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Farriery for the young horse: Flexural deformities
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Farriery in the Treatment of Acquired Flexural Deformities

Contracture of the Deep Digital Flexor Tendon

There is often confusion between the hoof pastern axis (HPA) and hoof angle. The HPA is the alignment of all three phalanges and the (dorsal) hoof wall. It is normal for a foal to have an HPA angle of 60 degrees or even 65 degrees to the horizontal. This drops to approximately 50-55 degrees in the mature horse. A high angle (60 degrees or more) does not necessarily mean that the foal has AFD or club foot (CF). When contracture of the deep digital flexor tendon (DDFT) occurs the distal interphalangeal joint (DIPJ) is flexed and the HPA is broken forward and the heels of the hoof do not bear weight. To differentiate from a CF, this is termed AFDdipj (Figure 1).

Figure 1: A foal with AFDdipj where the heels do not bear weight.

Characteristic signs of AFDdipj are:
1. A stilted gait
2. Standing on the toe only - heel clear of the ground
3. Excessive heel
4. Broken-forward hoof pastern angle (HPA)
5. Excessive wear at toe
6. Concave dorsal wall

CF is the final manifestation of AFDdipj involving relative contraction of the DDFT. It must be clearly understood that CF is secondary to the condition and is not the cause. A CF has similarities to a chronic laminitic foot and presents the farrier with many of the same bio-mechanical problems. The aim of farriery
is to return the foot to a normal alignment and shape in order that the horse does not have a chronic CF which is a permanent source of lameness. (Figure 2)

Figure 2: A Grade II club foot

The characteristic signs of a CF are:
1. HPA broken forward
2. Dorsal wall angle at 65 degrees or greater
3. Concave dorsal wall (not ‘foal foot’)
4. Heels growing faster than toe
5. Coronary band approaching a horizontal position
6. Growth rings diverging at the heels
7. Foot narrower than normal (than other foot)
8. Solar view shape more oval than round
9. Lateral clefts more vaulted than normal
10. Sole forward of frog apex flat or convex
11. Atrophied frog
12. Separation of white line/poor hoof quality at toe
13. Lateral radiograph shows distal phalanx rotation in relation to hoof capsule and middle phalanx with remodelling and lytic changes including the dorsodistal border.

Farriery Treatment of DDFT Contracture

Farriery is aimed at creating a straight HPA. In horses with normal joint flexion reducing the heels will raise the angle of the pastern and a broken-back HPA is created. Raising the heels will lower the pastern angle and a broken-forward HPA is created. The ability of the farrier to alter the HPA is used in the treatment of dorsal-caudal imbalances in the mature horse, e.g. long toe/low heel syndrome. It follows that, when an AFD contracture has created a broken-forward HPA, then heel trimming is indicated to achieve correct alignment. In the least severe cases heel trimming allows the hoof capsule and PIII to ‘de-rotate’. In more severe cases especially where the heels are already not in contact with the ground, then tendon tension maintains the HPA in a broken-forward misalignment. Below are described 4 possible ways of treating DDFT contracture.
Mechanically Forcing the Hoof and Phalanges into Alignment by means of Hoof Trimming, alone or in conjunction with a shoe.

Where there is a broken-forward HPA and the heels are in contact with the ground (CF,) or the heels are just off the ground, radical heel trimming is often used in the belief that the toe will act as a fulcrum and the body weight of the foal will force the foot and/or HPA into alignment. This was undertaken in Case 1 in the report of AFD. However, it does not seem logical to believe that, when the tendon contracture has been strong enough to lift the heels off the ground despite the foal's body weight, the process will be reversed by increasing the gap between ground and heel by trimming the heels. The increased tendon tension must be transmitted to the dorsal hoof wall laminae and extra stress placed upon the distal dorsal border of PIII.

Toe extension shoes have been historically used to apply additional mechanical pressure to gain realignment of the HPA. The Swan Necked shoe is traditionally made of steel. This shoe has a toe extension that projects horizontally and dorsally and then curls dorsal and caudal until it rests against the dorsal wall. The rationale for the swan neck is to transfer some of the leverage stress from the solar toe area onto the more robust dorsal wall. This also lessens the chance of leverage forces lifting the shoe’s heels. A more modern version of the swan-necked shoe is an aluminium toe extension with the stress being transferred to the dorsal wall via an acrylic insert. This shoe has the advantages of being lighter, easier to make and the acrylic spreads the stress across a greater area. Another alternative is one of the glue-on shoes now available. Present day glue-on shoes are also very light and have the advantage of avoiding the need to nail to a small and possibly damaged hoof. (Figure 3)

I believe that the toe extension has its place in the treatment of AFD if not used aggressively. If the heels are trimmed radically and a toe extension is fitted then the additional leverage will increase the tension upon the DDFT. This additional tension must be borne within the hoof and may well result in extra damage to the dorsal laminae and remodelling of PIII. Even where the hoof capsule is forced to the ground the continual tendon pull may be enough to maintain the rotationally misalignment of the phalanges. In such a case PIII is even more rotated within the hoof capsule. It is ineffective in treating the primary problem, i.e. the tendon contracture. The use of this shoe alone, without nutritional and especially exercise reduction, increases the risk of creating the secondary problems mentioned above.

