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Racing performance after arthroscopic removal of apical sesamoid fracture fragments in Thoroughbred horses age ≥2 years: 84 cases (1989–2002)

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Summary

Reasons for performing study: **Studies have shown that surgical removal of apical fracture fragments in Standardbred racehorses carries the best prognosis for return to racing performance, but there are no reports involving mature Thoroughbred (TB) racehorses.**

Objectives: **To describe the incidence of apical proximal sesamoid fractures in TB racehorses and determine probability and quality of racing performance after arthroscopic removal of such fractures in TB racehorses age ≥2 years.**

Methods: **Medical records and pre- and post operative race records of TB racehorses age ≥2 years that underwent arthroscopic surgery for removal of apical proximal sesamoid fracture fragments were reviewed.**

Results: **Sixty-four percent of fractures occurred in the hindlimbs and 36% in the forelimbs. Horses with forelimb fractures had a reduced probability of return to racing (67%) compared to those with hindlimb fractures (83%), but the majority (77%) of treated horses recovered to return to race post operatively. Horses with medial forelimb fractures raced at only a 47% rate; those with suspensory desmitis at 63%. Unlike Standardbreds, there was no difference in probability of racing post operatively between horses that had, and had not, raced preoperatively.**

Conclusions: **Data show that arthroscopic removal of apical proximal sesamoid fracture fragments is successful at restoring ability to race in skeletally mature TB horses without evidence of severe suspensory ligament damage. Prognosis for return to racing is excellent (83%) in horses with hindlimb fractures and good (67%) in those with forelimb fractures. Medial fractures of the forelimb have the worst prognosis.**

Potential relevance: **The determination of prognosis for differing sites in TB racehorses should increase knowledge of apical proximal sesamoid bone fractures and improve communication from veterinarian to owner, and trainer, on the potential for arthroscopic restoration of the ability to race.**

Introduction

Apical fractures are the most common type of proximal sesamoid fractures in racing Standardbred (SB) and Thoroughbred (TB) horses (Fretz *et al.* 1984; Woodie *et al.* 1999; Nixon 1999; Bertone 2002). The fractures are articular and generally defined as involving less than one-quarter or one-third of the proximal aspect of the bone (Nixon 1999; Bertone 2002). Apical fractures of the proximal sesamoid bones (PSBs) occur most often in the hindlimbs of Standardbred horses (Spurlock and Gabel 1983; Bouré *et al.* 1999; Woodie *et al.* 1999; Bertone 2002), while such fractures are said to occur most often in the forelimbs of TB horses (Wirstad 1963; Fretz *et al.* 1984). It is the lateral PSB that is most commonly affected in SB horses (Spurlock and Gabel 1983; Bouré *et al.* 1999; Woodie *et al.* 1999; Bertone 2002). No such predisposition is described in TB horses.

The PSBs, suspensory ligament and distal sesamoidean ligaments comprise the suspensory apparatus of the horse, which functions to prevent metacarpophalangeal and metatarsophalangeal joint hyperextension (Bukowiecki *et al.* 1987; Bertone 1996, 2002; Nixon 1999). The dorsal surfaces of the PSBs are lined with articular cartilage and are the palmar and plantar surfaces of the metacarpophalangeal and metatarsophalangeal joints, respectively. The suspensory ligament inserts on the nonarticular apical and abaxial surfaces of the sesamoid bones and is functionally continued by the distal sesamoidean ligaments, which originate from the basilar surface of the sesamoid bones and insert on the palmar or plantar surfaces of the proximal two phalanges. In addition, the collateral sesamoidean ligaments, which arise from the abaxial surface of the sesamoid bones and insert on the third metacarpal or metatarsal bone, and the intersesamoidean ligaments, which connect the axial surfaces of the paired sesamoid bones, provide stability to the apparatus (Kainer 2002).

