences imply a problem in application. Those cases involving subsequent infection at the crack or defect site were usually the result of attempting to repair a defect that was known to be actively inflamed or not thoroughly explored at the time of application. Repairs with subsequent cracking or breaking of the patch appeared to be the result of failing to address the foot balance problems. An additional type of failure appeared to be the result failing to remove unattached wall. This type of failure presents with the patch attached to the wall but not the wall to the underlying tissue. Appreciate that these comments are not based on critical review but rather experience and clinical impression.

4. Discussion

The use of various materials and designs to repair a variety of hoof wall defects, and thus return an otherwise non-useful equine athlete to work, can be very rewarding and useful. The adhesives that are available are excellent in the authors’ collective opinion. The likelihood of success is greatly enhanced with meticulous preparation and attention to detail. The goal of this presentation and article is to define the steps and to show where failures seem to occur. In our collective experience, the encountered failures were much more a function of user error than product failure.

References and Footnotes


bEqui-build, Vettec, Inc., Oxnard, CA 93030.