Original Article

# Comparison of treatment outcomes for superficial digital flexor tendonitis in National Hunt racehorses

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**Highlights**

- We collected race performance data for National Hunt racehorses treated for superficial digital flexor tendonitis.
- We compared racing performance for 5 common treatment modalities in treated and age- and sex-matched control horses.
- Our data demonstrate that SDF tendonitis remains a career limiting injury.
- Control horses raced more often, with higher performance rating and a longer racing distance, after the date of case injury.
- Rate of return to racing was not associated with lesion severity or treatment group.

## Abstract

Superficial digital flexor (SDF) tendonitis is a common injury in Thoroughbred racehorses. Injuries require prolonged rehabilitation, with unpredictable outcomes and a high incidence of re-injury. This observational case-control study aimed to compare race outcomes after commonly advocated treatments for tendon healing. Clinical and racing records were evaluated for 127 National Hunt racehorses treated between 2007 and 2011 for an SDF tendon injury. Two age- and sex-matched control horses were selected for each case horse to analyse the effect on post-injury racing outcomes of pre-injury data, lesion severity and treatment group (controlled exercise alone, bar firing, intralesional platelet-rich plasma (PRP), tendon splitting, tendon splitting combined with bar firing).

Control horses raced more often than case horses, with higher maximum racing post rating ($RPR_{max}$) and longer racing distances. Pre-injury racing performance was not associated with treatment group. Rate of return to racing was not associated with lesion severity or treatment group. Number of races, total distance raced post-injury and $RPR_{max}$ were not associated with lesion severity or treatment group. Controlled exercise alone offered similar post-injury racing outcomes in National Hunt racehorses with SDF tendonitis to the other treatment options examined. Bar firing, either alone or in conjunction with tendon splitting, provided no additional benefit in rate of return to racing and race performance.

*Keywords:* Controlled exercise; Firing; PRP; Splitting

## Introduction

Superficial digital flexor (SDF) tendonitis is the most common cause of lameness in National Hunt racehorses, with prevalences as high as 24% (Lam et al., 2007; Avella et al., 2009; Dyson et al., 2011), or 1.71 per 100 horse months in training (Ely et al., 2009). SDF injuries require prolonged rehabilitation, with unpredictable outcomes and high incidences of re-injury (Marr et al., 1993; O'Meara et al., 2010). SDF tendonitis is often career ending (Marr et al., 1993; Lam et al., 2007; Dyson et al., 2011).

Immediate treatment of SDF tendonitis targets a reduction in inflammation (Ross et al., 2011; Avella and Smith, 2012), and thereafter various interventions are advocated to improve tendon healing. Tendon firing and blistering were believed to promote repair but positive clinical evidence is lacking and these treatments are widely considered unethical[1] (Silver et al., 1983; Marr and Bowen, 2012). Tendon splitting to release the pressure of haemorrhage and promote vascularisation in the injured area has yielded mixed results (Stromberg.B et al., 1974; Henninger et al., 1990; Ross et al., 2011). Desmotomy of the accessory ligament of the superficial digital flexor tendon produced favourable rates of return to racing and number of races completed but resulted in increased suspensory ligament strain experimentally and higher incidence of suspensory ligament desmitis clinically (Bramlage, 1986; Bramlage, 2012). Intralesional β-aminopropionitrile fumerate, polysulphated glycosaminoglycans and sodium hyaluronate (Dowling et al., 2000) have been superceded by regenerative therapies. Isolated exogenous growth factors such as insulin-like growth factor 1 and transforming growth factor-β can be administered intra-lesionally (Dowling et al., 2000; Witte et al., 2011), however more recently mixed endogenous cytokines have been delivered

[1] See: Firing of Horses: RCVS position unchanged on this unethical procedure, In: RCVS News. https://www.rcvs.org.uk/publications/rcvs-news-november-2011/ (Accessed 8 August 2016)

in the form of platelet rich plasma (PRP, Schnabel et al., 2007; Arguelles et al., 2008; Bosch et al., 2010; McIlwraith, 2012) or stem cells (Smith et al., 2003; Smith and Webbon, 2005). Intra-lesional mesenchymal stem cell therapy yielded reduced re-injury rates in National Hunt racehorses (Godwin et al., 2012) and foetal-derived embryonic- and induced pluripotent stem cells show similar promise (Watts et al., 2011; McIlwraith, 2012; Smith et al., 2014).

In spite of the evolution of tendon therapies, controlled exercise remains fundamental to the rehabilitation of SDF injuries. A standard 48-week rehabilitation program, with progress monitored ultrasonographically at 3-month intervals has been advocated (Avella and Smith, 2012; Smith and McIlwraith, 2012).

Measures to quantify racehorse performance include race starts (Parente et al., 2008), races placed (Weller et al., 2006), race earnings (Cheetham et al., 2008; Parente et al., 2008), 2 years post-injury racing rate (Dyson, 2004; Smith and McIlwraith, 2012), rate of completion of greater than one race (Parente et al., 2008; Smith and McIlwraith, 2012), racing post rating (RPR; Weller et al., 2006; O'Meara et al., 2010), official rating (Weller et al., 2006), and top speed rating (Weller et al., 2006). Combinations of these parameters have been used to calculate performance indices (Woodie et al., 2005; Reardon et al., 2012). Completion of five post-injury races is considered an adequate measure of success (O'Meara et al., 2010; Smith and McIlwraith, 2012).

