How to Repair a Quarter Crack

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A successful quarter crack repair should be simple, strong, safe to apply, and durable. It must be emphasized that the cause of the crack must be addressed in order to prevent reoccurrence. Author's address: Northern Virginia Equine, 7135 Mt. Eccentric Rd., The Plains, VA 20198.

1. Introduction

Quarter cracks are a common cause of foot lameness or decreased athletic performance in race and sport horses. They typically originate at the coronary band and continue distally. A true quarter crack is full thickness, extends into the dermis of the hoof often leading to instability, inflammation, and infection. Quarter cracks can be painful due to infection or instability caused by movement of the hoof wall posterior to the crack. The vertical movement of the heel bulb on the affected side further complicates this instability. Causes of quarter cracks may include trauma to the coronary band; preexisting damage to the corium from infection; abnormal hoof conformation, especially the long toe underrun heel; and focal foot imbalances, such as a sheared heel, short shoes, or an abnormal landing pattern when the foot strikes the ground.

Often the problem facing equine practitioners is that many of the horses that develop quarter cracks must continue to perform. For this to occur it is essential for the repair to provide strength and stability to the hoof wall defect, which allows the horse to perform without pain while the quarter crack heals. Various techniques for repairing hoof cracks have been described. They include corrective shoeing, stabilizing the crack by placing implants across the defect, and covering the crack with an acrylic material.[1–4] This report describes a simple, consistent method of repairing a quarter crack that, when combined with appropriate shoeing, gives superior stability.

2. Correct the Cause

For a successful repair, it is necessary to determine the underlying cause of the quarter crack and to correct it where possible. Horses with long toe underrun heel foot conformation appear to be prone to quarter cracks. This type of heel may be weak due to insufficient hoof wall growth and there may be insufficient solar surface to adequately support the palmar/plantar part of the foot. In addition, there may be increased pressure in the quarter and heel during the stance phase as a result of delayed breakover caused by the long toe. On the other hand, upright hoof conformation with high heels promotes heel-first landing, which increases pressure through the heels and quarters often leading to a hoof wall defect.

Short shoes leave the heels unsupported and put the weight-bearing surface in front of the vertical axis of the limb. In such instances, a vertical line drawn from the origin of the quarter crack will invariably coincide with the end of the shoe (Fig. 1). The use of an aluminum plate with a toe grab as used in racehorses raises the toe, creating a broken-

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Fig. 1. An example of a quarter crack.

Fig. 3. Stainless steel wire and steel tabs.

back hoof pastern axis. This would also appear to increase the pressure in the posterior part of the foot.

Of utmost importance is the landing phase of the stride. Many horses will contact the ground asymmetrically, landing first on one side of the hoof and then impacting with the opposite side. This strike pattern is generally related to conformation but can also be caused by inappropriate trimming. This type of stride may place excess forces on one side of the hoof wall, causing the heel bulb to displace proximally creating a sheared heel (Fig. 2). Quarter cracks usually occur over the point of impact. This is the point where the coronary band is deviated proximally and generally contains the most shear within the hoof wall.[5] The landing pattern coupled with abnormal foot conformation may also perpetuate quarter cracks caused by trauma to the coronary band or a previous submural hoof abscess.

3. Methods and Materials

When infection is present, it is characterized by marked lameness, pain on palpation, and a swollen discolored coronary band above the defect. Occasionally, exudate can be expressed when digital pressure is applied to the coronet. If infection is present, the crack should be opened and bandaged with 2% iodine, or a similar disinfectant agent, for at least 48 hours before the repair.

Before beginning the quarter crack repair, the shoes should be removed and the feet trimmed appropriately. In horses with the long toe underrun heel conformation, attempts to move the breakover back is helpful. The hoof wall is lowered, if possible, from the quarter to the heel on the affected side.[2] Lowering the hoof wall of the quarter and heel beneath the quarter crack will decrease the amount of impact when the foot strikes the ground.

When starting the repair, the hoof wall should be thoroughly cleaned and dried. The quarter crack is explored its entire length using a Dremel tool[a] with a tungsten carbide bit, being careful (especially near the coronary band) not to create any unnecessary hemorrhage. All loose undermined horn should be removed from the crack as this undermined horn lacks mechanical strength and can lead to secondary cracks. The hoof surface on either side of the defect should be sanded using the Dremel tool with a coarse grit drum sander. Two sets of paired 3/64-inch holes one-quarter inch apart are then drilled across from each other on either side of the crack beginning at least 3/8 inch from the margin of the crack and ending within the depths of the trough. Stainless steel (21-gauge) wire is bent in a "hair pin" shape 2.5 inches long and a small steel tab is placed on each wire unit (Fig. 3). One wire unit is passed through the holes from palmar to dorsal direction and another wire unit is passed through the opposing holes in a dorsal to palmar direction into the depth of the crack. The ends of the wires are pulled tight and bent outwards (Fig. 4). The tab placed on the wire unit will now lie against the outer hoof wall. This prevents the wires from cutting into the hoof wall. Additional sets of these wire units can

Fig. 2. Sheared heel resulting from an asymmetrical stride.

Fig. 4. The ends of the wires are pulled tight and bent outwards.

Fig. 5. After twisting, the excess wire is cut off within the defect.

