Clinical article

Superficial digital flexor tendonitis in Thoroughbred race horses: outcome following non-surgical treatment and superior check desmotomy

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Objective This study documents the results of non-surgical treatment and treatment by superior check desmotomy in Thoroughbred racehorses with superficial digital flexor (SDF) tendonitis.

Design A prospective study was made of 124 thoroughbred racehorses with unilateral or bilateral SDF tendonitis.

Procedure The flexor tendons were assessed by physical and ultrasonographic examination before treatment, and the lesions detected in affected tendons were characterised according to lesion type, length and cross-sectional area. Ninety three horses were managed non-surgically and 31 by superior check desmotomy. Recurrent or new injuries were defined as injuries affecting a previously injured superficial digital flexor tendon, the contralateral SDF tendon, or the suspensory ligament (interosseous muscle) in either forelimb.

Results No statistically significant difference was found in ultrasonographic lesion severity between treatment groups. Horses managed by superior check desmotomy were 1.3 times more likely to complete five or more races than horses managed non-surgically (95% confidence limits 0.93-1.82). Horses treated surgically were 1.2 times more likely to develop recurrent or new injuries after returning to training than horses managed non-surgically (95% CL 0.95-1.55). Horses undergoing superior check desmotomy were 5.5 times more likely to develop suspensory desmitis than horses treated non-surgically (95% CL 1.13-26.4). There was no difference in the time to recurrent or new injury between treatment groups.

Conclusion There was no statistically significant difference between treatment groups in the proportions of horses able to complete five or more races after an episode of superficial digital flexor tendonitis. Superior check desmotomy did not appear to offer an advantage over non-surgical treatment in preventing recurrent or new injuries in Thoroughbred racehorses. Horses undergoing superior check desmotomy appeared to be at greater risk of developing suspensory ligament injuries than horses managed non-surgically.

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SDF Superficial digital flexor

Injury to the SDF tendon in Thoroughbred racehorses is a common and career-threatening injury. Recovery from such injury is prolonged, and recurrence frequent after affected horses return to training or racing.[1] Recently, superior check desmotomy (transection of the accessory ligament of the SDF muscle) has been suggested as a treatment to reduce this high recurrence rate.[2-5] 'Success' following treatment for tendonitis has been determined by the proportion of treated horses able to compete in five or more races postoperatively, without recurrence of injury.[6] Reported success rates following superior check desmotomy vary from 52%[3] to 67%[6] for Thoroughbred racehorses, and 69%[5] to 71%[3] for Standardbreds. Data are lacking on success rates for Thoroughbred racehorses managed by non-surgical methods for SDF tendonitis. The purpose of this study was to document the results of non-surgical treatment and treatment by superior check desmotomy for SDF tendonitis in New Zealand Thoroughbred racehorses, and to determine risk of recurrence of injury in these two groups of horses.

Materials and methods

One hundred twenty four Thoroughbred racehorses with injuries to the SDF tendon in the metacarpal region, presented at the Massey University Veterinary Clinic (MUVC) between September 1991 and January 1995, were included in a prospective study. Horses with injuries secondary to lacerations, horses without detectable SDF tendonitis, and those with inadequate follow-up were excluded.

History and physical examination

On the day of examination, a detailed history was taken from the owner or trainer, and horses examined for lameness at the walk and trot. The tendinous structure affected, the presence and severity of lameness, and the amount of swelling and pain on palpation were recorded. The presence of

abnormalities unrelated to the flexor tendons (for instance joint effusion) was also noted.

Ultrasonographic examination

Before ultrasonographic examination, the hair was clipped from the palmar surface of the affected limbs, from the accessory carpal bone to the ergot or, in some cases, the coronary band. The skin over the site to be examined was thoroughly wetted, and coupling gel applied. Ultrasonographic examination of the flexor tendons was performed in sagittal and dorsal planes, using a linear 7.5 MHz micro-probe (Toshiba Ultrasound System Model SAL-55AS, with linear 7.5MHz micro-intra-operative probe IOE-702V, Toshiba, Japan). Images were recorded on medical imaging film (Fuji Medical Imaging Film MI-NH, blue base, Fuji, Japan).