Racing outcomes have been evaluated for individual treatments, but never across multiple treatments within a population of horses from the same breed engaged in the same athletic pursuit. Randomised, masked controlled trials represent the best form of evidence for clinical decision-making, but are lacking for tendon treatments. Observational studies or single treatment prospective studies therefore currently represent the best available evidence. This observational case-control study compared racing outcomes in a population of National Hunt racehorses in the Republic of Ireland. Outcomes were compared between injured horses and control horses, and between treatments, for a range of contemporary and more traditional therapies including thermocautery, which is still widely practised in spite of the ethical considerations. We hypothesised that lesion severity would be correlated with racing performance post-injury; that horses treated with PRP would more frequently return to racing, and at a higher standard than horses treated by bar firing, controlled exercise, tendon splitting or bar firing combined with tendon splitting; and that bar firing alone or in conjunction with tendon splitting would provide no additional benefit for racing performance post-injury.

## Materials and methods

*Horses*

All National Hunt racehorses that had competed over jumps under rules and were presented to a single clinic between June 2007 and July 2011 for evaluation of an SDF tendon injury were identified (Fig. 1). Two age- and sex-matched horses were selected using a random number generator from the starters of the last race prior to presentation for each injured horse, to act as controls. Where identical matches were not available, the closest matches were selected. If the treated horse had not yet raced, control horses were selected from the first race after treatment.

Age, sex, horse origin (ex-store, ex-flat or point-to-point), lesion severity and treatment were taken from hospital records. Lesions were defined ultrasonographically as mild, moderate or severe (<10%, 10-40% or >40% of tendon cross-sectional area affected at the zone of maximum injury; Smith and McIlwraith, 2012).

In the acute stage, when heat, pain or swelling were evident (Smith and McIlwraith, 2012), horses were box-rested and treated with non-steroidal anti-inflammatory drugs, ice and bandaging. Horses were re-evaluated during the sub-acute phase (2-3 weeks post-injury), treated as described below and/or issued a standard rehabilitation regimen. Treatment decisions were made after discussion with the trainer, rather than through random allocation.

*Controlled exercise*

A 48-week controlled exercise program was recommended, with increasing exercise intensity starting with walking only, then trotting and finally canter and fast work (Table 1).

*Bar firing*

This was undertaken under sedation with detomidine (0.01 mg/kg IV) and butorphanol (0.01 mg/kg IV). Procaine penicillin (22000 IU/kg IM), gentamycin (6.6 mg/kg IV) and phenylbutazone (4.4 mg/kg IV) were administered pre-operatively. High 4-point regional anaesthesia and proximal cannon-bone ring block were performed on the affected leg. Horizontal lines were scored at an interval of approximately 2 cm in the skin overlying the palmar metacarpus. The glowing wire was placed against the skin, scalding the skin superficially but taking care not to cause a full thickness skin defect. A bandage was applied and changed every 48 h for 2 weeks. Horses received phenylbutazone (2.2 mg /kg PO twice daily for 7 days). The standard 48-week exercise program was recommended (Table 1).

*Injection of platelet rich plasma*

PRP was injected 2-3 weeks after injury. PRP was harvested using an Osteokine PRP device (Dechra) and activated with calcium chloride prior to injection. Twenty-two to 25 gauge needles were placed throughout the length of the lesion under ultrasound guidance. PRP was injected starting distally and proceeding proximally with final injection volume determined by lesion size. A bandage was applied and changed every 48 h for 2 weeks. Horses received phenylbutazone (4.4 mg /kg PO twice daily for 5 days) and procaine penicillin (22000 IU/kg IM twice daily for 4 days), were box rested for 2 weeks and then the standard 48-week exercise program was recommended (Table 1).

*Tendon splitting*

Horses underwent tendon splitting 3-4 weeks after injury. This was undertaken under sedation with detomidine (0.01 mg/kg IV) and butorphanol (0.01 mg/kg IV). Procaine penicillin (22000 IU/kg IM), gentamycin (6.6 mg/kg IV) and phenylbutazone (4.4 mg/kg IV) were administered pre-operatively. High 4-point regional anaesthesia and proximal cannon-bone ring block were performed on the affected leg. Under ultrasound guidance a No. 11 scalpel blade was introduced in a longitudinal plain into the core lesion. Repeat incisions were made over the length of the lesion. A bandage was applied and changed every 48 h for 2 weeks. Horses received phenylbutazone (2.2 mg /kg PO twice daily for 7 days), were box rested for 2 weeks and then the standard 48-week exercise program was recommended (Table 1).

*Tendon splitting then bar firing*

Horses underwent tendon splitting 3-4 weeks after injury using the technique described above. They subsequently underwent bar firing as described above. The interval between splitting and firing was not available for analysis.

