Deep digital flexor tenotomy and Distal Phalanx realignment for the treatment of Chronic Laminitis in horses: a literature review

Tenotomia do flexor digital profundo e realinhamento da Falange Distal para o tratamento de Laminite Crônica em equinos: revisão de literatura

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ABSTRACT
Laminitis is the second most common cause of death from disease in horses and causes great suffering in the animal and economic and emotional losses for the people involved. Several therapeutic modalities are used in the treatment of this disease, but their results are not consistently described in the literature. In this scenario, deep digital flexor (DDF) tenotomy is a therapeutic modality that can be used for the treatment of chronic laminitis, releasing the traction force that the DDF tendon exerts on the distal phalanx, which helps with realignment of the latter. The objective of this study was to address the important factors of DDF tenotomy and distal phalanx realignment for the treatment of horses with chronic laminitis. The results of the above analysis suggest that DDF tenotomy and realignment of the distal phalanx is a therapeutic option that should be learned by veterinarians and that it can produce benefits to horses with chronic laminitis.

Keywords: Horses, Laminitis, Tenotomy, Distal phalanx.

RESUMO
A laminite é a segunda enfermidade causadora de óbitos em equinos, além de ocasionar grande sofrimento ao animal, prejuízos econômicos e emocionais para as pessoas envolvidas. Diversas modalidades terapêuticas são empregadas para o tratamento desta enfermidade e não apresentam resultados consistentes descritos na literatura. Neste cenário, a tenotomia do flexor digital profundo (FDP) é uma modalidade terapêutica que pode ser empregada para o tratamento da laminite crônica, liberando a força de tração que o tendão FDP exerce sobre a falange distal, favorecendo o realinhamento da falange distal. O objetivo deste trabalho é abordar os fatores de importância da tenotomia do FDP e do realinhamento da falange distal para o tratamento de equinos com laminite crônica. Diante do exposto, pode-se concluir que a tenotomia do FDP e o realinhamento da falange distal é uma opção terapêutica que deve ser conhecida pelos médicos veterinários e que pode trazer benefícios aos equinos com laminite crônica.

Palavras-chave: Cavalos, Laminite, Tenotomia, Falange distal.

1 INTRODUCTION
In 1800, the term “laminitis” was used to refer to a disease that, since 1350 BC, had been described by the term "hoof problems" (WALSH; BURNS, 2017). Despite the length of time that this disease has been known, there are still great difficulties in its treatment, which often generate negative results (O’GRADY, 2006; WAGUESPACK; CALDWELL, 2009).
Among the phases of laminitis, the chronic phase is characterized by some authors by the presentation of clinical signs lasting more than 72 hours or by the separation of the dermal laminae of the hoof and displacement of the distal phalanx on the vertical and/or horizontal axis, as seen on radiographic examination (EUSTACE, 2010a; MORRISON, 2011).

Among the clinical and surgical treatment options for horses with chronic laminitis, notable techniques include hoofing and shoeing, support for correction of the uprights and angles, resection of the hoof wall, demotomy of the accessory carpal ligament and deep digital flexor (DDF) tenotomy (PARKS; O’GRADY, 2003).

The goal of DDF tenotomy is to release the traction force that this tendon exerts on the distal phalanx, reducing the pain caused by the separation of the dermal lamina from the epidermal lamina of the hoof. The technique helps with realignment of the distal phalanx and avoids new episodes of distal phalanx displacement in relation to the hoof (SIKKEL, 2020; WAGUESPACK, 2017; WAGUESPACK; CALDWELL, 2009). This surgical technique can be performed in the area of the pastern; however, at this site, there are descriptions of a greater number of complications than at the middle of the third metacarpal region (BURBA; HUBERT; BEADLE, 2006).

Tenotomy of the DDF and the realignment of the distal phalanx remains a controversial therapy among veterinarians, and few results from this procedure have been described in the literature. Thus, the present study aims to address the important factors of DDF tenotomy and realignment of the distal phalanx in horses.

2 MATERIALS AND METHODS

To perform the present study, several reference sources were used, included book chapters, journal articles, and articles presented at events.

