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Case Report

Partial coronary epidermectomy (coronary peel), dorso-distal wall fenestration and deep digital flexor tenotomy to treat severe acute founder in a Connemara pony

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Keywords: horse; laminitis; acute founder; coronary epidermectomy; coronary peel; founder distance

Summary

A new surgical treatment is described that was used to treat acute founder of 16 days' duration in both front feet of an overweight pony. The decision to employ the new method was influenced by the founder having occurred relatively recently, the presence of a large founder distance and the low anticipated success rate based on data obtained from 166 previous cases of acute founder treated with a heart bar shoe, dorsal wall resection and deep digital flexor tenotomy method. The treatment provided rapid improvement in lameness and a successful outcome with a good cosmetic result.

Introduction

The treatment of laminitis and its sequelae in horses present clinicians with considerable challenges. A wide range of diagnostic, managemental, farriery and surgical protocols have been advocated for use in the treatment of the sequel acute founder (White and Baggett 1983; Chapman and Platt 1984; Goetz and Comstock 1985; Eustace and Caldwell 1989; Hunt *et al.* 1991; Eustace 1992; Redden 2001a,b; Parks 2003; Rendle 2006). Few reports of the results of these treatments have been published (Allen *et al.* 1986; Baxter 1986; Peremans 1991; Eustace and Cripps 1999). This report describes a new surgical technique used to treat severe acute founder in a horse 16 days after the onset of clinical signs.

The nomenclature relating to laminitis is not universally agreed (Eustace 1991; O'Grady *et al.* 2007). The problems relating to terminology are discussed in the accompanying Clinical Commentary (Parks and Mair 2009). The terms used in this Case Report are those the authors consider to have prognostic significance for clinical cases (Eustace 1991; Eustace and Cripps 1999).

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The term founder is used to indicate anatomical dislocation of the distal phalanx from its normal position in the hoof. Horses with chronic founder show characteristic abnormalities of affected hooves including: a broken back hoof-pastern axis, long or concave dorsal hoof walls, abnormally wide white lines from quarter to quarter, and divergent growth rings on the hoof walls. The growth rings are more widely spaced at the heels compared to the toes leading to relative over-growth of the hoof wall at the heels (**Fig 1**). The soles are flat or convex. On palpation, the coronary bands often seem soft or indistinct and the skin seems to merge directly with the horn with no recognisable perioplic ring. These changes indicate that the animal has suffered from acute founder in the past and may have an increased founder distance on radiographs. A horse suffering laminitis for the first time does not show the hoof distortions characteristic of a chronic founder case. Laminitis cases have abnormally strong pulsation in the digital arteries of affected feet, tend to adopt a heel-loading and toe-relieving stance, and repeatedly shift their weight from one affected foot to another. There has been no dislocation of the distal phalanx from its normal position in the hoof in the first-time laminitis cases.

Similar to horses with acute laminitis, an animal suffering acute founder for the first time does not show the hoof distortions characteristic of a chronic founder case. Horses with acute founder have the same clinical signs as acute laminitis, but in addition have palpable depressions just above the coronary band (supra-coronary depressions) (**Fig 2**). These depressions extend a variable distance (but not all the way) around the coronary band. The wider and the deeper that the depressions are, the greater the displacement of the distal phalanx in relation to the hoof (resulting in a greater founder distance) on radiographs.

Founder distance is a radiological measurement made from a latero-medial exposure; it correlates well

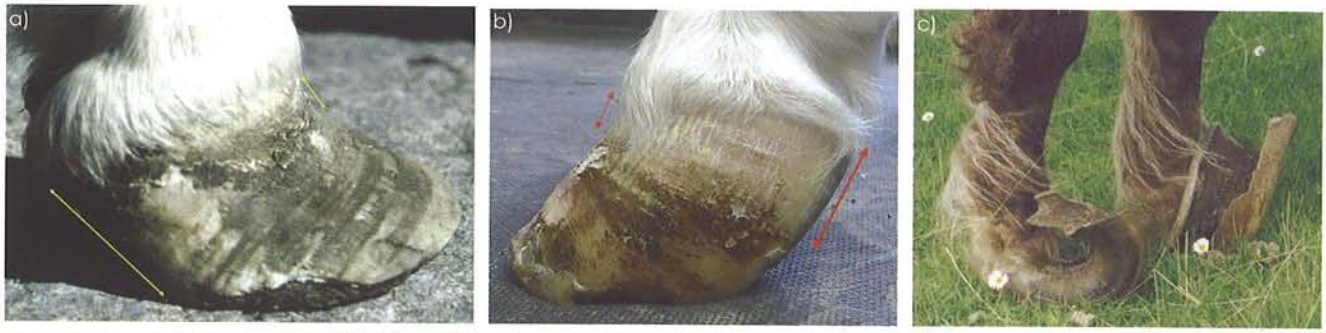

Fig 1: a), b) and c) Chronic founder hooves all showing greater heel than toe growth. Red and yellow arrows indicate the amounts of toe and heel horn produced during the same time period.

