Clinical findings and prognosis of interference injuries to the palmar aspect of the forelimbs in Standardbred racehorses: A study on 74 cases

General article

Clinical findings and prognosis of interference injuries to the palmar aspect of the forelimbs in Standardbred racehorses: a study on 74 cases

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Summary

Reasons for performing study: Information on interference injuries in racehorses is lacking.

Objective: To describe clinical findings and prognosis of palmar forelimb interference injuries in Standardbreds.

Study design: Retrospective cohort study.

Methods: Records of 74 racehorses sustaining palmar forelimb interference injuries were studied, 7 during training, 67 during racing. The number of starts before injury, hind shoeing status, gait penalties, and racing speeds in cases occurring during racing were compared with negative controls, 67 age, sex and speed category matched horses from the same races. The number of starts and racing speed in 30 racing days preceding recruitment were compared with those following recruitment (negative controls) or return to racing (cases). Clinical aspects and outcome in interference-induced superficial digital flexor (SDF) tendinitis were compared with 77 horses with overstrain-induced SDF tendinitis.

Results: In 89% of cases, there was SDF tendinitis and this was associated with a longer time to return to racing (6 months vs 1 months; p<0.001). The presence of gait penalties (odds ratio (OR) 11.13; 95% CI 3.74, 41.64; p<0.001) and unshod hind feet (OR=6.26, 95% CI 2.26, 19.62; p<0.001) increased risk of interference injuries. After recruitment/return to racing, horses with interference injuries participated in a lower number of races (24 starts *per* racing day, interquartile range (IQR) 20-32) compared to controls (49, IQR 43-55, p<0.0001). Interference-induced tendinitis cases (n=58) had a shorter time to return to racing (245 +/- 137 days) than overstrain-induced tendinitis cases (331 +/- 118 days, p<0.001).

Main limitations: Data were collected retrospectively, time of ultrasonographic assessment varied and health status of the racing controls is unknown.

Conclusions: SDF tendinitis is common with palmar forelimb interference injuries in Standardbreds and increases time to return to racing. Interference-induced SDF tendinitis has a better prognosis than overstrain-induced tendinitis.

Introduction

Flying trot is a unique gait adopted by Standardbred racehorses at racing speed, in which the hindlimbs overstep the forelimbs laterally to sustain a long stride length [1]. At racing speed, fore and hind hoof trajectories differ during the swing phase of the stride, with fore hooves projecting more dorsally and less laterally compared to the hind hooves [2]. Interference injuries, i.e. trauma inflicted by one hoof hitting the soft tissues of another leg, are commonly reported in Standardbred racehorses, and encompass a spectrum of lesions of varying severity, from simple skin lesions to severe superficial digital flexor (SDF) tendinitis or laceration.

Interference injuries are believed to stem from incoordination [3,4] or muscular fatigue [5]. Drivers also ascribe these injuries to unexpected interactions with other animals during racing. Standardbred racehorses are usually equipped with a variety of protective boots to prevent interference injuries during racing (hind-ankle boots, hind-shin boots and pastern boots) [5], while forelimb protection is limited to the heels (bell boots) and medial aspect of the carpus (knee-boots, splint-and-half-knee and knee-and-arm boots). This leaves the palmar aspect of the metacarpus and the fetlock unprotected. Direct contusion of these regions can result in interference-induced tendinitis of the SDF, which negatively affects the athletic career of the animal [7-10]. However, there is no study investigating the relationship between the occurrence of interference injuries to the palmar aspect of the forelimbs and traumatic tendinitis of the SDF in Standardbred racehorses.

The objectives of our study were to describe the clinical findings associated with interference injuries affecting the palmar aspect of the forelimbs and to outline their outcome in a cohort of affected Standardbred racehorses compared to matched controls. Given the high number of interference-induced SDF tendinitis in our study population, we also included a group of Standardbred racehorses which had sustained overstrain-induced tendinitis to compare the outcome of both types.