*Retired*

Horses were retired without further treatment for various reasons including lesion severity, financial concerns, concomitant injuries and trainer preference.

*Racing data collection*

The following racing data were obtained from the Racing Post[2]: total number of pre- and post-injury races, binary variables of completion of one, three and five races; pre- and post-injury total distance raced in furlongs; pre- and post-injury maximum RPR ($RPR_{max}$). RPR is a handicap rating determined by a horse's performance in a given race taking into account weight carried, race class and outcome. Precisely how this rating is calculated is commercially confidential. Interval (days) to the first race post-injury was compared between injured and control horses and between treatments, as were minimum, median and maximum intervals between all races post-injury.

*Data analysis*

Data were analysed using R 3.2.4 (R-Project[3]). Percentage and median (minimum and maximum) were used to summarise categorical and continuous variables. All continuous racing measurements were log transformed prior to inferential data analysis except for pre- and post-injury maximum RPR. Horses that were retired were excluded for analysis of post-injury racing performance, along with their matched controls. Conditional logistic regression that accounted for the age-sex matching stratum was used to assess whether horse origin and pre-injury racing measurements were predictors of injured/control status. Linear models that

[2] See: The Racing Post: http://www.racingpost.com/ (Accessed 8 August 2016)
[3] See: The Comprehensive R Archive Network: http://cran.r-project.org/ (Accessed 8 August 2016)

adjusted for age and sex of the horses were used to assess the effect of SDF/control status on continuous post-injury racing performance. Binary logistic regression that adjusted for age and sex was used to assess the effect of injured/control status on dichotomised post-injury race measurements. Odds ratios (OR) and 95% confidence intervals (CI) from conditional logistic regression and binary logistic regression models are presented. For injured horses, Fisher's exact tests were used to assess association between categorical variables. One-way ANOVA was used to compare continuous variables between treatment groups or severity groups. Type I error rate was set at 5%.

## Results

*Horses*

Three hundred and eighty-one horses were included in the study, 127 with SDF tendonitis and 254 control horses. Ex-flat racehorses made up 19% (*n* = 71) of the population, 75% (*n* = 287) were ex-store horses and the remaining 6% (*n* = 21) were point-to-point horses (Table 2). The likelihood of injured horses being ex-flat was significantly lower than their being ex-store (OR [95% CI]: 0.398 [0.181, 0.877]; *P* = 0.022), but there was no difference between point-to-point and ex-store groups (1.378 [0.516, 3.682]; *P* = 0.523; Table 2) and only a marginal difference between point-to-point and ex-flat groups (3.463 [0.990, 12.112]; *P*=0.052).



Geldings represented 82% (*n* = 104) of the injured horses. The remainder were mares, and sex was not correlated with horse origin (*P* = 0.363). Injured horses ranged in age from 3-11 years (median = 6), and age was not correlated with horse origin (*P* = 0.799).

The number of races prior to the injury date was not correlated with injured or control status ($P$ = 0.094; Table 2). Median pre-injury total race distance and median pre-injury $RPR_{max}$ were not correlated with injured or control status (Table 2).

Nine horses were retired from racing. Post-injury racing performance was analysed for the remaining 118 horses. Overall, compared to control horses, injured horses had fewer races, a shorter total distance and lower $RPR_{max}$ (Table 2) post-injury. The odds of racing once (OR 0.04 [0.01, 0.15]; $P < 0.001$), three (0.25 [0.15, 0.41]; $P < 0.001$) or five (0.29 [0.18, 0.46]; $P < 0.001$) times post-injury were also lower. Interval to first post-injury race was longer for injured horses than control horses ($P < 0.001$; Table 2). Median and minimum intervals between post-injury races did not differ significantly between injured horses and control horses ($P$ = 0.246, 0.108, respectively; Table 2), but maximum interval was significantly shorter in injured horses ($P < 0.001$; Table 2). The timing of the largest interval between races was interval 1 in injured horses and interval 4 in control horses ($P < 0.001$),

*Lesion severity*

Seventeen horses (13.4%) had mild lesions, 78 (61.4%) had moderate lesions and 32 (25.2%) had severe lesions. Lesion severity was not associated with horse origin ($P$ = 0.496), sex ($P$ = 0.530) or age ($P$ = 0.912), nor did it have a significant correlation with pre-injury number of races ($P$ = 0.338), pre-injury total race distance ($P$ = 0.281) or median pre-injury $RPR_{max}$ ($P$ = 0.972; Table 6).

*Treatment and racing performance*

Treatment group was not associated with horse origin ($P$ = 0.158; Table 3), age ($P$ = 0.298) or sex ($P$ = 0.152), but was significantly associated with lesion severity ($P < 0.001$;

Table 3). Treatment group was not associated with pre-injury total race distance (*P* = 0.634), number of pre-injury races (*P* = 0.384), or with pre-injury $RPR_{max}$ (*P* = 0.107; Table 4). Post-injury number of races and total race distance did not differ with lesion severity (*P* = 0.593 and *P* = 0.811, respectively; Table 6) or by treatment group (*P* = 0.480 and *P* = 0.480, respectively; Table 4). Post-injury $RPR_{max}$ did not differ with lesion severity (*P* = 0.635; Table 6). Overall post-injury rate of return to racing did not differ significantly by lesion severity (*P* = 0.650; Table 7) or treatment group (*P* = 0.579; Table 5). Odds of racing three times post-injury did not differ with lesion severity (*P* = 0.684, Table 7) or treatment group (*P* = 0.068; Table 5). Odds of racing five times post-injury did not differ with lesion severity (*P* = 0.765; Table 7) or treatment group (*P* = 0.730; Table 5).