with the palpable depth of supra-coronary depressions in acute founder cases, and is the most significant radiological prognostic parameter in acute founder cases (Eustace and Cripps 1999). To measure founder distance accurately a straight, stiff, wire marker (preferably 5 cm long), is taped to the hoof wall. The wire marker is placed in the sagittal plane of the hoof with the proximal end where the sub-coronary horn changes from hard to soft as determined by firm digital palpation. This point is not at the coronary band but distal to it. Placement of the proximal end is easier in an acute founder case when the skin has been pulled down behind the top of the hoof wall creating an obvious ridge. Two lines, parallel to the ground, are drawn on the radiographic image, obtained from a latero-medial radiograph. One line passes across the top of the wire marker and the other across the top of the extensor process of the distal phalanx. The vertical distance between these 2 lines is the imaged founder distance (**Fig 3a,b**). To correct for any magnification effects the following formula is applied to calculate the true founder distance. True founder distance = imaged founder distance x actual length of wire marker/imaged length of wire marker.

Fig 2: The site above the coronary band to evaluate a supra-coronary depression characteristic of acute founder cases.

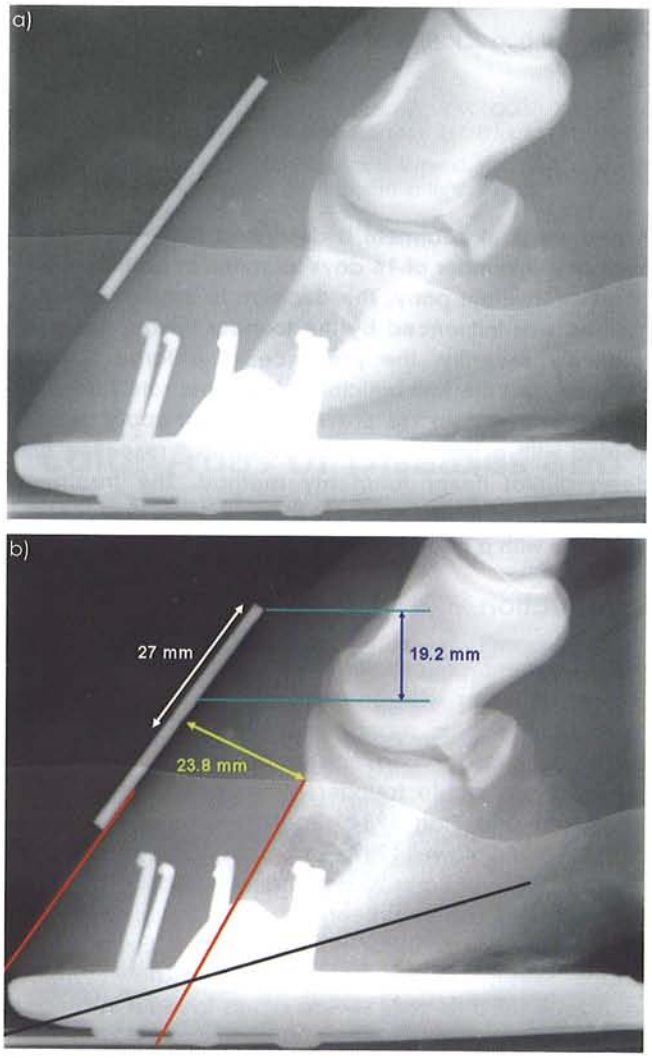

Fig 3: a) Latero-medial radiograph of left fore foot on Day 13 at admission to the Laminitis Clinic. b) The same radiograph as in a) but with measurements added (corrected for magnification). Angle subtended by the solar margin of the distal phalanx and the ground: 13° (RF 12°); difference between the angles subtended by a line from the dorsal surface of the distal phalanx to the ground and a line from the dorsal hoof wall to the ground (red lines): 7° (RF 5.5°); distance between the base of the extensor process and the hoof wall: 23.8 mm (RF 23 mm); distance between the top of the dorsal wall marker and the proximal limit of the laminae: 27 mm (RF 25 mm); founder distance: 19.2 mm (RF 17.3 mm).