Materials and methods

Case and Control Animals

Medical records and long-term follow-up of a cohort of Standardbred racehorses trained in a single racetrack and experiencing interference injuries at the palmar aspect of the forelimbs from August 2008 to July 2013 were retrospectively reviewed. Two groups of control horses were studied. To assess risk factors for the occurrence of interference injuries and their effect on performances, from an eligible population of 683 horses racing the same competitions as cases, a negative control group was enrolled. Negative controls were selected from those horses running the same race that the case injury was sustained that matched the same age, sex, and speed category of the cases. Where only one eligible control horse was available, there was no random choice. When 2 or more horses in the same race, matched on these criteria, one was randomly selected.

From an eligible population of 494 horses available in our database, a positive control group of racehorses sustaining overstrain-induced tendinitis during the study period within the same age range as cases (from 2 to 8 years) was included (Supplementary item 1).

Horse signalment and racing data were obtained from the official racing website[a]. Injury data (for both interference injuries and overstrain-induced SDF tendinitis) were obtained from our historical Standardbred racehorses musculoskeletal injury archive, which includes all injuries that resulted in ≥15 days of rest [7]. Horses included in this database belong to stables where first-opinion veterinary care was provided regularly and exclusively by members of our team.

Interference injuries

Interference injuries were defined as self-inflicted sharp skin lacerations or superficial cuts in target regions of the forelimbs (medial aspect of the carpus, palmar metacarpal region, palmar aspect of the fetlock, and palmar/medial aspects of the pastern) occurring during races or fast training and causing an acute lameness (grade≥3/5 AAEP scale). Interference injuries were identified using two methods. First, records of examinations of horses leaving the racetrack after racing performed by official veterinarians were reviewed and cases of skin injury were identified. Race video footage was scrutinized in order to exclude injuries caused by other accidental trauma (i.e. contact between horses). Second, clinical reports from the archives of the equine section of the Veterinary Teaching Hospital of the University of Turin were assessed for cases with a history of any adverse event occurred during racing or fast training in the study period. Duplicates were excluded. Cases were confirmed as interference injury based on clinical descriptions provided by the official report of the treating veterinarian at the racetrack, interview of drivers, and/or clinical data retrieved from hospital archives. Diagnosis was supported by digital photos of the injured leg performed at first clinical examination by one of the investigators. Only horses where training was interrupted for longer than 15 days were included and this was evaluated by checking training log-books in the stables.

Interference injuries were classified based on their anatomical distribution on the palmar aspect of the forelimbs in five zones: medial carpal region (zone 1), palmar metacarpal region (zone 2), digital sheath region identified by the manica flexoria (zone 3), palmar aspect of the fetlock (zone 4), and palmar aspect of the pastern (zone 5). Soft tissue involvement was defined based on review of the clinical descriptions of the wound, ultrasonographic findings, and/or tenoscopic findings. The presence/absence of the following injuries was considered: skin laceration, trauma to the medial styloid process of the radius, SDF tendinitis or partial laceration, digital flexor tendon sheath laceration, annular ligament injury, and neurovascular bundle laceration.

Ultrasonographic examination and scoring

Ultrasonography was performed in every interference injury case with a mobile system[b], using a linear probe in B-mode, at the reference veterinary hospital or at the racetrack by one of two investigators (BR or AB). Transverse and longitudinal scans of both the injured and contralateral tendons were obtained during weight bearing as previously described [11]. Briefly, transverse scans of the SDF tendon were obtained at five landmarks within the metacarpal [12] and pastern regions to assess the tendon cross-sectional area (CSA) and cross-sectional hypoechogenic area (CSHA) of the lesion, using free image analysis software[c]. Total cross-sectional area (T-CSA) and total cross-sectional hypoechogenic area (T-CSHA) were calculated by summing the values of CSA and CSHA measured at all landmarks. The maximal injured zone of the tendon was defined where maximal CSHA was identified and the CSHA/CSA ratio was determined at this level. The ratio between CSA of the injured tendon at the maximal injured zone and the corresponding CSA in the contralateral tendon were determined (CSA/cCSA). In transverse images, lesions were classified as: superficial/marginal, diffuse, core lesion and longitudinal splits. Longitudinal scans of the SDFT were obtained at three specific landmarks in the metacarpal region [13] to assess echogenicity scores. The fibre alignment score was assessed using a 4-points semi-quantitative scale at the maximal injured zone [11].