Interval to first post-injury race did not differ with lesion severity (*P* = 0.918; Table 6) or treatment group (*P* = 0.219; Table 4). In injured horses, median, minimum and maximum intervals between post-injury races did not differ by treatment group (*P* = 0.560, 0.685, 0.776, respectively; Table 4) or by lesion severity (*P* = 0.925, 0.815, 0.834, respectively; Table 6). The timing of the largest interval between races in injured horses did not differ significantly by treatment group (*P* = 0.822; Table 4) or by lesion severity (*P* = 0.288; Table 6).



**Discussion**

Relevance and homogeneity of the study population was confirmed by the absence of statistically significant differences in demographics and pre-injury racing performance between injured horses and the randomly selected, matched control horses. Subclinical tendon changes with exercise and age have been identified as predisposing factors in tendonitis (Wilmink et al., 1992; Dowling et al., 2000; Smith et al., 2002; Pinchbeck et al., 2004), but while we were not able to quantify pre-injury training load or intensity, we failed to demonstrate differences in pre-injury racing history when comparing injured horses with control horses.

Our data demonstrate that SDF tendonitis remains a career limiting injury (Ross et al., 2011). Injured horses had shorter careers after injury, achieved a lower career $RPR_{max}$ and completed a shorter total career distance compared to control horses. After the first race post-rehabilitation, intervals between post-injury races were similar between injured horses and control horses, indicating that injured horses could race as frequently as their uninjured counterparts.

We hypothesised that lesion severity would be correlated with racing performance post-injury. Our data confirm that horses with severe lesions had the highest rate of retirement (Table 3; Marr et al., 1993). For treated horses, there was no difference in the rate of return to racing or the number of races post-injury across lesion severity, contrasting with previous work showing a detrimental effect of lesion severity on return to work (Marr et al., 1993). Injury severity also showed no significant association with post-injury $RPR_{max}$. Although increasing lesion severity increases the rate of retirement, it need not negatively affect the post-injury racing performance of treated horses.

Cost and pre-injury racing standard are likely to influence treatment selection. However, when comparing pre-injury racing standard across treatment groups, we found no evidence that horses racing at a higher standard were overrepresented in any treatment group, such as more expensive intralesional PRP.

We assessed career longevity by completion of three and five races post-injury as well as total number of races. Controlled exercise alone proved superior and bar firing inferior for the proportion of horses racing three times. Treatment group did not have an effect on the proportion of horses racing five times, reflecting the significantly shorter careers of injured horses compared to control horses overall, regardless of treatment. Previous studies have established re-injury rates ranging from 16 to 53% (Marr et al., 1993; Dyson, 2004; O'Meara et al., 2010). In the absence of verbal follow-up, we evaluated time to return to racing and the intervals between post-injury races as quantitative proxies for re-injury. The absence of differences across lesion severity and treatment group suggests that the rate of re-injury prior to a return to racing and further career intervals due to re-injury were similar across groups and lesion severities.

We hypothesised that horses treated with intralesional PRP would more frequently return to racing, and at a higher standard than horses treated by other means. PRP did not prove superior to other treatments. Although it has been a popular treatment for tendonitis, the evidence for the use of PRP is weak. Experimental studies have reported stronger tissue in treated tendons compared to control horses (Bosch et al., 2010; McIlwraith, 2012) and the only case-control study describes the treatment of mid-body suspensory desmitis in nine Standardbred horses which all returned to racing following a single intralesional PRP injection (Waselau et al., 2008). While our study does not provide further clinical support for these results, postulated reasons for differences in outcome include sub-optimal platelet concentration, increased leukocyte concentration, or differences in PRP activation during administration. Platelet concentration correlates with growth factor concentration and tendon matrix gene expression and elevated leukocyte numbers can increase catabolic gene expression and reduce tendon matrix gene expression (McCarrel and Fortier, 2009; Fortier, 2011; Sundman et al., 2011). Platelet concentrations achieved with the system used in our study are comparable to those described in the literature (Sundman et al., 2011; Smith et al., 2014). The method of PRP activation can influence platelet derived growth factor concentration (Textor and Tablin, 2012), but calcium chloride activation as used in our study has been reported to be optimal.

The proportion of horses racing at least three times post-injury was highest for those treated with a controlled exercise rehabilitation program alone, supporting previous work showing that 71% of horses with SDF tendonitis returned to racing after a controlled exercise regimen, compared to only 25% of those that were put out to pasture (Gillis, 1997). Full compliance with rehabilitation programs can be challenging, and difficult to monitor, but regular ultrasound assessment allows horse-specific rehabilitation, reducing the recurrence of tendonitis (Gillis, 1997; Smith and McIlwraith, 2012).