![Figure 3: An aluminium and polymer urethane toe extension](image)

Protecting the Hoof Capsule and/or the Third Phalanx (PIII) From Remodelling Changes

In cases of DDFT contracture weight is borne at the toe. There is often excessive wear with the possibility of damage to the underlying sensitive tissues. The laminae joining the dorsal wall to the dorsal aspect of
PIII may already be weakened due to laminal tearing caused by PIII, leading to remodelling, lytic changes and crushing of both the papillae of the white line and the sensitive sole.

A nail-on aluminium shoe offers protection but may be difficult to apply due to lack of wall on which to nail. A glue-on shoe avoids this problem. A cuff-type glue shoe (Dalmer) protects and may also disperse stress.

**Conservative Heel Trimming**

In the least severe cases where the heels are seen to be in contact with the ground, conservative heel trimming should be tried. Only a small amount should be removed and the foal then observed both walking and standing to ascertain the HPA and whether the heels are still in contact with the ground. If the HPA is still broken forward and the heels are on the ground then more heel can be removed. If, however, after the initial trimming there is clearly a gap at the heel and the foal is walking on its toe then further heel trimming is not recommended. Further heel trimming may be undertaken after 1 week of restricted exercise if the heel is then on the ground.

I believe that the most effective treatment for AFD of this type can be summed up as immediate and conservative. The best results occur on stud farms where there is close and continual observation of stock, and where action is taken at the slightest signs (stilted gait, broken-forward HPA). Such action includes a reduction/alteration in nutrition, box rest and not radically trimming the heels until relaxation of the DDFT has occurred. Progress can then be made towards returning the foot to alignment with the limb. Where this pattern is followed the incidence of chronic CF is drastically reduced.

**Farriery in Conjunction with a Check Ligament Desmotomy**

In conjunction with a distal check ligament desmotomy, corrective farriery is essential. When a distal check ligament desmotomy has been carried out, regardless of the stage of the condition, the foot should be trimmed to allow a straight HPA. Thus, in the case of a CF the heels should be radically reduced. It is not usually necessary to use a toe extension to ensure correct HPA alignment.

**Discussion**

The hoof capsule is very susceptible to changes in shape due to stresses from within and uneven weight bearing. Temporary changes in shape may also occur due to uneven wear. Because the horny (insensitive) structures of the young horse are more flexible than those of a mature horse and are growing faster, they are more easily affected by weight and stress factors. This is also true of media-lateral imbalances where straightening of the side of the foot and shunting of the heel occurs on the weight bearing side and flaring of the wall occurs on the other side.

It is important to recognise that a CF is the result of AFD and not the cause. Correction of the underlying condition must be successful for there to be any chance of preventing the creation of a CF or returning the foot to something approaching normal.

The aims and possibilities of corrective farriery have become confused. In the least severe cases of AFD the foot may be the only sign of the condition. With only slightly greater than normal tension on the DDFT the weight of the foal is thrown upon the toe. This may cause extra wear. The heel, although apparently in contact with the ground, is not taking the weight of the limb and in response the hoof wall at the heel grows more rapidly. The hoof capsule has fulfilled one of its main functions. By overcoming a limb imbalance, in this case between tendon and skeletal length, the foot is now bearing weight evenly and the tendon is not under continual stress.
It is difficult to resist the temptation, when first confronted with an AFD that has already produced extra heel growth, to trim the heels immediately. If one could be certain that the primary condition was under control then it is sensible to attempt to return the foot to a normal HPA as soon as possible. Where there is clearly a gap between the ground and the heel it makes no sense at all to trim the heel. Far from “lowering the heel” as this is often described, the opposite is achieved. Without heel contact contraction of the foot is bound to occur. This extra DDFT tension induced, especially with exercise, may lead to rotation of PIII within the hoof capsule with all the consequences mentioned previously. It is possible that the heel may be forced into contact with the ground and therefore success claimed but the phalanges remain in the rotated (broken forward) position.

In an ideal case the condition is recognised at an early stage, i.e. before the dorsal hoof wall is almost vertical or a CF has been created. The foal is box rested and nutrition is altered and reduced. Heel rasping is minimal until the condition is stabilised. The heel is then rasped by small amounts weekly.

**Contracture of Superficial Digital Flexor Tendon (SDFT)**

This condition (knuckling forward at the fetlock) appears to occur after 6 months of age. It can easily be differentiated from a DDFT contracture by the limb conformation. When the SDFT is involved the foot remains in normal contact with the ground and the pastern angle is raised. This creates a broken-back HPA. (Figure 4)

Traditional and present day farriery treatment is to shoe with a raised heel and toe extension. The raised heel reduces tension on the flexor tendons (allowing the fetlock to descend) and the toe extension is to prevent further knuckling.