The searches were conducted at the following sites:

The CAPES/MEC journals portal: http://www.periodicos.capes.gov.br
International Veterinary Information Service (IVIS): www.ivis.org
Scientific Electronic Library Online: www.scielo.org
Google Academic: https://scholar.google.com.br/
LITERATURE REVIEW

3.1 CHRONIC LAMINITIS

3.1.1 Definition

Equine laminitis is a highly challenging disease for veterinarians and owners. It is a traumatic disease for those who live with the sick animal and is usually associated with the end of athletic activity (REDDEN, 2007b). Laminitis can be simply defined as inflammation of the dermal laminae of the hoof, which, to a greater or lesser degree, will result in alterations of the lamellar interdigitations (O’GRADY; PARKS, 2008; REDDEN, 2007b; STASHAK, 2005).

Chronic laminitis is a stage of laminitis and, in most cases, derives from the acute phase of the disease (EUSTACE, 2010b; RENDLE, 2006). The chronicity of laminitis is characterized by some authors by the development of clinical manifestations of pain after more than 72 hours or when there is displacement of the distal phalanx due to failure of its suspensory apparatus, which responsible for maintaining its stability (COLLINS et al., 2010a; HOOD, 1999a; O’GRADY, 2010; O’GRADY et al., 2007). This stage of laminitis has a variable duration depending on the severity of the injury to the hoof structures, the treatments instituted, the duration of its development, structural changes and the individual response to the disease. These factors determine the capacity of bone and structural remodeling in the hoof (HERTHEL; HOOD, 1999). In addition, the longer the duration of chronic laminitis is, the greater the likelihood of the occurrence of concomitant systemic diseases, negatively impacting the prognosis of the animal (HERTHEL; HOOD, 1999).

Horses with chronic laminitis may exhibit different clinical manifestations and to varying degrees depending on the severity of the lesion on the digit structures (KAUFFMANN; CLINE, 2017). Among the main signs are varying degrees of claudication, change in the support on the digit shifting the weight to the heel, sole sensitivity, formation of “laminitic” rings in the hoof, inadequate hoof growth, sole perforation, subsolar abscess formation, subsidence of the coronary band and constant pain ranging from mild to severe (KAUFFMANN; CLINE, 2017; MORGAN; GROSENBAUGH; HOOD, 1999; RICHARD, 2015).

The literature also indicates that chronic laminitis generates changes in the conformation of the distal phalanx, with trabeculation and increased porosity of the dorsal and plantar cortices, bone remodeling and even fractures (ENGILES et al., 2015).
Another consequence of distal phalanx displacement is the formation of a filling scar tissue between the distal phalanx and the dorsal wall of the hoof. This tissue interferes with the internal biomechanics of the hoof, contributing to increased pain and predisposing the hoof to secondary fungal infections (COLLINS et al., 2010a; ENGILES et al., 2015).

The constant pain in horses with chronic laminitis is the result of several factors, including the intermittent pressure of the distal phalanx extensor process on the lamellar corium and the pressure of the distal phalanx apex on the soleus corium. These factors induce hypoperfusion and ischemia in the region, an increase in inflammatory mediators, constant injury to the lamellar tissues and stress on the tendons and ligaments (COLLINS et al., 2010b; HOPSTER; VAN EPS, 2019; MORGAN; GROSENBAUGH; HOOD, 1999).

Chronic laminitis can be subdivided into compensated chronic laminitis, characterized by changes in the positioning of the distal phalanx, which is stable and does not demonstrate displacement progression, allowing the hoof capsule to develop even with these changes (MORRISON, 2004, 2010). Another classification is decompensated chronic laminitis, defined as a displacement of a still progressing distal phalanx, generating a high degree of pain and a higher degree of claudication (HERTHEL; HOOD, 1999; MORRISON, 2004, 2010).

Displacement of the distal phalanx is a consequence of gravity and the amount of suspension apparatus tissue that was damaged, together with the influence of the forces acting on it (HOOD, 1999b). The displacement of the phalanx can be classified as capsular rotation, in which there is a separation of the dorsal surface of the distal phalanx from the hoof wall without loss of the alignment of the phalanges; phalangeal rotation, determined by the displacement of the distal phalanx independent of the other phalanges, where its apex migrates in a dorsal palmar/plantar direction, flexing the distal interphalangeal joint; vertical displacement or sinking, which occurs by the symmetrical displacement of the distal phalanx in the distal direction; and mediolateral displacement, which occurs when there is asymmetric distal displacement of the distal phalanx, i.e., only one side will move in the distal direction. The results presented in the literature show that animals may present with one or a combination of these types of displacement (HOOD, 1999b; PARKS; MAIR, 2009; PARKS; O’GRADY, 2003).
3.2 TENOTOMY OF THE DEEP DIGITAL FLEXOR

3.2.1 Indications

Tenotomy is a therapeutic modality that aims to release the distal-proximal traction force that the DDF tendon exerts in the palmar/plantar region of the distal phalanx. Thus, the technique can be used to treat severe flexor deformities and certain cases of laminitis (DEARO et al., 2012; FÜRST; LISCHER, 2019; HENDRICKSON, 2007).