Although recently out of favour, tendon splitting showed similar results to controlled exercise in this study. Initially thought to promote vascularisation in chronic tendonitis cases, later studies found that splitting induced excessive granulation tissue and slowed scar tissue formation (Asheim, 1967; Stromberg.B et al., 1974; Ross et al., 2011). Tendon splitting is reported to be most effective during the acute to sub-acute stage (2-3 weeks post-injury) of injury, as in this study (Dabareiner, 2000; Ross et al., 2011; Avella and Smith, 2012; Smith et al., 2014).

We hypothesised that bar firing alone or in conjunction with tendon splitting would provide no additional benefit for racing performance post-injury. Supporting a long-held hypothesis, bar firing did not yield any improvement in outcome.  A lack of improvement in tendon histology following line firing led to the conclusion that line firing should not be considered a desirable or effective treatment of acute or chronic equine tendon injury (Silver et al., 1983). Few studies have assessed the clinical value and efficacy of firing, and even though this approach has lost support on ethical grounds, it remains commonplace. This study found no evidence to suggest that the procedure of firing offers a therapeutic advantage relative to other treatments [4].

Post-hoc power calculations indicated that more than 160 injured horses were required in each group to detect a statistical difference in completion of five races between controlled exercise (50%) and bar firing (34.2%). Furthermore, more than 2,400 injured horses were required to demonstrate equivalence with an acceptable difference of less than 10% between controlled exercise and bar firing assuming 80% power and 5% type I error rate.

The realities of clinical practice and the retrospective nature of our study meant that the choice of treatment for injured horses was not randomly allocated. Injured horses vary in a number of ways that may affect outcome. Although we have demonstrated where injured horses, control horses and treatment groups were similar or different across quantifiable factors such as age, sex, lesion severity and pre-injury performance, it is possible that treatment choice was related to unquantifiable human decisions based on clinical information that could have been related to the outcome. As a result of this potential source of bias, differences or similarities between treatment groups could be due to factors related to the reason that a treatment was chosen, rather than due to treatment effects. It is impossible to

[4] See: British Equine Veterinary Association position statement on thermocautery – firing of tendons https://www.beva.org.uk/Portals/0/Documents/Working For Change/Thermocautery 2014 approved.pdf (Accessed 8th August 2016)

compensate for these inexplicit factors in an observational study. The large sample size required in a controlled trial to demonstrate equivalence would be unlikely to be achieved given the incidence rate of SDF tendonitis and the number of horses participating in National Hunt racing in the Republic of Ireland annually. In addition, a truly randomised prospective study would be difficult to undertake for SDF tendonitis, given the realities of the racing industry and clinical practice.

## Conclusions

Controlled exercise alone offered similar post-injury racing outcomes for National Hunt racehorses with SDF tendonitis to the other treatment options examined. Bar firing provided no additional benefit. PRP was not superior to other treatments in the studied population.

## Conflict of interest statement

None of the authors has any financial or personal relationships that could inappropriately influence or bias the content of the paper.

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## Figure legend

Fig. 1. Inclusion criteria for a retrospective study of outcomes of superficial digital flexor tendon injuries in National Hunt racehorses.

**Table 1.** Generic rehabilitation program recommended for superficial digital flexor tendon injury in racehorses (Smith and McIlwraith, 2012)

| Weeks after injury | Duration and nature of exercise |
|---|---|
| 1-2 | Box rest |
| 3-4 | 10 min walking |
| 5-6 | 15 min walking |
| 7-8 | 20 min walking |
| 9-10 | 25 min walking |
| 11-12 | 30 min walking |
| 13-14 | 35 min walking |
| 15-16 | 40 min walking |
| 17-20 | 40 min walking; 5 min trotting |
| 21-24 | 35 min walking; 10 min trotting |
| 25-28 | 30 min walking; 15 min trotting |
| 29-32 | 45 min exercise daily with slow canter |
| 33-40 | 45 min daily with fast work three times a week |
| 41-48 | Return to full competition/race training |

**Table 2**. Horse origin, pre- and post-injury maximum racing post rating ($RPR_{max}$), number of races and race distance, post-injury inter-race intervals (range) and rate of return to racing for 127 National Hunt racehorses treated for superficial digital flexor tendonitis and 254 matched control horses.