During exercise, the suspensory and distal sesamoidean ligaments exert tensile forces on the PSBs. At high speeds and at the end of a race, when hyperextension of the metacarpophalangeal and metarsophalangeal joints is greatest due to fatigue, maximal loading can produce tensile forces on the

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sesamoid bones in excess of their strength, resulting in a fracture (Churchill 1956; Bukowiecki *et al.* 1987; Bertone 1996, 2002; Nixon 1999). The level of training of the horse, however, has been shown to affect whether it is the suspensory ligament or PSBs that will fail first when the joints are loaded to failure (Bukowiecki *et al.* 1987). In untrained horses, the suspensory ligament is most likely to fail; in trained horses, the PSBs are most likely. The load at failure is also significantly higher in trained horses (Bukowiecki *et al.* 1987).

In addition to apical proximal sesamoid fractures, 5 other basic fracture types have been described. They are mid-body, basal, abaxial, sagittal and comminuted (Fretz *et al.* 1984; Bukowiecki *et al.* 1987). Each of these fractures has a different preferred treatment approach (Henninger *et al.* 1991; Bertone 1996; Nixon 1999).

Few studies on PSB fractures (including apical fractures) to date have included TB racehorses, and they involve small numbers (Churchill 1956; Wirstad 1963; Fretz *et al.* 1984; Palmer 1989). In the study by Fretz *et al.* (1984) of 20 TBs with PSB fractures, 5 had apical fractures treated via arthrotomy. Of these 5 horses, 3 held or improved their class while 2 did poorly (Fretz *et al.* 1984). In a study by Palmer (1989), 3 TB horses underwent arthroscopy to remove proximal sesamoid fracture fragments, 2 of which had apical right forelimb medial PSB fractures. Little was stated about racing performance, other than that all horses resumed normal preoperative athletic activity within 3–9 months.

The purpose of this study was to determine, with quantitative data, the probability and quality of racing performance after arthroscopic removal of apical proximal sesamoid fracture fragments in various locations in TB racehorses age ≥2 years.

Materials and methods

Subjects

The medical records of TB racehorses age ≥2 years that underwent arthroscopic removal (1989–2002) of acute apical proximal sesamoid fracture fragments, one-fourth to one-third of the volume of the sesamoid bone, at Rood and Riddle Equine Hospital, were reviewed. Information obtained from medical records included subject details, affected limb, affected proximal sesamoid bone(s) and other serious conditions, including suspensory desmitis and sesamoiditis of the affected limb. Horses with multiple independent injuries, including a sesamoid fracture, were not selected. All horses were presented for acute lameness in training, and had acute fractures involving one-fourth to one-third of the volume of the bone through the area of predisposition to fracture during training described by Young *et al.* (1991) and consistent with fractures described in the literature as apical sesamoid fractures (Churchill 1956; Wirstad 1963; Spurlock and Gabel 1983; Fretz *et al.* 1984; Palmer 1989; Bouré *et al.* 1999; Nixon 1999; Woodie *et al.* 1999; Bertone 2002). The presence of sesamoiditis was determined according to the radiographic parameters defined by Spike-Pierce and Bramlage (2003). Ultrasonography of the suspensory ligament was performed preoperatively on all horses with clinically detectable suspensory desmitis.

Surgical technique

Arthroscopic surgery was performed with the horse positioned in lateral recumbency. The metacarpo- or metatarsophalangeal joint was distended with fluid and the arthroscope inserted into the proximal aspect of the palmar or plantar pouch, respectively. The sesamoid fracture was identified and an instrument portal made. The fracture fragment was isolated, cut from the intersesamoidean ligament using a right-angled Beaver Blade[1], transected from its suspensory ligament attachments using a straight Beaver Blade[1] and elevated from the parent bone using a periosteal elevator. The fragment was then grasped with a rongeur and retrieved from the joint. After debridement of the lesion, inspection of the fracture bed and inspection of the margins of the suspensory ligament insertions, the joint was thoroughly lavaged and the stab incisions were closed.

Peri- and post operative care

Potassium penicillin (22,000 iu/kg bwt i.v. q.i.d.) and gentamicin (6.6 mg/kg bwt i.v. s.i.d.) were administered for 24 h. One dose of phenylbutazone (4.4 mg/kg bwt i.v.) was administered preoperatively, as was tetanus toxoid. Post operative care included phenylbutazone (2.2 mg/kg bwt *per os* b.i.d for 10 days), bandaging for 30 days and stall confinement for 2 weeks, followed by 2 weeks of stall confinement and hand-walking. Ultrasonography of the suspensory ligament was performed on all horses after 4 weeks post operatively in order to determine when to initiate training. In cases where suspensory ligament lesions were identified, horses were returned to training when the suspensory ligament had no areas of fibre pattern (other than those that were detached from the fracture fragment) that were not healed with fibrosis.