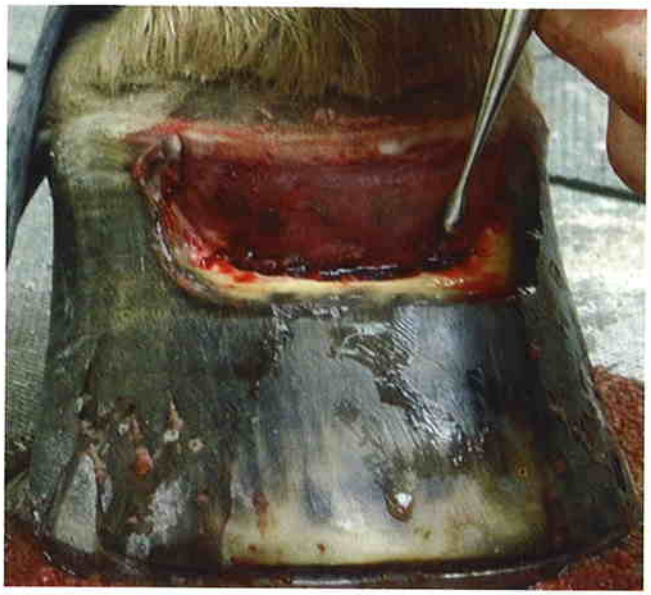

Fig 4: Dorsal view of the left fore foot following the coronary peel and during light curettage on Day 16.

Fig 5: a) and b) Dorsal view of left fore foot on Day 43 during and after the fenestration procedure.

Fig 6: Front view of left fore foot on Day 58 showing evidence of regenerating coronary band and the area of dorso-distal hoof wall removed during the fenestration procedure.

Fig 7: Frontal view of right fore foot on Day 102 after the removal of the dorsal 'bridge' but before foot dressing and shoe re-set.

Fig 8: Frontal view of left fore foot on Day 195 just prior to discharge from the Laminitis Clinic.

Case details

History

A 13-year-old Connemara pony gelding, 143 cm tall and weighing 500 kg developed bilateral forelimb lameness (Day 1). The pony was presented for examination and treatment at the first author's clinic on Day 13. The pony was overweight (condition score 4; Carroll and Huntington 1988), and had a large preputial sheath, swollen with subcutaneous fat, which prevented protrusion of the penis and resulted in urine dribbling over the dependent prepuce. The pony was also suffering from a thrush-like infection of both left frogs. The pony had received 6 g phenylbutazone, 500 mg flunixin meglumine and 100 mg acepromazine in the previous 24 h, yet showed a *grade 3* lameness on both front feet (Eustace and Cripps 1999). Deep supra-coronary depressions, 8 cm wide, were present on the front feet, which, along with strong digital pulses, led to a diagnosis of acute founder. The pony wore a set of open steel shoes. The soles of the front feet were markedly convex. Radiological examination of the front feet revealed founder distances of 17.3 mm and 19.2 mm in the right and left fore feet respectively (**Fig 3b**).

The pony was confined to a large stable 4.5 m square, covered with clean dry whitewood shavings to a depth of 36 cm at the back and 10 cm at the front. Medications were withdrawn in order to evaluate the true degree of lameness and recognise whether deep digital flexor muscle contracture was present. Within 36 h the pony began to stand on the toes of the fore feet and would not take weight on the heels: this, along with the palpably increased tension in the deep digital flexor tendons of the front legs, indicated significant deep digital flexor muscle contracture. This suggested that deep digital flexor tenotomies would be helpful. The pony was administered 2 g phenylbutazone (Equipalazone)[1] and sedated using 5 mg detomidine hydrochloride (Domosedan)[2] followed by 10 mg of butorphanol tartrate (Torbugesic)[3], i.v. The skin between the front metacarpo-phalangeal joints and the carpi was clipped, washed in a povidone iodine solution (Vetasept)[4], rinsed then rinsed again in surgical spirit[5]. High palmar nerve blocks were performed in the left fore leg using lignocaine hydrochloride with adrenaline[6]. The deep digital flexor tendon was divided in the lower third of the cannon region. The 3.5 cm skin wound was closed using 4 size 0 Polysorb sutures[7]. The leg was bandaged down to the metacarpo-phalangeal joint using sterile semi-permeable dressings (Zorbopad)[8] under Gamgee tissue[9] and self-adhesive bandages (Bandesive and Co-Lastic)[8].