| | Injured horses [a] | Control horses [a] | *P* [b] |
|---|---|---|---|
| Total | 127 | 254 | |
| Horse origin | | | |
| Ex-flat | 17 (13.4%) | 54 (21.3%) | |
| Ex-store | 101 (79.5%) | 186 (73.2%) | |
| Point-to-point | 9 (7.1%) | 14 (5.5%) | 0.043 |
| Pre-injury $RPR_{max}$ | 105 (0, 171) | 106 (0, 170) | 0.231 |
| Post-injury $RPR_{max}$ | 95 (0, 163) | 113 (0, 165) | <0.001 |
| Pre-injury races | 7 (0, 66) | 8 (0, 61) | 0.094 |
| Post-injury races | 3 (0, 30) | 9 (0, 61) | <0.001 |
| Pre-injury race distance (furlongs) | 135 (0, 916) | 138 (0, 1334) | 0.204 |
| Post-injury race distance (furlongs) | 71 (0, 621) | 180 (0, 1525) | <0.001 |
| Days from injury to first race | 552 (152, 1384) | 33 (1, 1090) | <0.001 |
| Median interval between post-injury races (days) | 26 (12, 384) | 28 (7, 799) | 0.246 |
| Minimum interval between post-injury races (days) | 12 (1, 56) | 9 (1, 799) | 0.108 |
| Maximum interval between post-injury races (days) | 151 (14, 1138) | 245 (15, 1441) | <0.001 |
| Timing of maximum interval between races (race number since injury) | 1 (1, 21) | 4 (1, 61) | <0.001 |
| Return to racing | 92/118 (78.0%) | 233/236 (98.7%) | <0.001 |
| Three races completed | 66/118 (55.9%) | 196/236 (83.1%) | <0.001 |
| Five races completed | 50/118 (42.4%) | 168/236 (71.2%) | <0.001 |

[a] Values shown are median (range) or proportion (%) as appropriate.
[b] *P*-values were determined by Fisher's exact test (categorical variables) or one-way ANOVA (continuous variables).

**Table 3.** Horse origin and lesion severity with vertical (within treatment) and horizontal (between treatment) percentages, for 127 National Hunt horses with superficial digital flexor tendonitis. P-values were determined by Fisher's exact test.

| | Treatment | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Controlled exercise | | Bar firing | | PRP | | Tendon splitting | | Tendon splitting and bar firing | | Retired | | *P* |
| Total | 24 | 18.9% | 38 | 29.9% | 26 | 20.5% | 18 | 14.2% | 12 | 9.4% | 9 | 7.1% | |
| Horse origin | | | | | | | | | | | | | |
| Ex-flat horse | 3 | 17.6% | 3 | 17.6% | 4 | 23.5% | 4 | 23.5% | 3 | 17.6% | 0 | 0.0% | |
| | 12.5% | | 7.9% | | 15.4% | | 22.2% | | 25.0% | | 0.0% | | |
| Ex-store horse | 21 | 20.8% | 31 | 30.7% | 22 | 21.8% | 12 | 11.9% | 8 | 7.9% | 7 | 6.9% | |
| | 87.5% | | 81.6% | | 84.6% | | 66.7% | | 66.7% | | 77.8% | | |
| Point-to Point | 0 | 0.0% | 4 | 44.4% | 0 | 0.0% | 2 | 22.2% | 1 | 11.1% | 2 | 22.2% | |
| | 0.0% | | 10.5% | | 0.0% | | 11.1% | | 8.3% | | 22.2% | | 0.158 |
| Lesion Severity | | | | | | | | | | | | | |
| Mild | 9 | 52.9% | 6 | 35.3% | 2 | 11.8% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | |
| | 37.5% | | 15.8% | | 7.7% | | 0.0% | | 0.0% | | 0.0% | | |
| Moderate | 12 | 15.4% | 21 | 26.9% | 20 | 25.6% | 12 | 15.4% | 11 | 14.1% | 2 | 2.6% | |
| | 50.0% | | 55.3% | | 76.9% | | 66.7% | | 91.7% | | 22.2% | | |
| Severe | 3 | 9.4% | 11 | 34.4% | 4 | 12.5% | 6 | 18.8% | 1 | 3.1% | 7 | 21.9% | |
| | 12.5% | | 28.9% | | 15.4% | | 33.3% | | 8.3% | | 77.8% | | <0.001 |

PRP, intralesional platelet-rich plasma
[a] *P* values were determined by Fisher's exact test

**Table 4.** Pre- and post-injury maximum racing post rating ($RPR_{max}$), number of races, race distance, and post-injury inter-race intervals, for 127 National Hunt horses with superficial digital flexor tendonitis.