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Figure 4: SDFT contracture causes “knuckling forward” of the fetlocks.

Raising heels in cases of SDFT contracture is not a new idea (Dollar 1898). Although my experience is limited, in the few cases seen there has been improvement using this method. It is interesting to compare the fact that raising the heels has been an accepted treatment for many years in SDFT contracture, but only in recent years has a similar procedure been used for DDFT cases. It has been suggested that the DDFT is also under excessive tension in cases when the pastern is raised and the reason that the heels remain in contact with the ground is that the route from its origin to its insertion has been shortened by the angle at the
fetlock decreasing. In other words, because increased tension of the SDFT has raised the fetlock the tension in the DDFT is relieved and therefore the coffin joint is not forced to flex.

Effective Farriery Treatment of Hypoflexion Tendons (severe digital hyperextension) in Foals

Introduction

Flexor tendon laxity is a relatively common limb deformity in neonatal foals. There is a range of severity, in its most severe form, it results in the foal weight bearing on the palmar/palmar aspect of the proximal phalanges and fetlock, with the toe raised. It is most frequently seen in premature and dysmature foals or those suffering serious systemic illness. The hind limbs are most commonly affected, although in premature foals all four limbs may be involved. Hypoflexion Tendons (severe digital hyperextension); bio- mechanical forces drive the heels forward and the toe up (Figure 54). In the less severe cases the condition usually resolves spontaneously, although the bulbs of the heel may need protection to prevent decubitus ulcers developing. Farriery treatment consists of trimming the heel to allow a longer base of support and to reduce rocking back on the bulbs. Some of the more severe cases fail to respond, and it has been recommended that caudal extensions may be applied by taping, gluing or nailing (Adams 1990; Leitch, 1985).

Taping is unsatisfactory and difficult to achieve without constricting the hoof capsule. Nailed on shoes require skilful forging ability to make them and risk damage to the sensitive structures of the foot. If pulled off there is usually hoof wall damage.

Figure 5: A case of flaccid tendons showing toe-up conformation.

Treatment and Course of Condition

The foal is tranquillised with detomidine 1mg i/v (Domosedan, Pfizer Ltd, Kent) and butorphanol 1mg i/v (Torborgesic, Willow Francis Veterinary, West Sussex) to allow farriery treatment while standing. Both hind feet are trimmed to normal proportions. The sole, bars, frog, and outer hoof wall were trimmed down to clean horn. The coronary band may be protected with elastoplast or other tape. Any open lesions on the bulbs are treated with Terramycin Aerosol Spray, (Pfizer Ltd, Kent).

Caudal extension shoes are made from 6mm aluminium plate. Two elongated triangles are cut approximately 75mm by 150mm. These are bent 30mm from the sharp end to fit the angle of the toe. A
layer of hoof repair composite (Equilox, Atlantic Equine, Rugby) is laid on the sole and dorsal hoof wall. The caudal extension is placed in position and another layer of composite material and strengthening cloth was wrapped around to secure it. The composite is worked to a smooth finish. Care is taken that the lesions are not covered by any of the materials. The composite material is allowed to set prior to weight bearing. The foal is exercised on a level firm surface 4 times each day for 10 minutes (Figure 6).

The foal is re-evaluated one month after the original application of the extensions. Both caudal extensions should be removed and the feet trimmed. If the stance and walk has improved with the foal no longer requiring the mechanical assistance of an extension, the shoes can be left off and the foal allowed nursery paddock exercise. Occasionally the treatment needs to be continued for another 3-4 weeks and exceptionally for a third time.

Discussion

Although many cases of flexor tendon laxity resolve with careful management there are a few that fail to respond during the first few weeks of life. It is important that as these foals improve and exercise may be increased, it should remain restricted to avoid the risk of avulsion fractures of the proximal sesamoid as a result of extreme dorsiflexion of the fetlock joint. Caudal extensions are considered to be the treatment of choice in severe or non-responsive cases (Adams 1990, Leitch 1985) although the method of attachment is not ideal.

This method is superior to other methods for a number of reasons: 1) This method carries no risk of infection (nailing into foals feet is always hazardous). 2) It is very light compared to alternative methods. 3) The attachment of the extension is extremely strong and able to withstand the stress placed upon it by the weight of the foal. 4) It is simple and requires no forging skills. The extension can be made in situ in minutes without any special tools. Because of the simplicity of method there is an economic advantage over other methods. 5) It does not restrict the hoof capsule or carry the risk of impeding the blood supply, as in the methods involving glue on shoes and taping.

Figure 6: A case of flaccid tendons treated with caudal extensions, the left fore (nearest) has a slight varal deformity and therefore the aluminium plate has been cut to offer lateral additional support.

References and Further Reading

1. Adams' Lameness in Horses 4th Ed. Stashak T.S.
5. Dalric, B1-B2, Brooks Lane Smithy, Middlewich CW10 0JH.
6. Equilox, Atlantic Equine, Calcutt House, Flecknoe, Rugby, CV23 8AU.