

## Therapeutic Shoeing for Spontaneous Quarter Cracks Induced by Sheared Heel in Thoroughbred Race Horse

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(Accepted: June 09, 2014)

**Abstracts :** A 3-year-old colt Thoroughbred horse was referred with obvious lameness (3/5G) and mild heat and pain on left hoof of forelimb. He was diagnosed with quarter cracks that have a typical conformation of sheared heel, which are a different length and height between medial/lateral heels. Various materials and techniques were carried out to repair quarter cracks by using many different kinds of clips, bar shoes on fifth times for about 10 months. It worked on him without pain and heat on the cracked hoof, and then he could retrain for racing from the 36th weeks beginning of therapeutic shoeing. We suggested that especially fiberglass reinforced plastic (FRP) material and therapeutic shoeing were a great help to treat quarter cracks induced by sheared heel.

**Key words :** Thoroughbred horse, hoof cracks, FRP, therapeutic shoeing.

### Introduction

A crack to the side of the quarter of the hoof wall, or the side of the hoof of a horse which is an odd-toed ungulate, is called a quarter crack. In general, cracks represent a longitudinal destruction of the hoof wall parallel to the horn tubules and lamellae, and expands up and down the hoof wall (6,19). If the crack originates from the coronet, it is classified as a minute crack, incomplete crack or a sand crack, and if it is caused by the ground, it is classified as a grass crack (20). However some authors call the type originating from the ground as a sand crack (7,11,15), and from among the cracks originating from the coronary band classified the ones where only a portion goes down the hoof wall as incomplete cracks, and the ones where cracks spread to the whole hoof as a complete crack (7). According to location, they are called toe, quarter, and heel cracks (1,7,11,15,20,21), according to direction, they are called vertical and horizontal cracks, according to depth they are called surface layer and deep layer cracks (1,7), according to length they are called complete and incomplete cracks (7,11). The hoof capsule is a highly complicated structure that is formed of keratinized epithelial cells that include a outer layer, middle layer, and an inner layer, and it is capable of enduring a great weight while at the same time experiencing any permanent deformities. Because cracks involve the capsule separating and breaking, it is called a hoof fracture (1,17,20).

Whether the origin of the crack is the coronet or the sole, the vertical crack expanding to the whole length of the hoof wall can occur anywhere on the hoof, but it is more common

at the quarter and observed more often on the median side than the lateral side (6,9). It is difficult to figure out the real cause of cracks and they are various. Congenital factors include abnormal foot shapes like a long toe, low heel, or a chronically unbalanced hoof (1,5-7,9,13,15,22,23). Repeated contusions or shocks which can be commonly viewed on race horses, cuts, and hoof shoeing where the shoe is too small or inadequately supports the heel belong to acquired factors (1,6,7,9,13,15,19). Hooves where trimming and shoeing have not been regularly conducted are also liable to crack (11,20-22). Sometimes the sensitive layer displays a secondary process where it is separated from the hoof wall at the toe (19). In particular, idiopathic quarter cracks with heel cracks are the most common cause of lameness (11,13). O'Grady and Castelijn (13) claimed that usually this occurs directly where the maximum weight created inside the hoof wall meets the point that receives the most force.

They say that a sheared heel occurs when inadequate shoeing, limb conformation and landing patterns cause hoof deformity and when the difference in length between the median and lateral side from the coronet to the ground is over 0.5 cm, this is called a sheared heel. This is judged to be one of various hoof deformities. On the one hand, Pleasant (16) has said that the posture of the foot is stood narrowly or widely, a weight burden occurs to one side of either the median or the lateral side, and the side which supports the weight is dislocated toward the coronary band and easily bends toward the direction of the axis that is same to the ground. The more unstable the crack of the hoof, the more severe are the bleeding and infection (7,21) as well as pain and lameness (1). Deep cracks or penetrative cracks which spread to the sensitive laminae can cause infection and lameness (6), and lameness may appear or not according to the degree of damage. Some cracks manifest as severe pain or bleeding by a hoof

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tester or finger press. The diagnosis of each crack is conducted based on clinical symptoms as they are easily identified by the careful observation with the naked eye or the easy operation of a hoof tester (6,7,11,15). On the other hand, anesthetics around the nerve aid in determining how much the crack affects the lameness (15,21).