Using a high speed drill fitted with a semi-blunt router bit, 2 full thickness vertical incisions were made in the hoof horn over the coronary groove as defined by O'Grady *et al.* (2007). The incisions were extended distally to the distal limit of the coronary groove, as measured radiologically (**Fig 3b**). A horizontal incision was made to connect the distal limits of the previous incisions. A tourniquet was applied around the pastern. Using a blunt ended strong probe, the horn overlying the coronary groove was levered proximo-dorsally and peeled away from the junction with the skin. The exposed coronary corium was lightly curetted using sterilised instruments; a blunt curette and teaspoon (**Fig 4**). The wound was liberally anointed with a hoof disinfectant (Solution⁴Feet)[10] and covered with a nonadherent paraffin gauze dressing (Jelonet)[11] then a sterile semi-permeable dressing (Zorbopad) under a Gamgee and self-adhesive bandage wrap. The tourniquet was removed. Ten megaunits of sodium benzylpenicillin (Crystapen)[12] were given i.v., once daily, for the next 5 days. The steel shoe on the left fore foot was removed, the heels reduced in height sufficiently to return the phalangeal column to the normal alignment without abnormal flexion in either interphalangeal joint. The foot was balanced medio-laterally following visual evaluation of the limb and the foot falls. The medial side of the foot was lowered and a flat, level ground surface produced so that both medial and lateral hoof walls touched the ground as near simultaneously as the human eye could evaluate. A plastic glue-on bar shoe (nylon gauze being glued to the foot surface) incorporating a palmar extension was fabricated and fitted (Eustace shoe kit)[10]. The ground surface of the toe of the shoe was beveled to move the area of breakover palmarly. The dorsal sole area was packed with cotton gauze swabs and the sole then filled with plastic sole filler (EquiPak)[13] up to the level of the ground surface of the shoe which was finally covered by a thin polystyrene self-adhesive pad. The swabs prevented the plastic sole filler from supporting the dorsal sole. A full sole support may have proven uncomfortable to the pony. The pony was maintained on a daily oral dose of 0.4 g of suxibuzone (Danilon Equdos)[14]. The above described surgeries and shoeing technique were repeated on the right fore 3 days later.

Post operative care

The pony was hand walked for about 100 m daily for 7 days and allowed to graze, otherwise he was completely box rested. He was fed a low calorie, high fibre diet (Happy Hoof[15], Hi Fi Lite[16]), a broad spectrum supplement (Formula⁴Feet)[10] and given weighed amounts of dry hay 3 times a day in order to achieve a gradual weight reduction. The wounds on the front feet were dressed with a hoof disinfectant (Solution⁴Feet) and covered with a colloidal gel (Granuflex)[17] under a Gamgee tissue and self-adhesive bandage every 4 days on 3 occasions, then at weekly intervals. The feet were no longer bandaged 14 weeks after the initial surgeries. Skin sutures at the tenotomy sites were removed 12 days after the surgeries. The legs were then kept bandaged with woollen stable bandages, re-set daily for a further 14 weeks. The frogs of the left feet were treated weekly by resection of all redundant horn and application of paste of granulated table sugar and povidone iodine antiseptic solution

(Sugardine) on 3 occasions. The frogs were then dressed with hoof disinfectant (Solution[4]Feet) twice weekly for 3 weeks. The shoes were removed, the feet dressed and reshod at 5-weekly intervals.

Sequelae and outcome

After the surgeries the pony appeared equally comfortable on both front feet. He started to develop an obvious right fore lameness on Day 33. On Day 39 the dorso-distal hoof wall was fenestrated using a high speed milling tool and a small hoof knife without need for local anaesthesia nor sedation (**Fig 5**). The fenestration was deep enough to enter the area of separated laminae and achieve drainage of sero-sanguinous fluid. The right fore foot was tubbed in a solution of povidone iodine scrub for 10 min. The foot was dried and the fenestration filled with sugardine. The foot was rebandaged. The right fore lameness was much improved the following day. The pony then began to show an increasing left fore lameness. A similar fenestration, foot bathing and bandaging procedure was performed on the left fore foot on Day 43, which was followed by a similar improvement in lameness. A loop knife was used to remove 5 mm of horn at the collateral limits of the coronary peel wounds on both front feet. New coronary bands producing tubular horn were apparent on the front feet by Day 58 (**Fig 6**). A soft lozenge-shaped mass of swollen partly keratinised tissue protruded from the fenestration on the right fore foot on Day 55. This was carefully cauterised using a black hot iron. The mass did not recur and healing proceeded in this area uneventfully thereafter.

On Day 102 the dorsal horn 'bridges' (the parts of the dorsal hoof wall remaining following removal of the proximal and distal parts of the dorsal hoof walls) connecting the 2 halves of the hooves were removed using half round hoof nippers (**Fig 7**). On Day 109 the shoeing style was changed from a pair of plastic glue-on shoes incorporating sole filler to a glue-on plastic heart bar shoe. Over the next week slight supra-coronary band depressions appeared. The shoes were removed and replaced with ones incorporating sole filler on Day 123. On Day 158 the shoes were removed; slight supra-coronary depressions were noticed on both front feet the following day, he was left unshod, the depressions were no longer palpable on discharge from the Laminitis Clinic on Day 195 (**Fig 8**). The thrush-like infections had resolved leaving confluent, full, intact frogs on the left feet. Although there was a crescent shaped defect of dorso-distal hoof wall on both feet the pony would walk soundly on concrete and gallop freely on grass by Day 160.