The release of the traction force of the DDF tendon in cases of laminitis provides pain relief, since one of the sources of pain is due to the separation of the dermal and epidermal layers, which is induced by the traction of the DDF tendon on the distal phalanx (MCGUIGAN et al., 2005; WAGUESPACK; CALDWELL, 2009). In addition to facilitating the realignment of the distal phalanx, DDF tenotomy allows realignment of the bone column and the relationship between the distal phalanx and the hoof capsule (WAGUESPACK; CALDWELL, 2009). This technique increases the support on the plantar face of the distal phalanx, decreasing the pressure exerted by the apex of the distal phalanx on the soleus corium. In addition, this procedure can also prevent future displacement of the distal phalanx and allow the animal to be kept on pasture without the aid of orthopedic horseshoes after a few cycles of hoofing and shoeing, with the added benefit of reducing the maintenance costs of the horse (COFFMAN et al., 1970; HUNT, 2011; HUNT et al., 1991; MORRISON, 2011; WAGUESPACK, 2017; WAGUESPACK; CALDWELL, 2009).

There are still no clear descriptions of the indications of this surgical procedure for the treatment of laminitis in horses. However, experts have often used this technique in animals with severe laminitis, with a high degree of pain and/or progression of distal phalanx displacement, and in animals whose diseases are refractory to other therapies (BURBA; HUBERT; BEADLE, 2006; EASTMAN et al., 1998; WAGUESPACK, 2017).

DDF tenotomy is also recommended for reestablishing the alignment of the distal phalanx in cases of chronic laminitis before bone changes of the distal phalanx, as well as in cases where on radiographic examination, the animals have a sole thickness less than 10 millimeters and a palmar angle greater than 15 degrees (FLOYD, 2007). In addition, the use of venography to monitor blood perfusion in the digit is also recommended for decision-making (FLOYD, 2007; MORRISON, 2010; WAGUESPACK, 2017).
3.2.2 Surgical technique

Two surgical approaches have been described in the conduction of DDF tenotomy in horses: one approach is performed in the palmar aspect of the pastern, while the other approach is performed in the middle of the third metacarpal region (ALLEN et al., 1986; BURBA; HUBERT; BEADLE, 2006; HUNT, 2011; HUNT et al., 1991).

The surgical approach performed on the palmar aspect of the pastern is performed with the animal under general anesthesia (ALLEN et al., 1986). After trichotomy and antisepsis of the region, an incision of approximately three centimeters is made, which begins one centimeter proximal to the bulbs of the heel, on the palmar face of the pastern, and extends proximally. After the skin incision, blunt divulsion of the subcutaneous tissue is performed until the DDF tendon sheath is revealed, which in turn is incised at the same length and direction as the skin incision, exposing the tendon that will be isolated from the other adjacent tissues to be sectioned. After sectioning the tendon, suturing is performed with absorbable sutures of the tendon sheath, subcutaneous suturing with continuous simple stitches and, finally, suturing of the skin with nonabsorbable suture using separate simple stitches (ALLEN et al., 1986; HENDRICKSON, 2007; WAGUESPACK, 2017).

Although the first descriptions of tenotomy on the palmar aspect of the pastern were performed with the animal under general anesthesia and in lateral decubitus, this technique has also been performed with the animal in quadrupedal support under sedation and local anesthesia (WAGUESPACK; CALDWELL, 2009). In this technique, the limb is suspended by an assistant and undergoes an incision of one centimeter in length in the region of the pastern in the lateral aspect between the lateral portion of the superficial digital flexor tendon and the DDF tendon. It is followed by blunt divulsion of the subcutaneous tissue until the DDF tendon sheath is revealed, where the tenotome is inserted to perform the tendon incision. After confirmation by palpation of complete incision of the tendon, only the skin is sutured with separate simple stitches (ALLEN et al., 1986; WAGUESPACK; CALDWELL, 2009).

The surgical approach in the middle of the third metacarpal is performed with the animal in quadrupedal support under sedation and local anesthesia (BURBA; HUBERT; BEADLE, 2006). Sedation can be performed with the use of α2 agonist medications (xylazine or detomidine) or the combination of some of these drugs with opioids (butorphanol), in addition to local anesthesia, which can be performed using lidocaine or
mepivacaine for palmar and palmar metacarpal nerve block and/or using local infiltration at the surgical site (HUNT et al., 1991; KRAMER, 2006).