Ultrasonographic findings were categorised according to lesion type, length, and the approximate cross-sectional area of the tendon affected (< 25%, 25-50%, > 50%). Limitations in equipment capability precluded more accurate documentation of cross-sectional area of the lesion. Core lesions were graded on a scale of type 1 to 4, according to the method described by Genovese et al[7] (Table 1). In addition to these four grades, some lesions were described as diffuse. These lesions had a generalised anechoic or hypoechoic appearance throughout the tendon, but were poorly defined, with few or no short linear echoes present. Horses examined more than 3 months after occurrence of the original tendon injury were assessed ultrasonographically for healing characteristics, but the lesions were not graded for comparison. In these cases, the ultrasonographic assessment was used in recommending the amount of exercise that the horse should be permitted. In horses with acute or resolving injuries of the SDF tendon, serial ultrasonographic re-examinations during the recovery phase were recommended.

Treatment

After ultrasonographic diagnosis, the owner or trainer of each horse made a choice between non-surgical management (rest alone, or rest plus a program of controlled exercise) or surgical treatment (superior check desmotomy) in addition to rest with or without a program of controlled exercise.

Table 1. Ultrasonographic grading system used to describe core lesions in SDF tendon according to Genovese et al.[7]

Type 1	Lesion slightly hypoechoic compared to normal tendon.
Type 2	Lesion is half echogenic, and half anechoic.
Type 3	Lesion is mostly anechoic, representing significant fibre tearing.
Type 4	Lesion is totally anechoic, with almost total fibre tearing and haematoma formation.

Non-surgical management consisted of rest, with the recommended area of confinement being based on the severity of the tendonitis. For horses with anechoic core lesions or severe diffuse tendonitis, stall rest with daily walking in-hand was recommended. Despite this, most horses were paddock rested. For horses with hypoechoic lesions, controlled exercise was recommended. This consisted of walking and trotting under saddle on level ground. Compliance with these recommendations was highly variable, and many horses were not returned for re-examination at the recommended times.

Superior check desmotomy was performed on 31 horses using the procedure described by Turner and McIlwraith.[8] All but two horses had the surgical procedure performed at Massey University. Two horses, one of which had unilateral, and the other bilateral surgery, were surgically treated in Australia but recuperated in New Zealand. Nine horses with unilateral SDF injuries, treated early in the study (1991, 1992), were treated by unilateral superior check desmotomy. Two horses subsequently developed SDF tendonitis in the contralateral limb, and all since then have been treated with bilateral superior check desmotomy. Surgery was performed with the horse in lateral recumbency in 29 cases, and in dorsal recumbency in 2 cases.

Outcome

Race records for horses returning to racing were obtained from the New Zealand Racing Conference. Further information was obtained by telephone interview with the owner or trainer of the horses, and from medical records in cases which were returned for re-examination. Follow-up intervals varied from 1.5 to 4.5 years from the time of first examination.

Horses were classified as: (1) retired from racing without returning to training, (2) retired for reasons unrelated to flexor tendon injury before completing five races, (3) did not race because of recurrent or new injury to the flexor tendons or suspensory ligament during training, (4) raced one to four times, but ceased training because of recurrent or new injury, or (5) raced five or more times, with or without recurrent injury.

Recurrent or new injuries were defined as recurring injury to the same SDF tendon, new injury to the contralateral SDF tendon, or injuries affecting the suspensory ligament in either forelimb subsequent to a previous SDF tendonitis. Horses that were still racing without recurrent or new injury, but which had not yet completed five or more starts, were considered 'untested',[6] and were not used in calculations.

Statistical analysis

Data were entered into a computerised data base program (Microsoft Access for Windows 95 Version 7.0, Microsoft Corporation, USA) and analysed using a statistical software package (NCSS for Windows Version 6.021, Number Cruncher Statistical Software, USA). During the statistical analysis, the following parameters were used as outcome variables: recurrence of tendon injury, occurrence of new injury to the flexor tendons or suspensory ligament, time to recurrence of injury and time to occurrence of new injury. Categorical type risk factors, including affected limb (left or right) and treatment category (surgical or non-surgical), and continuous type risk factors, including length, type and approximate cross-sectional area of the ultrasonographic lesion, were used as

Table 2. Age distribution of 124 Thoroughbred horses with SDF tendonitis.

Age (years)	2	3	4	5	6 and over
Number (%)	9 (7.3%)	32 (26%)	29 (23.3%)	20 (16%)	34 (27.4%)

independent variables in the following statistical analyses. Ultrasonographic lesion characteristics (length, type, cross-sectional area) were compared between treatment groups using the Mann-Whitney test and the chi-square test to assess if there was a difference between the sample of horses included in each treatment group. The statistical association between risk factors and each outcome variable was assessed using relative risk and its 95% confidence limits (95% CL), the Mann Whitney U test, or the Logrank test, depending on the scale of measurement. Time to recurrence was analysed using the Kaplan-Meier Product Limit Estimator.