Racing-related risk factors

In order to investigate the risk factors for the occurrence of interference injuries, the following data were collected from the official racing website[a] for both the cases (horses sustaining the injury during a race) and negative controls: total number of starts from the beginning of the racing career to the recruitment race, official gait penalties (horses breaking to gallop during the recruitment race), hindlimbs shoeing status during the recruitment race (shod/unshod). Racing speed (average speed maintained by the horse over the last 1000 meters of a race, [m/s]), was assessed as risk factor using speed categories in the group of cases. For this analysis, horses were classified based on their mean racing speed immediately before the recruitment race in five different categories: animals performing at ≥78 s/km (category 1), ≥76 and <78 s/km (category 2), ≥74 and <76 s/km (category 3), ≥72 and <74 s/km (category 4), and <72 s/km (category 5).

Outcome measures

Racing information was obtained from the official racing website[a] and used to determine the time to return to racing in cases and positive controls, defined as the interval in days elapsing from the injury until the first race post-injury. The number of starts during the 30 racing days preceding the injury and during the 30 racing days following the return to racing (cases) or the recruitment race (negative controls) were also acquired from the official website. Two variables were studied: participation rate and mean racing speed during races. Participation rate was calculated as the number of horses participating in each of the 30 racing days preceding the injury and following the return to racing (or preceding and following the recruitment race, for negative controls). Racing speed was the average speed maintained by the horse over the last 1000 meters of a race [m/s]. In cases and in the positive control group, information on clinical outcome was obtained by reviewing of clinical archives and by telephone discussions with 18 drivers. Each horse was assigned to one of three clinical outcome categories, i.e. returned to racing, recurrence of tendinitis, or definitively retired.

Data analysis

Statistical analyses were performed using R libraries[d] and Prism v.7[e], with an alpha level set at 0.05. The incidence rate of interference injuries in the population studied was calculated considering all races performed in the reference racetrack during the study period. Data distribution was assessed with D'Agostino-Pearson omnibus normality test. Chi square test and Fisher exact test (with Bonferroni correction for post-tests) were used to examine any association existing between the anatomical region where interference injuries occur and the occurrence of tendon injury.

To examine risk factors for interference injury, a conditional logistic regression model comparing cases (only injured during races) and negative controls was employed that assessed the effect of the variables shod/unshod (binary), official gait penalty yes/no (binary), total number of starts before the injury (quantitative) and racing speed category (categorical). Conditional regression analysis was performed introducing the variable pairing as a clustering random effect in the lme4 library of the R package (the more common clogit library did not provide convergence of the iterative estimation procedure).

To examine the effect of all interference injuries on race performance, mean racing speed in the 30 races before the injuries was compared to mean racing speed in the 30 races after the injury using a general linear model (analysis of covariance) in the group of cases. The effect of interference injury on participation rate was studied with a general linear model (analysis of covariance).

The effect of the injury zone on clinical outcome was assessed with Chi-square test. Kruskal-Wallis with Dunn's post-tests and Student t-test with Welch correction were used to compare the time to return to racing of cases with interference injuries in different zones and with/without SDF tendon lesions, respectively.

For comparison of the outcome in the sub-group of horses with interference-induced SDF tendinitis and the positive control group with overstrain-induced SDF tendinitis, Kaplan-Meier estimator and log-rank (Mantel-Cox) test were used. Time to return to racing was estimated to be 400 days for horses that had not resumed training before the end of the study period, based on the fact that Standardbred racehorses experiencing >1 year off from racing do not generally resume training (retired horses were included in this analysis). Ultrasonographic features in the interference-induced tendinitis sub-group and the overstrain-induced tendinitis group were compared using Student t-test or Mann-Whitney test.