Discussion

Using data from a report of the results of treatment using heart bar style shoes, dorsal wall resection and deep digital flexor tenotomy techniques (Eustace and Cripps 1999), this case had an anticipated 10% chance of success. Of the 166 acute founder cases treated to date at the Laminitis Clinic, 21 of which had founder distances >15 mm, this is the only case with a founder distance >19 mm that was a success. Apart from one horse with a founder distance of 18.4 mm in a hind foot, 14.9 mm is the next greatest founder distance in an acute founder case treated successfully at this clinic using the above described techniques.

Serial radiological measurements of founder distance in this case showed a reduction from 19.2 mm at referral to 9.2 mm in the left fore, and from 17.3 to 6.8 mm in the right fore over a period of 7 months (**Fig 9**). Additionally there was a marked reduction in dorsal laminar horn production in this case, reflected by a wall thickness of 15.5 mm (measured on Day 235; **Fig 9**), which is within the normal range for non-Thoroughbreds (Linford 1987; Cripps and Eustace 1999). The affected feet showed no indication of the distortions characteristic of chronic founder at Day 396 (**Fig 10**).

Although this surgery appears to be radical it was noted that it resulted in a significant reduction in pain, and the dosage of analgesic necessary to keep the pony comfortable was 6 g phenylbutazone daily pre- and 0.4 g suxibuzone post surgery.

The slight founders that occurred in this case following the foot dressing and shoeing at Days 109 and 158 resulted in an increase in founder distance and wall thickness. This exemplifies how fragile the juvenile laminal attachments are even 5 months after acute founder and emphasises the need for continued box rest. Once the firm architecture of the coronary groove is established, subsequent post founder remodelling of coronary papillae can only occur in a proximal direction if the coronary papillae are to regain their parallel relationship with the dorsal surface of the distal phalanx. This remodelling is never perfect and results in both increased laminar horn production (to fill the gap between the dorsal hoof wall and the dorsal surface of the distal phalanx), increased wall thickness and increased founder distances (**Fig 11**).

The decision to divide the deep digital flexor tendons in this case was made on clinical grounds alone, but this view is not held by all clinicians (Riley and Stephenson 2005). When analgesia is removed or reduced, a tendency for the animal to land and stand on the toe of the affected hoof is a strong indication that deep flexor contracture is present when combined with a palpable increase in tension in the deep flexor tendon. Acute founder cases that stand on their toes without an increase in tension of the deep digital flexor tendon often have an abscess developing in the palmar or plantar parts of the hoof. Deep digital flexor contracture cannot, in the authors' experience, be diagnosed from radiological examinations although an increase in Angle R (Cripps and Eustace 1999) is confirmatory evidence of a relatively long standing contracture. (Angle R is the difference between the angle subtended by a line drawn down the dorsal surface of the distal phalanx and the ground and a line joining the