Statistical significance was defined as $P < 0.05$, 95% CL for relative risks which did not include 1, and statistical power was estimated using $P = 0.05$.

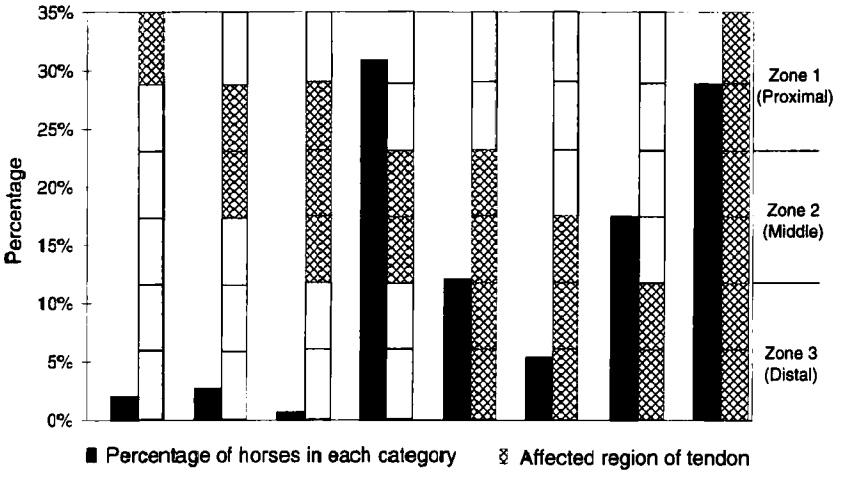

Figure 1. Distribution of lesions detected ultrasonographically in the SDF tendons of 124 Thoroughbred racehorses. The SDF tendon in the metacarpal region has been divided into three zones.7 The middle and distal thirds of the tendon were most commonly injured, although 29% of horses had injuries involving most of the length of the SDF tendon.

Results

History and physical examination

Of the 124 Thoroughbred racehorses included in the study, 33 were females, 5 were entire males and 86 were geldings. The average age of the horses was 4.5 years (SD ± 1.7 years), with a range from 2 to 10 years. The age distribution of horses is shown in Table 2. Thirty seven horses (30%) had not raced at the time of initial presentation, 18 horses had raced between 1 and 4 times, 32 between 5 and 15 times, and 37 horses had raced more than 15 times. In 91 cases the injury was < 3 months old at the time of examination. Fifteen horses were presented 3 to 6 months after injury, and 17 were presented more than 6 months after the time of injury. The duration of injury was unknown in one case.

The left SDF tendon was affected in 52 cases, the right in 53 cases and both SDF tendons in 19 cases. Of 114 cases in which the results of lameness examination were recorded, 43 horses (37%) were lame in the affected limb on the day of presentation and 10 (8.7%) were lame in another limb.

Ultrasonographic examination

The length of the ultrasonographically detected lesion in the worst affected limb was 8 cm or less in 52 cases, between 10 and 16 cm in 30 cases, and 20 to 24 cm in 9 cases. The distribution of the lesions within the SDF tendon is shown in Figure 1. Type 1 lesions were documented in 17 cases (19%), type 2 in 13 cases (14%), type 3 in 13 (14%), type 4 in 38 limbs (42%), and in 10 limbs (11%) the lesions were classified as diffuse. Approximate cross-sectional area was documented in 88 horses with injuries of < 3 months duration. In 44 cases (50%), the lesion occupied less than 25% of the cross-sectional area of the tendon, in 28 cases 25-50% and in 16 cases over 50%.

Treatment and outcome

Ninety three horses received non-surgical treatment and 31 were treated by unilateral or bilateral superior check desmotomy.

Non-surgical treatment (n=93) – From this group, 17 horses were retired without returning to training for various reasons including severity of injury; advanced age of the horse, perceived breeding value, concurrent injuries, lack of ability, economic and other unspecified reasons. Another 17 horses were retired before they had completed five races for reasons unrelated to flexor tendon injury including: unrelated lameness or injury (12), lack of ability (4) or death (1). Although some of these horses were successful in alternative careers of dressage, show-jumping or eventing, they were not considered in further analyses for this paper.

The outcome for the remaining 59 horses which returned to training is shown in Table 3. New or recurrent injuries occurred between the time the horse resumed training and 36 months (50th race) after initial examination for injury.

Superior check desmotomy (n= 31) – Seventeen horses were treated by unilateral or bilateral superior check desmotomy for a first episode of SDF tendonitis, and 14 horses were undergoing treatment for recurrent episodes.