Results

Seventy-four Standardbred racehorses with interference injuries were identified (median age 4 years, interquartile range (IQR) 3-6; 50 males, 24 females). Sixty-seven (90%) occurred during racing while 7 (10%) occurred during training. Seventy-seven racehorses with overstrain-induced SDF tendinitis were included in the positive control group (median age 4 years, IQR 3-6; 47 males, 30 females), while 67 healthy horses constituted our negative control group (median age 4 years, IQR 3-6; 46 males, 21 females). The incidence rate of interference injuries at the palmar aspect of forelimbs during racing was 2.8/1000 race starts during our observation period.

Clinical description of interference injuries

Interference injuries most commonly occurred in zones 2 and 3, where 39% and 27% of the lesions were observed, respectively, while 5% of traumas occurred in zone 1, 15% in zone 4, and 14% in zone 5 (Fig. 1). Lacerations requiring skin suture were detected in 41/74 horses (55%), while small skin lesions not requiring any suture were found in 33/74 animals (44%). The digital neurovascular bundle was lacerated in 2 animals (3%) and swelling of the medial aspect of the carpal region was detected in 4 animals (5%), due to blunt trauma at the level of the medial bony styloid process of the radius (Supplementary item 2). Interference-induced SDF tendinitis and digital sheath laceration were present, respectively, in 58 (78%)

and in 13 (17.5%) cases. Interference-induced annular ligament desmitis was observed in 11 animals (15%), and laceration of the SDF tendon was detected in 8 cases (11%). The presence of skin lacerations requiring suturing was associated with interference injuries occurring in specific zones of the forelimbs (p<0.001) and skin lacerations were more frequently observed in the zone 4 compared to zones 1 (p=0.005) and 2 (p=0.004). Tendinitis of the SDF tendon was more frequently observed in the zone 2 and 3 compared to zone 1 (p<0.0001 and p=0.002, respectively) and in zone 2 compared to zone 5 (p=0.005, Table 1).

Risk factors for interference injuries to the palmar aspect of forelimbs

Thirty-five (52%) of the 67 horses with interference injuries sustained during racing and 5 (7%) negative controls were disqualified due to gait penalties. Twenty-nine (43%) horses with interference injuries during racing and 6 (9%) negative controls were unshod in the hindlimbs. Considering racing speed categories, 7/67 (16%) of interference injuries occurred in category 1, 8 (12%) in category 2, 29 (43%) in category 3, 22 (33%) in category 4, and 1 (2%) in category 5.

The conditional logistic regression model identified that hindlimb shoeing status and gait penalties were significant predictors for the occurrence of interference injuries. Risk of interference injury was decreased with increased number of races (Table 2).

Consequences of interference injury on racing performances

Following interference injury, 50/74 horses (68%) resumed training while 24/74 (32%) was retired from racing. In the horses which resumed training, median time to return to racing was 152 days (IQR 64-195 days). Within the interference injury group which resumed training, the time to return to racing was longer in horses with concurrent SDF tendinitis compared to horses with no SDF tendon involvement (Fig. 2a). Time to return to racing was also affected by the zone where the interference injury occurred (p=0.003, Supplementary item 3). Horses sustaining interference injuries in zones 3 had longer times to return to racing (median 186 day, IQR 165-276) compared to horses with injuries in zones 1 (median 44 days, IQR 23-127, p= 0.03) and 5 (median 73 days, IQR 28-169, p= 0.03). In interference injury cases which resumed training, 17/50 (34%) had recurrence of SDF tendinitis. Clinical outcome was not significantly affected by the region of the interference injury (p=0.07, Fig. 2b). Within the interference injury cases, the mean racing speed over 30 racing days before the injury was similar to the mean racing speed after return to racing (Fig. 3a). However, after recruitment/return to racing, horses with interference injuries participated in a lower number of races (24 starts per racing day, interquartile range (IQR) 20-32) compared to controls (49, IQR 43-55). As such, the post-injury race participation rate (expressed in percentage) was lower than the post-recruitment race participation rate in the negative control group (p<0.0001, Fig. 3b).