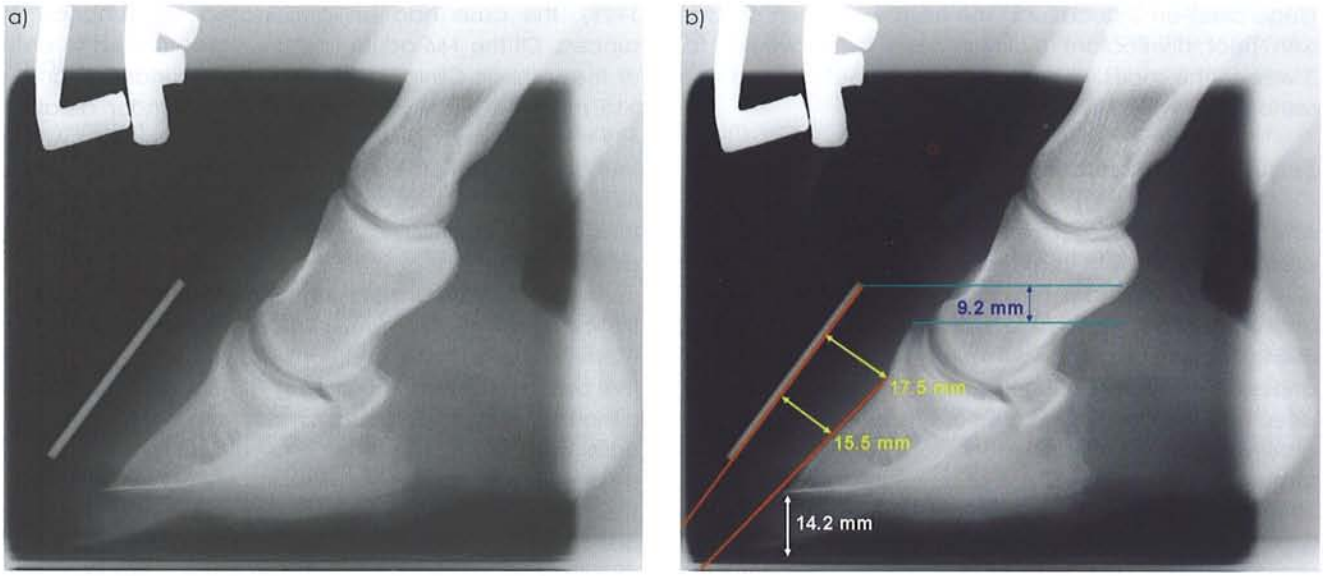

Fig 9: a) Latero-medial radiograph of left fore foot on Day 235. b) The same radiograph as in a) but with measurements added (corrected for magnification). Angle subtended by the solar margin of the distal phalanx and the ground 0° (RF 0°); difference between the angles subtended by a line from the dorsal surface of the distal phalanx to the ground and a line from the dorsal hoof wall to the ground (red lines): -7° (RF -12°); distance between the base of the extensor process and the hoof wall: 17.5 mm (RF 16.7 mm); solar depth: 14.2 mm (RF 13.1 mm); Founder distance 9.2 mm (RF 6.8 mm); wall thickness: 15.5 mm (RF 14.7 mm).

centres of curvature of the proximal and distal interphalangeal joints and the ground.) Division of the deep flexor tendon is necessary to normalise the fit of the interphalangeal joints in these cases, without which the horse is never likely to regain soundness.

The disadvantages of this surgery are that the foot has to be desensitised by regional anaesthesia in order to perform the surgery (this may lead to increased foundering or other injury if the animal is not constantly supervised whilst blocked), a major structure is being severed, albeit temporarily, and that the surgery itself is not without risk both to the horse and the surgeon. However, an alternative medical approach may be worth considering. If a neuro-muscular blocking agent, such as *Clostridium botulinum* Type A, could be injected into the deep digital flexor muscle before contracture occurs, this would obviate the need for such surgery. This toxin has been used successfully to treat stringhalt in horses (Wijnberg 2008). Surgical risks associated with deep digital flexor tenotomy under regional anaesthesia would be removed and the paralysis of the muscle, extrapolating from from human use of this molecule, would last approximately 3 months: ample time for new coronary

Fig 10: Left fore foot lateral view at Day 396.

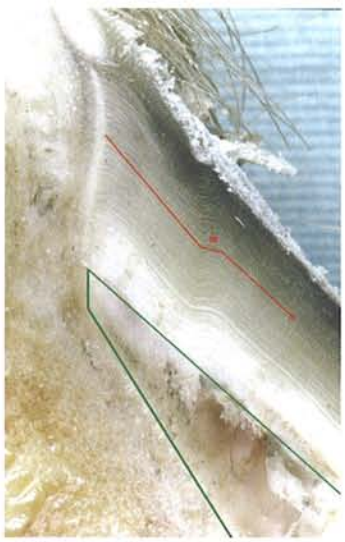

Fig 11: Note the changes in direction of the horn tubules in this sagittal section of the foot of a chronic founder case that suffered acute founder 8 weeks previously. The papillae and juvenile horn tubules try to realign parallel to the dorsal surface of the distal phalanx by retracting proximally. The new horn tubule alignment is slightly less divergent from the distal phalanx than the older tubules distal to the area marked with an asterisk, which corresponds to the animal's last acute founder episode. The area between the green lines represents the 'laminar wedge' a mass of stretched lamellae and amorphous horn produced to 'fill the gap' between the distracted dorsal hoof wall and the distal phalanx.

a) b)