Fig. 6. Completed treatment.

be used according to the length of the defect or until the desired stabilization is achieved.

The internal length of the crack usually exceeds the external length so it cannot be completely eliminated. In such cases, a drain must be placed before it is covered with the composite.[4] To place a drain, a small amount of medicated putty[b] is rolled into a tubular shape the length of the trough and placed within the debrided crack. One-eighth inch hollow rubber flexible tubing is pressed into the putty. The tubing will exit at the coronary band and below the crack to form the drain. The ends of all the opposing wires are now joined together and twisted until resistance is felt. The excess wire in front of the twist is cut off within the defect (Fig. 5). There should be no movement in the hoof wall on either side of the crack when digital pressure is applied.

Next, elastic adhesive tape is placed around the coronary band to prevent irritation from contact with the composite. Three sections of a strong structural fabric that resembles fiberglass, called "spectra,"[c] is cut 2 × 3 inches. The previously sanded hoof is rinsed with free-flowing denatured alcohol. The polymethylmethacrylate (PMMA) composite[d] is mixed thoroughly and a layer applied to the prepared area of the foot, being sure to fill the quarter crack.[3] The spectra fabric is thoroughly impregnated with the PMMA composite and a section is placed over the prepared area followed by another layer of composite. This procedure is repeated until three sections of fabric have been placed over the defect. Finally, the hoof wall is covered with plastic wrap and an elastic adhesive bandage is pulled tightly around hoof wall, compressing the fabric. Upon completion of the cure cycle, which takes two to three minutes, depending on the ambient temperature, the rubber drain is removed and the repair is sanded to remove excess composite.

4. Choice of Shoes

Any horse with a full thickness quarter crack that warrants repair should be placed in a bar shoe if possible. Various configurations of bar shoes such as a straight-bar, egg-bar, heart-bar, or Z-bar shoe can be used. All of these shoes effectively increase the bearing surface of the foot, provide palmar/plantar support, and decrease the independent vertical movement at the bulbs of the heels. No nails are placed palmar to the defect in the repaired area of the foot.

Recently, this author has glued the shoes on most horses with quarter cracks. Gluing the shoe offers several advantages. First, it allows the foot to be trimmed and shod to a more suitable foot conformation. Second, gluing on the shoe allows for more expansion to be provided under the quarter and heel of the affected side to increase support. Finally, when shoes are glued on, there is no concern with nail placement in the affected quarter (Fig. 6).[6]

5. Results

The technique described here for quarter crack repair has been performed on 25 horses over the past two years. This repair has produced consistent results when compared to previous methods used by this author and there have been no reoccurrences reported following the repair. Horses treated in this manner become sound almost immediately, are able to return to successful competition following the repair with no infection or bond failures being noted. Some of the cases presented with quarter cracks had been previously repaired using only a composite. With these repairs, the crack had repeatedly ruptured at the coronary band indicating instability of the repair. When the composite was removed, it was noted that many of these defects continued to bleed under the repair.

6. Discussion

The use of a composite (with fiberglass) alone may not provide sufficient stability for a quarter crack repair. Combining an implant with the composite in repairing a quarter crack increases the strength and durability of the repair. Types of implants described previously include fiberglass and screws, screws and wires, various suture patterns and clamps that apply tension across the crack.[1–4,7,8] These methods have been somewhat cumbersome; the screws present a risk as they often impinge on the dermis and uniform tension is rarely achieved across or within the crack.

The advantage of the method described in this report is that the procedure is exceptionally strong while being relatively simple and easy to learn. Secondly, the wires are placed from opposing sides of the defect and joined together within the defect creating uniform tension within the crack. The wires are also incorporated into the composite as part of the repair. Another advantage of this technique is that, since the implant is contained within the hoof wall, there is very little metal on the surface of the hoof wall to interfere with the adhesion of the composite.

Failures in quarter crack repair appear to be the result of three factors: 1) repair with a composite alone may not provide adequate strength and stability; 2) use of relatively rigid acrylics; and 3) use of materials with poor bonding capabilities. A consistent bond and the relative flexibility of the repair material are essential to maintain stability, which allows the subsequent horn growth to be free of the defect. The polymethylmethacrylate used in recent years has excellent adhesive characteristics with the horn wall, while having a flexibility that approximates that of the hoof itself, thus more closely approximating normal function.[9] The addition of spectra to the composite, instead of fiberglass, increases the strength of the overall repair due to its high tensile strength. Placement of a drain effectively decreases the risk of infection under the repair.

The importance of determining the underlying cause, trimming the feet properly, and applying the correct shoe cannot be over emphasized when repairing a quarter crack. Correcting any existing hoof imbalance along with palmar/plantar support provided by the appropriate shoe is as important as the repair itself.

Acknowledgments

Thanks to Mr. Ian McKinley for bringing the wire technique described in this paper to the author's attention.

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[a]Dremel®, Dremel Tool Co. Emerson Electric, 4915 21st, Racine, WI 53401.
[b]Keratex® putty, Advance Equine P.O. Box 54 Versailles, KY 40383.
[c]Spectra®, Equilox International, 110 NE 2nd Street, Pine Island, MN 55963.
[d]Equilox®, Equilox International, 110 NE 2nd Street, Pine Island, MN 55963.