Comparison of ultrasonographic features and outcome of interference-induced tendinitis and overstrain-induced tendinitis

Interference-induced tendinitis and overstrain-induced tendinitis had different ultrasonographic features (Supplementary item 4). Superficial (p=0.04), diffuse (p=0.004), and longitudinal split lesions (p=0.002) were seen more often with interference-induced SDF tendinitis, while core lesions more commonly found in overstrain tendinitis (p<0.0001). The location of the maximal injured zone varied significantly between the groups (p<0.0001), with overstrain tendinitis more frequently affecting zone 1A (p=0.002, Supplementary item 5) than interference-induced SDF tendinitis. There was no difference between the two groups in terms of echogenicity score (p=0.5), fibre alignment score (p=0.4), and CSHA/CSA ratio (p=0.07), whereas T-CSA (p=0.02) and T-CSHA (p=0.01) and CSA/cCSA ratio (p=0.009) were significantly smaller in interference-induced SDF tendinitis compared to overstrain-induced tendinitis (Table 3). The time to return to racing was significantly lower in horses with interference-induced SDF tendinitis (mean ± S.D. 245±137 days) compared to those with overstrain SDF tendinitis (331±118 days, p<0.001, **Fig. 4**).

Discussion

This is the first analytical study of clinical outcomes following interference injury in the palmar aspects of the forelimbs in Standardbred racehorses. These injuries can influence the athletic career of racehorses as they are associated with interference-induced SDF tendinitis, which, based on our data, significantly influences the outcome. SDF tendinitis was more frequently seen in association with interference injuries in the mid-metacarpal region (zone 2) and at the digital sheath region (zone 3) rather than the carpal region and palmar aspect of the pastern. Horses with interference injuries at the digital sheath region had a longer time to return to racing compared to those with injuries at the proximal metacarpal region and at the palmar pastern. Interference injuries were more likely to occur in horses racing unshod in the hind feet and in horses which sustained gait penalties. Based on the results obtained in our population, a greater number of career starts may slightly decrease the likelihood of an interference injury occurring.

The precise biomechanical aetiology of interference injuries is not well understood. The lesion distribution pattern that we observed suggests that interference injuries in the forelimbs most likely result from a toe-impact of the hind hooves hitting the palmar aspect of the limb, rather than the contralateral fore hoof. At high speed, joint flexion and peak height of the hind hooves increase during the swing phase of the stride [14], which may increase the risk of hind hooves reaching the palmar aspect of the forelimbs. Despite higher speed being reported previously as a possible risk factor for the occurrence of interference injuries in Standardbred racehorses [5], we did not observe an association between likelihood of injury and racing speed. Shoeing increases inertia in the distal limb [15] and maximal height of the flight arc of the foot during the swing phase of the stride [16]. Such shoeing-induced alteration of gait mechanics might have a protective role in Standardbred racehorses for the occurrence of this type of injuries. The significant association observed between interference injuries and gait penalties relating to breaking into a gallop (and out of trot) during racing is noteworthy but does not prove a cause-effect relationship between those two variables. Further studies are warranted to explore possible biomechanical determinants of interference injuries.

The presence of SDF tendinitis, more frequently detected in zones 2 and 3, was associated with a longer time to return to racing. In the current study, the anatomical site of interference injuries was not associated with clinical outcome category, but a low number of interference injuries was observed in the medial carpal region. Horses with interference-induced SDF tendinitis had a shorter time to return to racing compared to those with overstrain-induced tendinitis. The different ultrasonographic pattern and the smaller size of lesions seen with interference-induced SDF tendinitis may explain the shorter time to return to racing in this group. However, ultrasonographic examination was delayed many days in interference injury cases when a skin laceration was present which may have introduced bias in the assessment of echogenicity and longitudinal extension of the lesions [17]. Also, it is possible factors which were not examined in the current study, such as different therapeutic strategies adopted in interference-induced and overstrain-induced tendinitis may have impacted on time to return to racing.