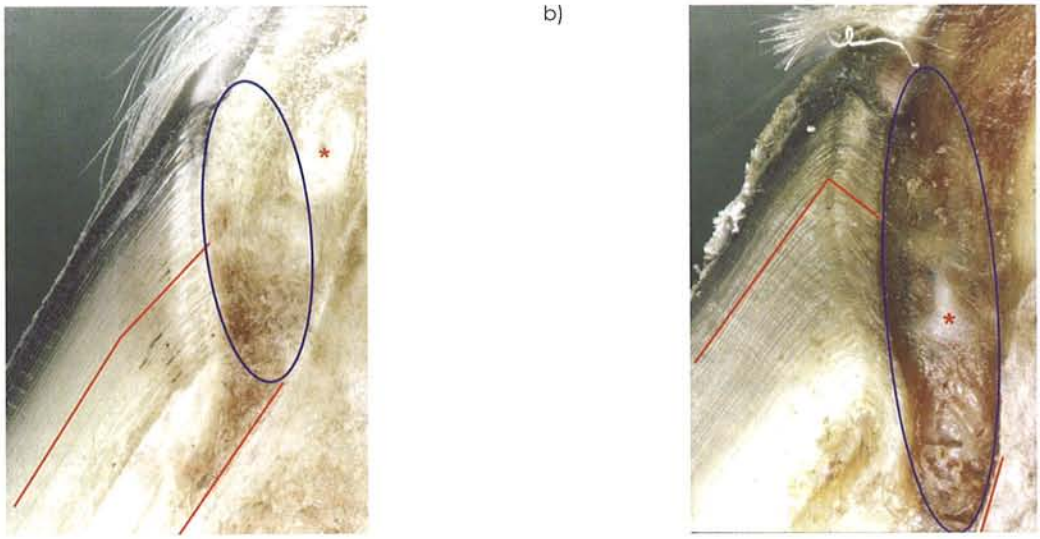

Fig 12: a) Sagittal section of a normal horse's hoof. Note the slight change in angulation of the horn tubules when free of their papillae and that their subsequent angle is parallel with the dorsal surface of the distal phalanx (red lines). The coronary corium is surrounded by the blue oval and the centre of the coronal cartilage is marked with a red asterisk. b) Sagittal section of an acute founder case, the red lines highlight the angles of the coronary papillae, horn tubules and dorsal surface of the distal phalanx. The coronary corium has become longer and thinner (blue oval, compare with a). The position of the coronal cartilage (red asterisk) is in a similar position in relation to the extensor process of the distal phalanx but in a much more distal position in relation to the dorsal perioplic corium than in the normal hoof (compare with a).

horn to be produced following the coronary peel surgery. Palmar extension shoes would still have to be fitted in order to prevent hyper-extension of the distal interphalangeal joints whilst the deep digital flexor muscle is paralysed. Should this technique be effective it would be necessary to use a firm sole pack in order to minimise any true elongation of the deep digital musculo-tendinous unit, which might result in rotation of the distal phalanx after the temporary paralysis resolves.

Fig 13: Sagittal section of an acutely foundered pony showing a 'brush border' of coronary papillae within juvenile horn tubules beneath the coronary epidermis. These papillae have either retracted from their original positions within the coronary epidermis or have regenerated beneath same in preparation for new coronary horn production.

With hindsight, the original surgery to the horn overlaying the coronary grooves should have been extended as far latero-medially as the full extent of the supra-coronary depressions. Similarly the light curettage performed following removal of the bulk of the hoof wall overlying the coronary groove may have been unnecessary and possibly counterproductive. Pollitt and Daradka (2004) described the healing of lamellar wounds following wall stripping and highlighted that a partially intact basement membrane was necessary for optimal healing. Our intention with curettage was to remove or realign any surviving coronary papillae and encourage regeneration in a direction parallel to the dorsal surface of the distal phalanx.

Acute founder results in stretching and compression of the affected coronary corium (**Fig 12**), which if left untreated results in permanent misalignment of the coronary papillae relative to the dorsal surface of the distal phalanx. In some cases, coronary corial necrosis occurs with separation of the hoof from the skin. The arc of epidermis removed following the coronary peel surgery is very stiff and strong. The grossly misaligned coronary papillae will either die, resulting in coronary sepsis and separation, or survive at an altered angle leading to the distorted hoof shape characteristic of a chronic founder case. The greater the founder distance the greater the likelihood of the former to occur. The coronary peel surgery removes the pre-existing coronary papillae and relies on new papillae to regenerate from epidermal basal cells possibly reliant on fragments of basement membrane. That new papillae do regenerate and enable new functional hoof wall to grow in a near-normal relationship to the distal phalanx is remarkable (**Fig 13**).

Angiographic studies have demonstrated a lack of venous perfusion (Redden 2001b) in the coronary corium, laminar vessels, terminal arch and circumflex artery of foundered horses. Also, weightbearing was shown to prevent perfusion of the circumflex artery whilst contrast material was being introduced. Compression of the coronary corium is due to compression of the coronary vasculature by the dorsal coronary epidermis. Blood flow through the laminar corium is partly dependent on an intact circulation in the circumflex artery and free venous drainage through the coronary corium. The coronary peel surgery removes all compression in the affected coronary blood vessels. Drainage of trapped serosanguinous fluid through a dorsal wall fenestration optimises blood flow in the solar corial vessels. There was no lack of blood supply to the operated area of coronary dermis in this case, necessitating the need for a tourniquet. However, this may not be the case if surgery is delayed. The authors believe that surgery should be made as soon as a founder distance greater than 13.5 mm has been measured in a first time acute founder case.