With the animal under sedation and local anesthesia and the surgical site prepared aseptically, a vertical skin incision approximately three centimeters in length is made in the middle of the third main metacarpal bone, in the lateral aspect between the superficial digital flexor tendon and the DDF tendon, immediately distal to the insertion of the accessory ligament in the DDF tendon (BURBA; HUBERT; BEADLE, 2006; MORRISON, 2011). Then, blunt divulsion of the adjacent tissue is performed until a paratendon incision is made. Thus, a tunnel is created between the superficial digital flexor tendon and the DDF tendon, and a second tunnel is created between the DDF tendon and the vascular/suspensory ligament plexus, isolating the incised tendon (Figure 1) (BURBA; HUBERT; BEADLE, 2006; HUNT et al., 1991; REDDEN, 2007a; WAGUESPACK, 2017).

Figure 1: Demonstration of the tenotomy technique in the region of the middle of the third metacarpal. Lateral view of the moment preceding the tenotomy, showing the isolation of the DDF tendon by blunt-tipped curved rods.

For the tenotomy itself, a tenotome can be used, which is placed between the superficial digital flexor tendon and the DDF tendon. Thus, with mild mediolateral movements, the tendon incision is performed (HUNT et al., 1991). Two blunt rods can also be used as auxiliary materials for the prevention of injury to adjacent tissues for
tenotomy with curved tips of the rods. These rods will be inserted one in each tunnel so that their tips are in the medial aspect to protect the tissues adjacent to the tendon from the scalpel that will make the incision. After complete incision of the tendon, the separation of the stumps is observed, forming a space of approximately two centimeters, followed by skin suturing (BURBA; HUBERT; BEADLE, 2006; FLOYD, 2007; WAGUESPACK, 2017).

Both techniques should be performed only after hoofing and placement of horseshoes with palmar/plantar extension and five-degree elevation of the heel. The horse should remain shod for a period of 8 to 10 weeks to prevent subluxation/dislocation of the distal interphalangeal joint (HUNT, 2011; MORRISON, 2011).

3.2.3 Complications

In addition to subluxation of the distal interphalangeal joint, additional intra- and postoperative complications may include arthritis and arthrosis resulting from a subluxation/dislocation of the distal interphalangeal joint; incomplete section of the tendon, causing much pain to the animal; trauma of the lateral palmar and/or medial palmar nerve, leading to hyperextension, inability to support weight or even the formation of a neuroma; vascular injury, causing intraoperative hemorrhage and regional circulatory deficit; infection of the surgical site; suture dehiscence; tendinitis of the superficial digital flexor and inability to align the distal phalanx (FLOYD, 2007; KRAMER, 2006; WAGUESPACK, 2017).

Some of these possible complications can be avoided by using certain techniques and/or specific materials during the surgical technique. Subluxation of the distal interphalangeal joint and the correct positioning of the distal phalanx can be circumvented when using horseshoes suitable for the performance of the tenotomy or by selecting the appropriate surgical technique that will be employed (DEARO et al., 2012; MORRISON, 2004). This is because when the tenotomy is performed in the region of the pastern, relaxation and a greater possibility of altering the angles are obtained when compared to the performance of the tenotomy at the metacarpal level (DEARO et al., 2012). This is especially because when performed in the metacarpal region, the paratendon connected to the subcutaneous tissue promotes stability to the distal phalanx (DEARO et al., 2012; HUNT, 2011; WAGUESPACK, 2017).
Neurovascular trauma can be avoided when blunt rods with curved tips are used for the tenotomy, as these tools, in addition to promoting isolation of the tendon, also isolates the adjacent tissues and thus reduces the possibility of injury with the scalpel when the tenotomy is performed (BURBA; HUBERT; BEADLE, 2006).

Infection, especially of the tendon sheath, can be avoided by accessing the metacarpal region, since there are no synovial structures in this region (HUNT, 2011; WAGUESPACK, 2017).

Surgical access in the metacarpal region is typically the first option for tenotomy because it is easily performed with the animal in a quadrupedal position (BURBA; HUBERT; BEADLE, 2006). In addition, this access presents no risk of contamination of the synovial sheath and preserves the possibility of performing a new tenotomy in the region of the pastern (PARKS; O'GRADY, 2003; WAGUESPACK, 2017).