Crack treatment normally starts with the evaluation of the hoof, and after determining heel balance, implication of corium, and presence of infection, the level of treatment is determined according to the location of origin and severity (1,7). Although most horses that have cracks including superficial cracks that are not associated with lameness do not require special trimming or shoeing technique (6,14), the basic treatment principle is as follows. The balance of the horse's foot is adjusted through a corrective therapeutic shoeing (5-7,9,16,20), weight support side and the loose crack side is removed, debridement with a motored drill (5,6,15,19,22,23), the boundary of the crack is fixed or minimized for movement by using a clip so that it does not move (5-7,9,11,13,20), and a substitute hoof wall made of artificial material is attached to the damaged area or a bar horseshoe is installed to stabilize the horse (5-7,9,11,13,20). As a method to stabilize the crack, Higgins and Nyder (7) suggested a metal plate method of nailing and tightening 1 or 2 plates or clamps onto the hoof wall, a method of binding in a 8 shape pattern by drilling a hole at a right angle into the crack area, a method of fixing the crack through the insensitive hoof wall with a stapler at a right angle, and a method of repairing or attaching the hoof wall with acrylic. On the other hand, Honnas *et al.* (8) claimed that not only surgical intervention but also knowledge of the specific disease entities, which requires in-depth understanding of the anatomy of the tissue beneath the hoof capsule, was critically important.

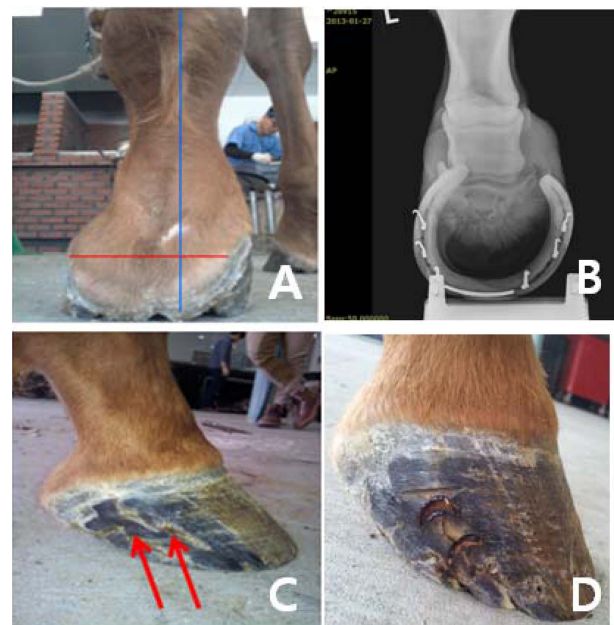
Other treatments include the method of burring or rasping the cracked area in a V or  $\wedge$  shape so that the crack is limited to the original area (11,15,19), the method of reducing weight to the cracked area through trimming (11,16,20,23), the method of using disinfectant or an antibiotics injection (15) or pad (11), and a method of attaching a substitute hoof wall which is made of artificial material that fills the defected area with glass fiber (19,22). Hoof injuries are common in horses. When it invades deep into the underlying structures, it is hard to diagnose and treat. So, if the wound management principle which includes understanding the biomechanical properties and knowledge on the anatomic structure are complies with, a good result can be predicted (2). Most often, prognosis is on the better side, but if it includes the coronary band, careful observation will be necessary (7).

In this study, after a length 6 cm  $\times$  width 2.5 cm connection plate made of FRP material which considered the status of the hoof during handling was made and fixed to the hoof wall with screws, various handling methods were chosen and applied including filling the artificial hoof wall, which had a good result.

### Case

A three-year-old Thoroughbred colt race horse which was scheduled to compete in a race conducted by the Korea Rac-

ing Authority (KRA) showed clear lameness on the left side of the foreleg during walking and trotting, mild heat, and pain. Thus, the participation of the horse was scratched, and the horse was immediately hospitalized at the Korean Racing Authority's equine hospital. Before the hospitalization, the horse entered into the Seoul Racecourse at the ages of 26 months, and debuted in a race about four months later. After a three week rest, while training for a competition, it was diagnosed, by the private veterinarian practitioner in charge, with a foreleg left side crack when it manifested hoof cracks accompanying lameness to the foreleg left side due to continued stimulus to the median of the right side foreleg shoe. Also he has hoof conformation with typical sheared heel (Fig 1A) Subsequently, it was injected 25 times with antibiotics, nonsteroidal anti-inflammatory drugs (NSAIDs), and adrenocortical hormones agents and weighted about 500 kg. When hospitalized it was X-rayed as it was confirmed with heat and pain at the left foreleg hoof (Fig 1B). There was no particular finding of bleeding besides the outer wall crack or severe deformity to the 3rd phalangeal bone in the hoof. Afterward it was additionally injected 12 times with antibiotics nonsteroidal anti-inflammatory drugs (NSAIDs), and adrenocortical hormones agents. But the condition of the hoof underwent a complete medical examination to conduct the therapeutic shoeing. The hoof was an outward base-wide and a severe sheared heel in which the length disparity of the median and lateral of the left hoof is extremely large, and which the pastern and hoof axis do not coincide. Heat was severe in the hoof, and lameness that accompanied bleeding



**Fig 1.** Palmar view of sheared heel on 3rd therapeutic shoeing. Note disparity between medial and lateral heel/corony band length (A). Dorsopalmar 45° radiograph of a foot before 1st therapeutic shoeing. Note unbalance of lateral and medial sides (B). Hoof wall that was cleaned out with a motorized burr on 3rd therapeutic shoeing. Note cracks (two arrows) (C). Hoof that was debrided, trimmed and cauterized on 3th therapeutic shoeing and burning of a half-round groove at the top and middle of the crack on 4th therapeutic shoeing (D).