No horses in this category were retired from racing before returning to training. Four horses were retired prior to completing five races for reasons unrelated to the flexor tendon injury, including exercise-induced pulmonary haemorrhage (1), death associated with colic (2) and an unspecified respiratory condition (1).

The outcome for the 27 horses which returned to training, and did not retire for unrelated reasons, is shown in Table 3. New or recurrent injury to the flexor tendons or suspensory ligament occurred between the time the horse resumed training, and the 48th month after examination for injury.

Relationship between outcome variables and recurrence of injury

The relative risk of recurrent or new injuries in the right forelimb compared with the left forelimb was 1.19 (95% CL 0.88 to 1.6). No statistically significant difference was found when comparing ultrasonographic length of lesion, lesion type, or cross-sectional

Table 3. Outcome for the horses that returned to training.

	Conservative management n = 93	Superior check desmotomy n = 31
'Untested' horses:		
Retired after diagnosis, or raced < 5 times for reasons unrelated to flexor tendon injury	34	4
Outcome of horses returning to training:		
Did not race because of recurrent or new injury[a] occurring during training	16 (27%[b])	6 (22%[b])
Raced 1-4 times but ceased training because of recurrent or new injury	10 (17%)	2 (7%)
Raced 1-4 times, still racing without injury	1 (2%)	-
Raced 5 or more times prior to, or without recurrent/new injury	32 (54%)	19 (70%)
Recurrent or new injuries:		
Percentage of horses returned to training/racing which developed recurrent or new injuries	39 (66%)	21 (78%)
Developed suspensory desmitis after return to training	2 (3%)	5 (18%)

[a]Recurrent injury to the previously affected SDF tendon, or new injury to the contralateral SDF tendon or a suspensory ligament.
[b]Percentage of horses which returned to training, and did not retire for unrelated reasons.

area between treatment categories (for length of lesion z = -0.91, P = 0.36; for lesion type (2 = 0.31, 2 df, P = 0.86; for cross-sectional area (2 = 0.76, 3 df, P = 0.86). No difference was found in ultrasonographic characteristics of lesions in horses with or without re-injury using the Mann Whitney U test (for length of lesion z = -0.60, P = 0.55; for lesion type z = 0.67, P = 0.50; for cross-sectional area z = 0.23, p = 0.82).

There was no statistically significant difference between the survival curves (Figure 2) for time to recurrent or new injury between right and left forelimbs or between surgically and non-surgically treated horses (forelimb: (2 = 0.68, df = 1, P = 0.41; treatment: (2 = 1.29, df = 1, P = 0.26).

Horses undergoing superior check desmotomy were 1.3 times more likely to complete five or more races than horses treated non-surgically (95% CL 0.93 to 1.82; power = 0.28). There was no significant difference in the risk of recurrent or new injuries between the two treatment groups, although the relative risk of new injury was slightly higher (1.18) in the horses undergoing surgical treatment (95% CL 0.9 to 1.55; power = 0.19). Horses treated by superior check desmotomy were 5.46 times more likely to develop suspensory desmitis than those treated non-surgically (95% CL 1.13 to 26.4).

Discussion

Thoroughbred horses in New Zealand race on turf tracks, in a clockwise or anti-clockwise direction depending on the location of the racetrack. A relatively large proportion of horses race to the age of 6 years in flat races, and some continue beyond that age in hurdle races and steeplechase events. The age distribution of affected horses, and the equal proportion of left and right forelimbs affected by injury, probably reflect the local racing population and conditions. Where anti-clockwise racing predominates, other authors have found that a large proportion of tendon injuries occur in the left forelimb of Thoroughbred racehorses.[9,10]

Forty four per cent of horses were presented for evaluation of tendon injury before their fifth race start. This group of horses sustained injury during preparation for racing, or during their first few starts. A similar observation was made by Rooney and Genovese[11] of horses racing in the United States. They concluded that fatigue due to lack of fitness may have contributed to the large proportion of injured horses in this group. In this study, however, a large proportion of affected horses were mature. Older horses may be predisposed to SDF tendonitis by naturally occurring, age-related changes in crimp formation in the central core of the SDF tendon.[12,13] Patterson-Kane et al[12] demonstrated age-related alterations in the crimp morphology in the SDF tendon of wild horses which had not undergone training, and proposed that training may accelerate the ageing process within the tendon.