Follow-up evaluation

Follow-up information included post operative time to first start, number of starts, highest race class, earnings and average earnings per start. All horses were followed to at least their 4-year-old year, and longer if data were available. This information was compared to the number of preoperative starts, race class of last 2 races, earnings and average earnings per start. Race classes were categorised as maiden, claiming, allowance, handicap and stake in ascending order. All racing information was obtained from the Jockey Club Information System (Equineline)[2].

Statistical analysis

A systematic analysis was carried out to assess the impact of surgery on recovery and performance of horses. The impact of surgery on recovery was assessed in terms of likelihood of returning to race and time to first start. The impact on performance was assessed in terms of number of races and total and average earnings per start. Initially, the bivariate association between input factors (sex, affected limb, affected sesamoid, raced preoperatively, presence of suspensory desmitis or sesamoiditis) and the likelihood of each of the outcomes was evaluated using either Chi-square or Student's *t* test, depending on the nature of the variable, categorical or continuous, respectively. Factors found to be significant in the bivariate analysis were considered in the multivariate approach to assess the significance of each factor while simultaneously controlling for the others. Survival analysis technique was used to determine the probability of returning to race post operatively. The general linear model was used for continuous outcomes for the multivariate approach. The

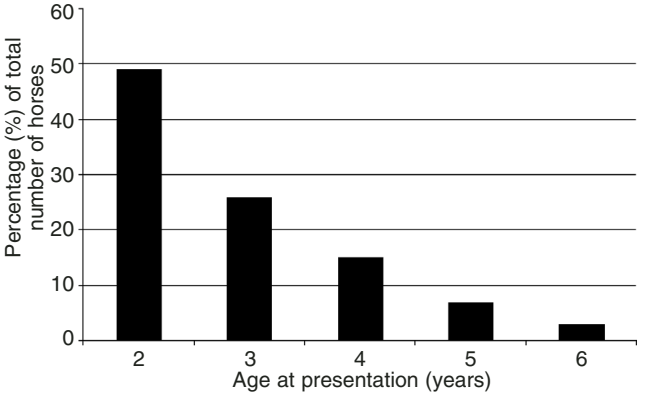

Fig 1: Age distribution of 84 mature Thoroughbred racehorses at the time of presentation for apical proximal sesamoid fractures, measured as a percentage of total horses in the study.

least square means method was used to evaluate the significant difference in adjusted means between groups. For all analyses, a value of P≤0.05 was considered significant. Chi-square tests, Student's *t* tests and survival analysis were performed using Statistix 8 software[3]. The general linear model and least squares means method were performed using SAS 9.1 software[4].

Results

Subject details

Affected horses included 42 females and 42 males. Forty-nine percent (41/84) of the horses presented as 2-year-olds, 26% (22/84) as 3-year-olds, 15% (13/84) as 4-year-olds and 10% (8/84) as 5- or 6-year-olds (Fig 1). Sixty-four percent (54/84) of the fractures occurred in the hindlimbs (Fig 2), with an equal distribution between the right and left, and with 15% (8/54) involving both hindlimbs. Of the forelimb fractures (Fig 3), 60% (18/30) occurred in the right forelimb and 40% (12/30) in the left. Overall, there was no preferential distribution for the affected sesamoid bone (39 lateral, 40 medial and 5 both lateral and medial). Medial sesamoid bone fractures, however, accounted for 63% (19/30) of the forelimb fractures (10/30 lateral and 1/30 biaxial), while lateral sesamoid bone fractures accounted for 54% (25/46) of the single hindlimb fractures (20/46 medial and 1/46 biaxial). Twenty-three percent (19/84) of horses had suspensory desmitis in the affected limb. Eleven percent (9/84) had inflammation of the sesamoid bone (sesamoiditis) noted either at the time of surgery or on follow-up examination.