**Fig 2.** Stabilizing hoof wall that was fixed with a FRP plate by using screws and the foot that shod therapeutic shoe (A). Hoof appearance that was treated on 3rd therapeutic shoeing (B). A steel bar shoe that was shod at the 4th try of therapeutic shoeing (C) and hoof condition that cracks was disappeared on the quarter of hoof wall on the 48th weeks beginning of therapeutic shoeing (D).

from the 2 vertical lines of the crack area manifested. Because the crack did not improve with medicine, therapeutic shoeing was conducted at the Korea Racing Authority's farriery center 5 times at an interval of about 6 to 8 weeks after 11 weeks of the initial diagnosis in order to achieve a fundamental treatment, and training was started two weeks after the last therapeutic shoeing with the aim of competing in races.

The surface of the hoof removed of the shoe was fit to level, without any sedatives, and the cracked area was cleanly smoothed. The cracked area was sterilized with ethanol and dried (Fig 1B) and burned into the straight and half-round groove to prevent further split to the crack during handling (Fig 1C-D).

The cracked hoof wall is accurately measured and shaved, a groove is installed, and the separated sides are connected and grafted together. This study cut a recycled FRP fence, which had been used for horse management and boundary fence, into the adequate size and used that. A hole that could be fixed to the wall was created to make contact easier, and the edge was cut slanted and bent into a hoof shape by heat. Then the surface was ground with a grinder and fixed with screws as it was attached with glue (Fig 2A).

Space is left between the initial cracked area and the contact area, and a bar shoe with a wide shoe branch was attached to alleviate shock to the cracked area (Fig 2B). Next, the shoe with pad was attached to the cracked area so that shock to the contact area could be reduced. A shoe with a side shield was made and fixed to the cracked area and contact area to prevent additional split in later operations. During the 4th, and 5th trial of therapeutic shoeing, a straight bar shoe (Fig 2C) was made and attached to reduce weight to the heel.

During the initial treatment shoeing, a considerable area of the hoof was applied with filling to fix the crack connection plate. During the middle phase of the treatment, the cracked

area was fixed with a hoof clip for hooves that are sold commercially by screws, and the cracked area was smoothed out with a rasp after applying filling to the lower part of the hoof as the cracked area moves to the ground surface. During the last phase of the latter half, only some of the cracked area was applied with filling and underwent finishing touches 6 weeks after the initial therapeutic shoeing, the infected area of the hoof wall disappeared, and the cracked line moved down about 10 mm from the coronary band to the ground, but slight heat and light lameness during trotting still appeared. On the 13th week, the cracked line moved down about 15 mm from the coronary band, and since then, heat and lameness totally disappeared. Finally since 36th weeks, training for competition began and the cracked lines was entirely disappeared on the 48th weeks beginning of therapeutic shoeing (Fig 2D).

## Discussion

Hoof injuries like hoof wall defects are very common in horses. If the heel is damaged, bad quality horn forms, which promotes the development of cracks to the hoof wall, and this causes several different forms of cracks. The types are various from cracks in the insensitive structure of the surface to cracks that infiltrate the deep sensitive laminae (2,6,11). They occur due to unknown congenital factors and acquired environmental factors. Normal hooves include hoof walls, soles and frogs that respectively contain water to the amount of 25%, 33%, and 55%. However, when exposed to a overly damp or dry locations, or an environment that intersects between the two conditions, the hoof becomes dry and crumbly so that cracks easily occur (1,21). The hoof has viscoelastic structure which has a unique transformation ability that can equally receive weight for a long period of time, so if an unequal weight is placed continuously to one side of the quarter or the heel, a structural change occurs. Thus, when the foot is abnormally hit or lands on the ground, the reception of the hoof and the unbalance of the median and lateral resulting from being crushed can cause the hoof to become a sheared heel. This term was explained about 35 years ago on veterinary literature. but clinically accompanies lameness, and is closely related to quarter cracks (13). Rooney (18) said that quarter cracks occur due to a mechanism similar to hoof wall deficiency, and toe and quarter cracks, whether they originate from the damaged coronary or the coronary band, it is a coronary band injury or destruction, because this is wall damage which involves the deficient formation of new horn where the horn formation of the lamellae is temporarily blocked out, it is better to call this a defect rather than a crack. Christie *et al.* (3), after a physical examination on non-race horses in particular areas in Canada where the number of farriers are lacking and the management of the owners was deemed negligent, reported a 45.1% of hoof wall abnormalities including cracks, broken heels, white line disease, and toe overgrowth. There were no cracks in mini horses, but light horses showed broken hoofs and toe overgrowth, and draft horses showed the highest ratio of cracks among hoof wall abnormalities. Moyer (11) says that harness race horses that train and race on stone-dust surfaces had the highest incidence of painful cracks because the many nail holes