In order to compare the two treatments in this study, the groups of horses were standardised as much as possible. Although the owners made the decision on treatment for their horses, there was no significant difference in the ultrasonographic severity of lesion between treatment groups. Even so, horses managed by non-surgical methods were subjected by their owners or trainers to a wide variety of exercise regimens, and many of the horses were not returned for reassessment of tendon injury prior to returning to training. Horses which did not return to training, or which retired from training for reasons unrelated to tendon injury were not considered useful subjects for statistical comparison. Recurrent injuries to the same tendon and injuries to the contralateral tendon were considered together because owners and trainers sometimes had difficulty recalling which limb was originally affected, and they interpreted a new tendon injury as failure of treatment, whether it affected the originally injured limb or not.

Injuries to the suspensory ligament were considered to be related, new injuries. The suspensory ligament supports the fetlock joint in extension. Suspensory ligament injuries occurred in both treatment groups subsequent

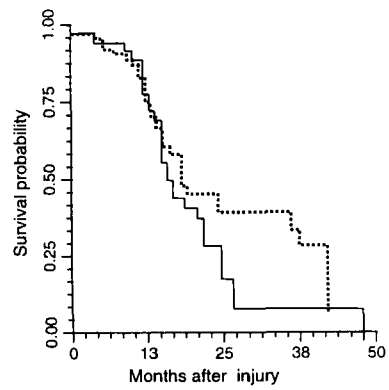

Figure 2. Kaplan-Meier survival curves showing proportion of horses still racing without recurrent or new injury after surgical (solid line) and non-surgical (dotted line) treatment.

to an episode of SDF tendonitis, although were 5.5 times more likely to occur in horses after superior check desmotomy. Hawkins and Ross[4] observed an apparently high incidence of suspensory desmitis in a group of Standardbred racehorses which were treated by superior check desmotomy for SDF tendonitis, but were unable to make comparisons with a group of horses treated non-surgically. They speculated that transection of the superior check ligament may result in hyperextension of the carpus or fetlock joint, and therefore predispose to suspensory desmitis. Superior check desmotomy on cadaver limbs resulted in hyperextension of the fetlock joint and carpus, and increased strain on the SDF tendon but not the deep digital flexor tendon.[14] Strain on the suspensory ligament was not measured in that study, but would be expected to increase with hyperextension of the fetlock joint.

No significant associations were found in this study between ultrasonographic features of the injury and the likelihood of recurrence. This is in contrast to the findings of Genovese et al,[1] who found that the greater the cross-sectional area and length of the lesion, the greater the likelihood of recurrence of injury when the horse returned to training. Similarly, Yovich et al[10] correlated increased lesion length with a greater likelihood of re-injury. Cross-sectional area was not accurately documented in this study, and many horses were not presented for treatment until several weeks to months after injury, thus affecting the ultrasonographic type of lesion documented at the time of examination.

Superior check desmotomy has been suggested to reduce the risk of recurrence of injury in horses returning to training following recovery from SDF tendonitis.[2] According to the results of this study, the risk of recurrent and new injury is not significantly different in non-surgically treated horses and in horses undergoing superior check desmotomy. There was no significant difference in the proportion of horses able to complete five or more races after either treatment, neither was there a significant difference in the time of recurrence between the two treatment groups. The power of this study was limited by the number of horses available for complete follow-up, however. While a larger proportion of horses were able to complete five or more races after undergoing superior check desmotomy, surgically treated horses appeared to be at greater risk of developing recurrent or new injuries, including suspensory desmitis, than horses managed by rest and controlled exercise.

In this study, horses were followed to the time of recurrent or new injury, or in many cases, to the end of their racing careers. Recurrent or new injuries occurred between the time the horse returned to training and 48 months after the time of first injury. Although many horses were able to complete five or more races after an episode of SDF tendonitis, recurrent or new injuries to the flexor tendons or suspensory ligaments limited the careers of a large proportion of cases.

Prospective studies involving clinical cases suffer many important limitations and this study was no exception. The number of horses available for complete follow-up was limited, as many horses developed unrelated injury or illness or were retired because of lack of ability, thereby preventing full evaluation of treatment for SDF tendonitis. It was difficult to ensure compliance with recommended treatment strategies, with horses in both groups receiving widely varied exercise programs during recovery from injury. In addition, owners had difficulty recalling exact details in cases of re-injury, making it impossible to separate recurrent from new injuries in the analysis of results. Nevertheless, the results of this study suggest that, despite treatment and apparent recovery, there is a high incidence of recurrent or new injury in Thoroughbred racehorses returning to training and racing following an episode of SDF tendonitis.

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