Performance outcome

Fifty-eight percent (49/84) of the horses had raced preoperatively. The mean number of starts in the preoperative period was 5, median 1 start (range 0–30 starts). Mean earnings for the preoperative period were US$41,723, median $208 (range $0–598,690). Mean average earnings per start for the preoperative period were $3879, median $125 (range $0–28,325).

Seventy-seven percent (65/84) of the horses raced post operatively. Mean number of days from surgery to first start for all horses raced post operatively was 243 days, median 236 days (range 36–700 days). Mean number of starts in the post operative period was 12, median 7 starts (range 0–80 starts). Mean earnings for the post operative period were $32,414, median $14,972 (range $0–262,260). Mean average earnings per start for the post operative period were $3345, median $989 (range $0–87,420). Of the 38 horses that raced both pre- and post operatively, 47% (18/38) improved their race class post operatively, 34% (13/38) maintained their race class and 19% (7/38) moved to a lower race class.

The only factor that had a significant association with likelihood of returning to race was the sesamoid affected (Table 1). Horses with medial sesamoid fractures were less likely to race post operatively than those with lateral sesamoid fractures (P = 0.0088). Only 65% of horses with medial sesamoid fractures raced post operatively (26/40), compared with 90% (35/39) of those with lateral fractures. Of the 14 horses with medial

Fig 2: Dorsolateral-plantaromedial oblique radiograph of the right metatarsophalangeal joint in a horse with an apical proximal sesamoid fracture.

Fig 3: Dorsomedial-palmarolateral oblique radiograph of the right metacarpophalangeal joint in a horse with an apical proximal sesamoid fracture.

TABLE 1: Input factors and association between likelihood of racing post operatively (Chi-square test; *P≤0.05) and number of days to first start post operatively (Student's *t* test; *P≤0.05)

	Percentage raced (No. raced/total No.)	Mean No. days to first start (median, range)
Females vs.	74% (31/42)	251 (241, 36–700)
Males	81% (34/42)	236 (234, 84–527)
Forelimb fractures vs.	67% (20/30)	235 (236, 129–375)
Hindlimb fractures	83% (45/54)	247 (239, 36–700)
Left forelimb fractures vs.	58% (7/12)	230 (241, 134–310)
Right forelimb fractures	72% (13/18)	238 (235, 129–375)
Left hindlimb fractures vs.	83% (19/23)	259 (241, 84–700)
Right hindlimb fractures	83% (19/23)	225 (227, 36–423)
Left+right hindlimb fractures vs.	88% (7/8)	276 (301, 118–342)
Single hindlimb fractures	83% (38/46)	242 (230, 36–700)
Medial sesamoid fracture vs.	65% (26/40)*	238 (229, 84–700)
Lateral sesamoid fracture	90% (35/39)	249 (237, 36–527)
Medial sesamoid+forelimb vs.	47% (9/19)*	218 (220, 129–344)
All other combinations	86% (56/65)	247 (238, 36–700)
+ Suspensory desmitis vs.	63% (12/19)	244 (233,120–388)
- Suspensory desmitis	82% (53/65)	243 (236, 36–700)
+ Sesamoiditis vs.	67% (6/9)	285 (278,110–527)
- Sesamoiditis	79% (59/75)	239 (236, 36–700)
Raced vs.	78% (38/49)	215 (214, 36–700)*
Unraced	77% (27/35)	284 (279, 131–428)

sesamoid fractures that did not race, 10 of these were of the forelimb. When further examined, it was found that while 81% (17/21) of horses with medial sesamoid fractures of the hindlimb raced post operatively, only 49% (9/19) of those with medial sesamoid fractures of the forelimb did so. Horses with medial sesamoid fractures of the forelimb were less likely to race post operatively than those that had sesamoid fractures in other locations (P = 0.0004). For comparison, 100% (10/10) of horses with lateral sesamoid fractures of the forelimb raced post operatively (1/1 horse with biaxial forelimb fracture raced post operatively), as did 83% (45/54) of those with sesamoid fractures of the hindlimb.

The only input factor found to influence the time to first start post operatively was whether the horse had raced preoperatively (Table 1). Horses that had raced preoperatively had a significantly decreased number of days to their first start than horses that had not (P = 0.0067). There was a significant association between having raced preoperatively and age, with horses having raced preoperatively being older than horses that had not (P≤0.0001).