| | Treatment [a] | | | | | | |
|---|---|---|---|---|---|---|---|
| | Controlled exercise | Bar firing | PRP | Tendon splitting | Tendon splitting and bar firing | Retired | $P$ [b] |
| Pre-injury $RPR_{max}$ | 104 (0, 171) | 106 (0, 149) | 112 (0, 156) | 101 (58, 141) | 112 (80, 132) | 81 (14, 114) | 0.107 |
| Post-injury $RPR_{max}$ | 105 (0, 163) | 86 (0, 149) | 95 (0, 159) | 91 (0, 138) | 99 (0, 150) | | 0.540 |
| Pre-injury races | 7 (1, 32) | 6 (0, 35) | 7 (0, 42) | 9 (1, 66) | 6 (1, 20) | 5 (1,15) | 0.384 |
| Post-injury races | 5 (0, 17) | 2 (0, 22) | 4 (0, 30) | 5 (0, 22) | 3 (0, 19) | | 0.480 |
| Pre-injury race distance (furlongs) | 135 (0, 570) | 128 (0, 725) | 144 (0, 677) | 209 (16, 916) | 96 (13, 275) | 98 (24, 277) | 0.634 |
| Post-injury race distance (furlongs) | 102 (0, 341) | 45 (0, 459) | 69 (0, 621) | 100 (0, 351) | 77 (0, 376) | | 0.480 |
| Days from injury to first race | 513 (226, 824) | 528 (152, 1202) | 539 (256, 1148) | 584 (325, 1384) | 737 (267, 1188) | | 0.219 |
| Median interval between post-injury races (days) | 23 (12, 68) | 28 (14, 384) | 25 (14, 46) | 25 (15, 304) | 30 (21, 39) | | 0.560 |
| Minimum interval between post-injury races (days) | 9 (3, 39) | 14 (1, 47) | 14 (2, 25) | 13 (1, 56) | 10 (5, 30) | | 0.685 |
| Maximum interval between post-injury races (days) | 118 (41, 763) | 154 (14, 731) | 91 (15, 535) | 179 (25, 1138) | 204 (30, 385) | | 0.776 |
| Timing of maximum interval between races (race number since injury) | 2 (1, 8) | 1 (1, 18) | 2 (1, 21) | 2 (1, 11) | 2 (1, 11) | | 0.822 |

PRP, intralesional platelet-rich plasma

[a] Values shown are median (range).

[b] $P$ values were determined by one-way ANOVA. Except for pre- and post-injury RPR, all variables were log transformed prior to one-way ANOVA.

**Table 5.** Rate of return to racing by treatment group, with vertical (within treatment) and horizontal (between treatment) percentages, for 127 National Hunt horses with superficial digital flexor tendonitis.

| | Treatment | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Controlled exercise | | Bar firing | | PRP | | Tendon splitting | | Tendon splitting and bar firing | | Retired | | *P* [a] |
| Total | 24 | 18.9% | 38 | 29.9% | 26 | 20.5% | 18 | 14.2% | 12 | 9.4% | 9 | 7.1% | |
| Return to racing | 21 | 22.8% | 28 | 30.4% | 20 | 21.7% | 15 | 16.3% | 8 | 8.7% | | | 0.579 |
| | 87.5% | | 73.7% | | 76.9% | | 83.3% | | 66.7% | | | | |
| Three races completed | 18 | 27.3% | 15 | 22.7% | 15 | 22.7% | 12 | 18.2% | 6 | 9.1% | | | 0.068 |
| | 75.0% | | 39.5% | | 57.7% | | 66.7% | | 50.0% | | | | |
| Five races completed | 12 | 24.0% | 13 | 26.0% | 11 | 22.0% | 9 | 18.0% | 5 | 10.0% | | | 0.730 |
| | 50.0% | | 34.2% | | 42.3% | | 50.0% | | 41.7% | | | | |

PRP, intralesional platelet-rich plasma

[a] *P* values were determined by Fisher's exact test

**Table 6.** Pre- and post-injury maximum racing post rating ($RPR_{max}$), number of races and race distance and post-injury inter-race intervals for 118 National Hunt racehorses that underwent treatment for superficial digital flexor tendonitis. This table excludes horses that were retired.

| | Lesion severity [a] | | | $P$ [b] |
|---|---|---|---|---|
| | Mild | Moderate | Severe | |
| Pre-injury $RPR_{max}$ | 110 (0, 171) | 106 (0,160) | 103 (13,149) | 0.972 |
| Post-injury $RPR_{max}$ | 106 (0,163) | 96 (0,154) | 86 (0,150) | 0.635 |
| Pre-injury races | 5 (0, 30) | 7 (0, 42) | 6 (1, 66) | 0.338 |
| Post-injury races | 4 (0, 19) | 4 (0, 30) | 3 (0, 19) | 0.588 |
| Pre-injury race distance (furlongs) | 96 (0, 570) | 150 (0, 677) | 135 (24, 916) | 0.811 |
| Post-injury race distance (furlongs) | 93 (0, 401) | 72 (0, 621) | 61 (0, 384) | 0.690 |
| | | | | |
| Days from injury to first race | 610 (226, 812) | 543 (152, 1384) | 508 (281, 1202) | 0.918 |
| Median interval between post-injury races (days) | 24 (16, 68) | 28 (12, 384) | 25 (14, 304) | 0.925 |
| Minimum interval between post-injury races (days) | 10 (3, 27) | 13 (1, 56) | 11 (1, 36) | 0.815 |
| Maximum interval between post-injury races (days) | 179 (24, 415) | 143 (15, 1138) | 167 (14, 763) | 0.834 |
| Timing of maximum interval between races (race number since injury) | 1 (1, 13) | 2 (1, 21) | 1 (1, 11) | 0.288 |

[a] Values shown are median (range).