Due to the retrospective nature of our study, we could not control for many variables, which might have introduced a bias into our results. Our inclusion criteria relied on information available in medical records in a musculoskeletal injuries database. All cases and positive controls were recruited in a single racetrack and were not randomly selected. We have no information on the health status of our negative control group, which may introduce a further source of bias. Nevertheless, we conclude that palmar forelimb interference injuries are frequently associated with SDF tendinitis. These injuries can negatively influence the athletic career of racehorses in terms of racing starts but not in terms of racing speed. Compared with overstrain-induced tendinitis, interference-induced SDF tendon lesions have a shorter time to return to racing. Further studies are needed to explore the pathogenesis and possible prevention of this injury.

List of Figure Legends

Figure 1. Anatomical distribution of interference injuries in 74 Standardbred racehorses. Each point represents an interference injury. L: lateral; M: medial.

Figure 2. Prognostic factors with palmar forelimb interference injuries in Standardbred racehorses. a) The effect of superficial digital flexor tendon involvement in the interference injury group on time to return to racing. b) The association between anatomical distribution of interference injuries and clinical outcome. Data are presented as percentage (analysis was performed on raw data).

Figure 3. Effect of palmar forelimb interference injuries on athletic performance in Standardbred racehorses. a) Cases' racing speed before and following injury. Racing day 0 = race in which injury was sustained. The error bars represent 95% confidence intervals.

b) Race participation rate before and following injury in cases and a negative control group. Cases' post-injury participation rate was lower than negative controls' post-recruitment participation rate ($p<0.0001$). Racing day 0 = race in which injury was sustained.

Figure 4. Kaplan-Meier plot of time to return to racing in Standardbred racehorses with interference superficial digital flexor tendonitis (n = 74) and overstrain-induced superficial digital flexor tendonitis tendinitis (n = 77). SDF: superficial digital flexor

Manufacturers' details

[a] http://www.ippicabiz.it.

[b] LOGIQ e, General Electric, UK.

[c] ImageJ, U.S. National Institute of Health, Bethesda, MD, USA.

[d] R version 3.4.0 ;http://www.r-project.org.

[e] GraphPad Software, La Jolla, CA, USA.

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Supplementary information

Supplementary item 1: Case and control enrollment flow chart

Supplementary item 2: Clinical presentations of interference injuries. a) Extensive laceration of the skin on the palmar aspect of the fetlock. b) Swelling of the medial styloid process at the radial epiphysis.

Supplementary item 3: Representative ultrasonographic images of marginal split (a), diffuse (b, c), and superficial (d) lesions of the superficial digital flexor tendon. Injured tendons are displayed in the right of each panel, while the contralateral tendon is displayed on the left.

Supplementary item 4: Effect of the injury zone on time to return to racing. Time to return to racing was significantly affected by the injury zone (p=0.003, Kruskal-Wallis test). Dunn's multiple post-tests revealed significant differences between zone 3 and zone 1 and between zone 3 and zone 5 (p=0.03 for both). Bars represent median and interquartile ranges, whiskers represent minimum and maximum values.

Supplementary item 5: Location of the maximal injury zone in interference- and overstrain-induced tendinitis of the superficial digital flexor tendon. Maximal injury zone was affected by the group (p<0.0001, Chi squared test). Post-tests were performed using multiple Fisher exact tests and Bonferroni correction for multiple comparisons. *: p=0.01. SDF: superficial digital flexor.

SI Legends – versions for text

Supplementary item 1: Case and control enrollment flow chart.

Supplementary item 2: Clinical presentations of interference injuries.

Supplementary item 3: Ultrasonographic images.

Supplementary item 4: Effect of the injury zone on time to return to racing.