3.2.4 Postoperative

After surgery, the animal receives a sterile bandage for a period ranging from 21 to 30 days that is changed weekly depending on the veterinarian. All animals should also receive prophylaxis against tetanus, and anti-inflammatory therapy with phenylbutazone at a dose of 2.2 mg/kg every 12 hours for three days is also indicated; after this period, a 2.2 mg/kg dose should be administered every 24 hours for a period of 30 days (dose and period of administration may vary depending on the professional) (ALLEN et al., 1986; HUNT et al., 1991; KRAMER, 2006).

The need for antimicrobials in this type of procedure is still controversial. Some authors use penicillin with or without gentamicin, while others argue that there is no need to use antimicrobial therapy in clean orthopedic surgeries (STÖCKLE et al., 2018; WAGUESPACK; CALDWELL, 2009).

After performing the tenotomy, the horse needs to stay in a restricted stall until it comfortably starts to support itself with all four legs most of the time (FLOYD, 2007). From this moment on, it is possible to allow short walks, preferably in soft and wide terrains, to allow smooth curves, which can be gradually expanded (FLOYD, 2007).

The animal must remain with the specific tenotomy shoe for a period of 8 to 10 weeks, accompanied by constant monitoring of the alignment of the distal phalanx by radiographic examination (HUNT, 2011). After this period, the animal may remain without a shoe if the hoof is able to go without it. After an interval of four weeks, the hoof
should be trimmed with radiographic monitoring to maintain the alignment of the distal phalanx and the hoof (FLOYD, 2007; HUNT, 2011; KRAMER, 2006).

Venography can also be used as an auxiliary method in the follow-up of the horse after tenotomy, as this technique provides indicators of the response to treatment as well as of the animal’s prognosis (BALDWIN; POLLITT, 2010; REDDEN, 2001).

3.2.5 Postsurgical evolution

The first study that described results obtained from 13 animals with refractory chronic laminitis who were subjected to tenotomy in the region of the pastern indicated that five animals returned to a reduced level of activity; six did not return to athletic activity but were healthy and allowed to roam free in the pasture; one animal showed improvement but was euthanized for economic reasons; and one horse improved and after nine months was euthanized for aggravating the case (ALLEN et al., 1986).

In comparison, another 20 horses with severe acute laminitis or chronic laminitis underwent tenotomy in the metacarpal region; of these, 11 animals survived less than one month, six horses survived more than six months, and none of the animals returned to athletic activity (HUNT et al., 1991).

Another study evaluating 37 horses subjected to tenotomy indicated that 77% survived six months after surgery and that 60% survived for up to two years after surgery (EASTMAN et al., 1998).

In 1999, a study evaluating 35 animals treated with tenotomy showed that 77% survived more than six months and that 59% survived more than two years (EASTMAN et al., 1999a).

In 2011, 245 horses treated with tenotomy were evaluated, among whom 51% survived for at least one year with good body condition and an Obel degree lower than 2 (MORRISON, 2011).

The studies that evaluated tenotomy as a treatment for laminitis obtained different results but were able to conclude that the procedure is a viable therapeutic option for the treatment of chronic laminitis. It is also worth noting that although the prognosis regarding athletic activity is poor, the horse can have a free and comfortable life in the pasture (ALLEN et al., 1986; EASTMAN et al., 1999b; KRAMER, 2006; WAGUESPACK, 2017).
3.3 ALIGNMENT OF THE DISTAL PHALANX

An element equally as important as the tenotomy technique is trimming and shoeing to re-establish the angles and the relationships of the distal phalanx with the hoof (DRYDEN, 2013). In addition, trimming and shoeing contribute to preventing the development of subluxation/dislocation of the distal interphalangeal joint, making it an indispensable procedure for horses that undergo tenotomy (DRYDEN, 2013; FLOYD, 2007; NICKELS, 2003).

Realignment of the distal phalanx seeks the return of making the plantar surface of the bone parallel with the soil surface, improving the distribution of the blood supply in the soleus corium and allowing the growth of the hoof sole in adequate proportions. It also promotes the reduction in pain generated by the pressure exerted by the apex of the distal phalanx on the soleus corium and by the pressure exerted by the extensor process of the distal phalanx on the coronary plexus. Thus, it favors the return of blood supply and adequate resumption of hoof growth in addition to preventing bone changes with improvement in local blood circulation (MORRISON, 2004, 2011; O'GRADY, 2006).