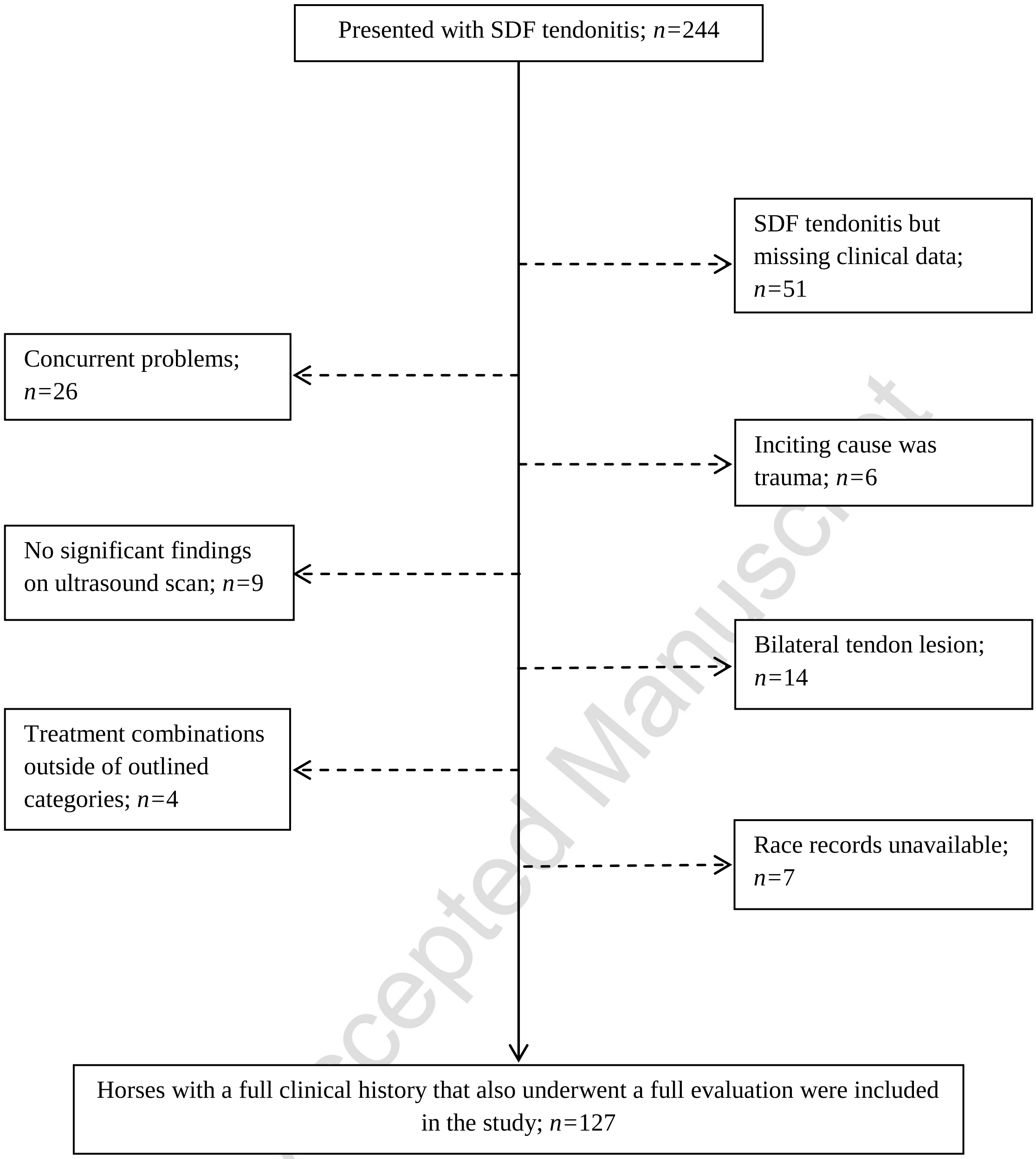
[b] *P*-values were determined by one-way ANOVA. Except for pre- and post-injury RPR, all race variables were log transformed prior to one-way ANOVA.

**Table 7.** Rate of return to racing by lesion severity, with vertical (within severity) and horizontal (between severity) percentages, for 118 National Hunt racehorses that underwent treatment for superficial digital flexor tendonitis. This table excludes horses that were retired.

| | | Lesion severity | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Mild | | Moderate | | Severe | | *P* [a] |
| Total | | 17 | | 76 | | 25 | | |
| Return to racing | 92 | 13 | 14.1% | 61 | 66.3% | 18 | 19.6% | 0.650 |
| | | 76.5% | | 80.3% | | 72.0% | | |
| Three races completed | 66 | 10 | 15.2% | 44 | 66.7% | 12 | 18.2% | 0.684 |
| | | 58.8% | | 57.9% | | 48.0% | | |
| Five races completed | 50 | 7 | 14.0% | 34 | 68.0% | 9 | 18.0% | 0.765 |
| | | 41.1% | | 44.7% | | 36.0% | | |

[a] *P*-values were determined by Fisher's exact test.

Figure 1.


Presented with SDF tendonitis; *n*=244
SDF tendonitis but missing clinical data; *n*=51
Concurrent problems; *n*=26
Inciting cause was trauma; *n*=6
No significant findings on ultrasound scan; *n*=9
Bilateral tendon lesion; *n*=14
Treatment combinations outside of outlined categories; *n*=4
Race records unavailable; *n*=7
Horses with a full clinical history that also underwent a full evaluation were included in the study; *n*=127