The decision to fenestrate the dorsal hoof walls was made on clinical grounds alone, when the pony began to show increasing discomfort. As this case showed, and was probably exaggerated by the flexor tenotomies, there is significant compression of the solar corium following acute founder. Fluid accumulation within an enclosed solar corium causes the animal significant pain. In our experience, it is preferable to release the compression on the solar corium by opening the junction between the dorsal hoof wall and the dorsal sole to allow a 'balloon' of swollen solar corium to protrude rather than fenestrating the horny sole. Fenestrating the sole in acute founder cases results in a mushroom of swollen solar corium that is painful to the animal and prone to physical trauma, pressure and infection and soon turns into an indolent solar granuloma. The 'balloon' resulting from dorsal fenestration is far less painful for the animal and, if necessary, can be reduced by cautery, which if applied correctly, does not cause the animal discomfort and leads to rapid keratinisation of the defect.

The absence of abscessation in this case is notable. Sub-mural and sub-solar abscesses are common sequelae within the 3 months following acute founder. The removal of the constraining coronary horn and opening of the junction with the proximal laminae and subsequent distal drainage by dorsal wall fenestration may have contributed to the lack of purulent infection. Additionally, the prompt referral and treatment of this case is likely to have contributed to the successful outcome. All too often animals tend to be referred around 6 weeks after onset when chronic tissue damage results in a treatment failure.

Although there appeared to be little suspension being provided by the dorsal laminae, there was an obvious sub-mural linear radiolucency from Day 33, the 'bridges' of dorsal hoof wall were left intact to prevent instability of the medial and lateral parts of the hooves. These bridges were left intact until Day 102 when there was adequate new proximo-dorsal horn to prevent the 2 halves of the hooves moving independently when shod.

The availability of glue-on shoes that can be made into any style, other than an open shoe, has been a huge benefit for those clinicians dealing with severely lame horses. There is no longer any need to nail shoes onto acutely foundered horses. The shoes used in this case, have the following advantages: they are retained by tabs so there is no constricting cuff around the hoof wall, which can therefore be seen and easily accessed; there is no shoe protruding dorsal to the trimmed hoof, optimising breakover; no heat is produced by the plastic or adhesives curing; and they can be simply and quickly removed and refitted without twisting or trauma to the hoof.

The bedding was maintained at 2 different thicknesses to provide a sleeping area with deep shavings and a standing/feeding area with a thinner bed. This is because following deep flexor tenotomies horses can find it difficult to gain a level footing in deep shavings, even when palmar extension shoes are fitted. However, a deep bed is necessary to prevent the development of bedsores. Fortunately this pony used the differently bedded areas in the intended manner and never laid down long enough to develop bedsores. Horses which will not lay down and rest have a significantly worse prognosis.

Acknowledgements

The authors are grateful to Ed Cashin MRCVS for the prompt referral and to Burney Chapman whose pioneering work remains greatly valued.

Manufacturers' addresses

[1]Arnolds Veterinary Products Ltd, Shrewsbury, Shropshire, UK.
[2]Orion Pharma, Espoo, Finland.
[3]Fort Dodge Animal Health Ltd, Southampton, Hampshire, UK.
[4]Animalcare Ltd, York, Yorkshire, UK.
[5]Vet Way Ltd, York, Yorkshire, UK.
[6]Norbrook Laboratories Ltd, Newry, Co Down, UK.
[7]United States Surgical, Tyco Healthcare, Norwalk, Connecticut, USA.
[8]Millpledge Veterinary, Retford, Nottinghamshire, UK.
[9]Robinsons Healthcare Ltd, Worksop, Nottinghamshire, UK.
[10]Equi Life Ltd, Dauntsey, Wiltshire, UK.
[11]Smith & Nephew Medical Ltd, Hull, Yorkshire, UK.
[12]Schering-Plough Animal Health, Welwyn Garden City, Hertfordshire, UK.
[13]Vettec Hoof Care Products, Oxnard, California, USA.
[14]Janssen Animal Health, High Wycombe, Buckinghamshire, UK.
[15]Mars Horsecare (UK) Ltd, Milton Keynes, Buckinghamshire, UK.
[16]Dengie Crops Ltd, Maldon, Essex, UK.
[17]ConvaTec Ltd, Deeside, Flintshire, UK.

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