3.3.1 Trimming

Realignment of the phalanx begins with trimming, which should be performed with the animal under block of the digital palmar nerve in the abaxial sesamoid region and with the aid of X-ray to make more precise adjustments (MORRISON, 2010). It is recommended to start with the nib of the ranilla, removing as much as possible mainly at its base while maintaining the healthy aspect. This excision will allow an easier evaluation of the present amount and how much of the hoof can be reasonably excised (FLOYD, 2007; MORRISON, 2010; REDDEN, 2007a).

It is recommended that the heel that should be trimmed be adjusted from a line parallel to the palmar face of the distal phalanx with a distance of 15 to 20 mm, making this cut line on the support surface (Figure 2). (O'GRADY, 2006; PARKS; O'GRADY, 2003). Due to the high degree of rotation, in some horses, it is not possible to excise hoof material of sufficient quantity for the plantar surface of the phalanx to become parallel to the ground (O'GRADY, 2006). Thus, it is recommended to place a silicone wedge with its greatest thickness positioned in the region of the apex of the distal phalanx and extends to the region of the lugs with its lowest thickness to achieve a palmar angle of zero degrees (FLOYD, 2007; NICKELS, 2003; O'GRADY, 2006, 2010).
The point of intersection of the first excision line with a line drawn parallel to the dorsal surface of the distal phalanx is the most dorsal region to place the horseshoe, but it can be inserted at a palmar point if necessary (O’GRADY, 2006). Conversely, the breakover point is determined by tracing a line from the apex of the distal phalanx in the direction of the first cutting line to form an angle of 90° with the same; the breakover point is then located 6 mm dorsal to this crossing point (O’GRADY, 2006, 2010; PAGE et al., 1999).

Figure 2. Adjustment of the heel and correction of the palmar angle: A Image taken prior to heel material excision; B Image taken after heel material excision.

Source: Dr. Marcelo Damas Pyles.

3.3.2 Shoeing

After trimming, horseshoes should be placed parallel to the plantar surface of the distal phalanx. This shoe can be fixed with nails or specific glues and/or plaster, which are less traumatic for fixation (MORRISON, 2011; REDDEN, 2007a; STASHAK, 2005). The horseshoes should provide palmar extension and elevation close to five degrees in the lugs to avoid dislocation of the distal interphalangeal joint. An aluminum plate can also be added, closing the palmar portion of the horseshoes to provide extra support in the palmar portion of the hoof (MORRISON, 2004, 2011; O’GRADY, 2010).

Aluminum is a lightweight material that is easy to manipulate, reusable and adheres easily to glues for fixation on the hoof. It is the material of choice for use in horseshoes that will be applied to horses with chronic laminitis and in cases of restoration of the angle of the distal phalanx (O’GRADY, 2010; REDDEN, 2007a).
In horses where the rotation angle of the distal phalanx is high, fixation of the horseshoe to a palmar angle of zero degrees will form a space between the hoof and the horseshoe in its dorsal portion, which should be filled with a wedge-shaped silicone support (O’GRADY, 2006). This silicone support should be positioned immediately palmar to the apex of the distal phalanx, decreasing in thickness until the region of the lugs, allowing excess space in the palmar portion of the hoof and horseshoes for the application of the glue to join the set (Figure 3) (O’GRADY, 2006; STASHAK, 2005). After placing the horseshoes and the silicone support in the correct position, fiberglass bands impregnated with glue are applied to the sidewall of the hoof, encompassing the horseshoe to give more adhesion of the materials to the hoof (MORRISON, 2004; O’GRADY, 2006).

Figure 3. Positioning of the horseshoe and the silicone wedge for reestablishing a palmar angle of zero degrees with the horseshoe surface

Source: Dr. Marcelo Damas Pyles.

It is recommended that hoofing and shoeing be performed before the tenotomy procedure to avoid the risk of dislocation of the distal interphalangeal joint and to avoid failure of glue adherence to the hoof due to the increase in moisture resulting from the surgery (MORRISON, 2004; O’GRADY, 2010). The angle-correcting shoe should remain equipped for eight to ten weeks, after which it should be removed, and periodic trimming should be performed to maintain the position of the distal phalanx. If there is no adequate hoof growth and there is a continuity solution, local dressings should be applied (FLOYD, 2007; HUNT, 2011).
4 FINAL CONSIDERATIONS

Understanding of the DDF tenotomy technique, realignment of the distal phalanx and its correct application is a determining factor for success in the treatment of horses with chronic laminitis. Therefore, understanding this therapy should be essential for veterinarians committed to developing work related to equine medicine.
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