Supplementary item 5: Location of the maximal injury zone

Tables

Table 1. Location and structures involved in palmar forelimb interference injuries in 74 Standardbred racehorses.

	Zone 1 *(n=4)*	*Zone 2* *(n=29)*	*Zone 3* *(n=20)*	*Zone 4* *(n=11)*	*Zone 5* *(n=10)*
Skin laceration requiring suture (n=41)	0[a]	10[a]	13	10	8
Superficial digital flexor tendinitis (n=58)	1	27[b]	14[b]	9	7[c]
Digital Sheath injury (n=13)	n.a.	n.a.	10	2	1
Annular Ligament lesion (n=11)*	n.a.	n.a.	n.a.	11	n.a.
Vascular injury (n=2)*	0	0	0	0	2
Laceration of the superficial digital flexor tendon (n=8)	0	1	6	1	n.a.
Bony lesions (n=4)*	4	0	0	0	0

Legend: n.a. = not applicable. [a]:significantly different from zone 4; [b]:significantly different from zone 1; [c]:significantly different from zone 2. *Statistical comparisons were not performed.

Table 2. Conditional logistic regression model for risk factors associated with interference injuries to the palmar aspect of forelimbs.

Variable		*Cases*	*Negative controls*	*Odds ratio*	*95% confidence intervals for the odds ratios*	*P value*
Number of races at time of injury		30 ± 30	39 ± 28	0.98	(0.96, 0.99)	**0.024**
Hindlimb shoeing status	*Shod*	38/67	61/67	reference		
	Unshod	29/67	6/67	6.26	(2.26, 19.62)	**<0.001**
Official gait penalties	*Yes*	35/67	5/67	11.13	(3.74, 41.64)	**<0.001**
	No	32/67	62/67	reference		
Racing speed categories						
	Category 1	7/67	n.a.	reference		
	Category 2	8/67	n.a.	1.56	(0.25, 10.41)	0.635
	Category 3	29/67	n.a.	1.35	(0.29, 6.96)	0.709
	Category 4	22/67	n.a.	1.65	(0.34, 8.96)	0.541
	Category 5	1/67	n.a.	3.08	(0.092, 104.6)	0.487

Total number of races is expressed as mean ± SD. n.a.: not applicable

Table 3. Ultrasonographic characteristics of interference-induced and overstrain-induced superficial digital flexor tendinitis cases.

	Interference-induced tendinitis (n=58)	*Overstrain-induced tendinitis (n=77)*
Cross-sectional description of the lesions [N cases]		
Superficial/Marginal	31 (53%)	27 (35%)[a]
Core	4 (7%)	44 (57%)[a]
Diffuse	16 (28%)	6 (8%)[a]
Longitudinal split	7 (12%)	0[a]
T-CSA of the SDFT [cm^2]	8.7 (8.4-9.1)	9.4 (9.0-9.8)[a]
T-CSHA of the SDFT [cm^2]	1.3 (1.1-1.6)	1.9 (1.6-2.2)[a]
CSA/cCSA at the maximal injury zone	1.7 (1.6-1.8)	1.9 (1.8-1.9)[a]
CSHA/CSA at the maximal injury zone [%]	34 (29-39)	38 (34-41)
Fibre alignment score at the maximal injury zone	4 (3-4)	4 (3-4)
Echogenicity score at the maximal injury zone	4 (3-4)	4 (4-4)

Legend: T-CSA= Total Cross Sectional Area, T-CSHA= Total Cross Sectional Hypoechogenic Area, CSA/cCSA= Cross Sectional Area/contralateral Cross Sectional Area, CSHA/CSA= Cross Sectional Hypoechogenic Area/Cross Sectional Area, SDFT= Superficial Digital Flexor Tendon. Data are indicated as mean (95% C.I.) with the exception of Fibre alignment and Echogenicity scores at the maximal injury zone, expressed as median (25^{th}-75^{th} percentile).

[a]: significantly different from interference-induced tendinitis group.