resulting from newly replaced shoes every 8 to 10 days accelerated hoof wall cracks. Fürst *et al.* (5), having examined horses that lame due to cracks, reported that among the diagnosed cracks the deep and complicated quarter crack was the most common form, and that the recurrence rate of the hoof wall cracks was at a high 20%. Among the various types of cracks caused by different reasons, whether originating from the coronary band or expanding to the coronary band, a vertical complete crack which expands to the whole length of the hoof wall is more common in the quarter (9).

During veterinary clinical practice, medical information on the health of horses including the presence of lameness and the farriery practice where the adequacy of shoe attachment as well as hoof management is determined can be obtained from X-ray evaluations during trimming and shoeing process, ultrasonography, thermography, nutritive conditions, and health consultations (10). Most hoof injuries respond well to adequate treatment, but when handling is required, detailed thorough preparation and continuous follow-up management are necessary compared to other areas of the body (4). Usually cracks are often experienced during horse management. Because it has been a routine problem for hundreds of years, many treatments have been introduced, and many techniques exist, but the successful management of cracks can be only achieved through the close cooperation between the veterinarian, the farrier, and the owner (6).

If establishing the cause, correcting and management have not been conducted, veterinarians or farriers must most importantly remove damaged horn, reduce ground impact to the damaged hoof wall and weight, and lastly stabilize the cracked area by fastening it, in order to treat the complete crack (9). Moyer (11), as a conservative approach, refers to the attaching of bar shoes, branding in the cracked area, and the use of a rasp or a clip, but the choice of treatment must be conducted while considering the owner's intention, the use of the horse, the severity of the defect, location, presence of infection, the degree of hoof wall loss, and complications resulting from the exposure of the sensitive structure.

On the other hand, Stashak *et al.* (20), as a method of treating severe cracks, reported failure for only one case in his study of 24 horses that had 38 hoof wall cracks, with a method of suturing by placing a metal plate with a stainless steel wire.

However, long lasting cracks and accompanying infections and coronary band deformities are not good prognoses and because they are only temporary recoveries and commonly undergo recurrences, removing the cause is important for successful management (4,7,12). Rose and Hodgson (19) have determined that secondary occurrences resulting from abnormalities in the coronary band or wall separation have not permanent solution and are difficult to treat.

Hoof injuries like cracks in the hoof wall in thoroughbred race horses are very commonly experienced by equine practitioners due to environmental conditions and individual characteristics in any situation whether it be during management, training or racing. Therefore, this case, despite the long treatment period, is a good example of resuming training for race competition without recurrence by promoting the relief and treatment of symptoms by choosing various treatment meth-

ods which involved connecting the two cracked areas with a FRP material connection plate.

## Acknowledgments

This study was supported by Kyungpook National University Research Fund, 2012.

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## 더러브렛 경주말에서 부등제종 기인 특발성 제촉열제 처치술

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**요 약** : 더러브렛종 세 살짜리 경주용 수말이 평보 및 속보 걸음에서 좌측 앞다리의 뚜렷한 파행, 경미한 열감 및 통증을 발현하여 한국마사회 동물병원에 내원하였다. 왼쪽 발굽의 내외측의 길이 차이가 매우 큰, 전형적인 부등 제종에 기인한 제촉 열제로 진단되었다. 열제면 고정, 부중 감소용 편자 장착 및 인공제벽 도포 등 다양한 처치방법을 약 2개월 간격으로 총 5차례 선택적으로 적용하여 좋은 결과를 나타내었으며, 발굽에 열감과 파행이 완전히 사라진 바 치료 개시 약 36주차 후부터 출전을 위한 훈련을 개시하였다. 특히 섬유강화플라스틱(FRP)제질의 연결판과 치료용 편자 장착 등 장제요법은 부등제종에 기인한 제촉 열제의 치료에 있어서 매우 도움이 되는 것으로 판단되었다.

**주요어** : 더러브렛 말, 열제, FRP, 장제요법