Variables found to have a significant association with performance outcomes included presence of suspensory desmitis in the affected limb and whether or not the horse had a medial sesamoid fracture of the forelimb (Table 2). When the differences in pre- and post operative number of starts, earnings and average earnings per start were compared for horses with and without suspensory desmitis, those with suspensory desmitis had a significantly lower number of starts (P = 0.0004), earnings (P = 0.0091) and average earnings per start (P = 0.0201) post operatively. Similarly, horses with medial sesamoid fractures of the forelimb had a significantly lower average earnings per start post operatively than horses with sesamoid fractures in other locations (P = 0.0227).

The results of the multivariate analysis are shown in Table 3. The interaction between the presence of suspensory desmitis and a medial sesamoid fracture of the forelimb was examined, because it was expected that the effect of having a medial sesamoid fracture of the forelimb would vary by the presence of suspensory desmitis. Horses with suspensory desmitis and a medial sesamoid fracture of the forelimb had significantly fewer starts post operatively when age and whether they had raced preoperatively were controlled for (P = 0.0026). These horses also earned significantly less money post operatively when the same factors were controlled for (P<0.0001). There was no significant difference in average earnings per start post operatively for horses with suspensory desmitis and a medial sesamoid fracture of the forelimb when compared to other horses (P = 0.0626).

Survival analysis was used to determine the probability of returning to race post operatively (Fig 4). After 180 days, there was a 75% chance that the horse would still return to race post operatively. After 236 days, the chance of returning dropped to 50%, and after 298 days, there was only a 25% chance that the horse would return to race.

Discussion

This study was performed to determine the prognosis for skeletally mature Thoroughbred racehorses that sustained apical proximal sesamoid bone fractures, subsequently treated arthroscopically. Importantly, assessment of the different sesamoid fracture locations, forelimb vs. hindlimb, and medial vs. lateral, identified major variations that can be taken into account preoperatively in discussions with owners and trainers, for a more accurate prognosis for productive return to racing. In this group of 84 horses, there were no horses age <2 years,

TABLE 2: Input factors determined to have a significant association with differences between pre- and post operative number of starts, earnings or average earnings per start (AEPS) (Student's *t* test; *P≤0.05)

	Preoperative means			Post operative means		
	No. starts	Earnings ($)	AEPS ($)	No. starts	Earnings ($)	AEPS ($)
+ Suspensory desmitis	11*	97,640*	5695*	6*	10,119*	1321*
Median	9	24,255	3489	3	1957	163
Range	0–30	0–598,690	0–24,945	0–31	0–41,195	0–7280
vs. - Suspensory desmitis	4	25,378	3348	14	38,931	33,937
Median	1	0	01	8	16,800	1215
Range	0–30	0–395,525	0–28,325	0–80	0–262,260	0–87,420
Medial sesamoid + forelimb	6	51,253	5869*	9	23,599	1977*
Median	3	21,338	4043	0	0	0
Range	0–28	0–219,016	0–28,325	0–55	0–112,019	0–7660
vs. All other combinations	5	38,937	3297	13	34,991	3745
Median	1	0	0	8	15,001	1022
Range	0–30	598,690	0–24,495	0–80	0–262,260	0–87,420

TABLE 3: Input factors determined to be significant in multivariate analysis (general linear model; P≤0.05) when controlled for other factors (as listed in model)

Significant input factors (Model: Suspensory desmitis * medial sesamoid fracture of forelimb, raced preoperatively, age)	P value Least squares means Post operative - preoperative[a] No. starts	Earnings	AEPS
Suspensory desmitis (SD) * Medial sesamoid fracture of forelimb (MSF)	0.0026	<0.0001	0.0626
Neither present	10.14	$15,546.44	$1651.92
- SD + MSF	4.01	-$15,694.16	-$2368.35
+ SD - MSF	-1.47	-$80,096.61	-$3773.68
Both present	-1.84	-$32,561.36	-$2557.65

*Interaction between presence of suspensory desmitis and a medial sesamoid fracture of the forelimb.[a]As the difference between pre- and post operative number of starts, earnings and average earnings per start (AEPS) was defined as post operative minus preoperative, a negative least squares mean indicates that the post operative value was less than the preoperative value.

although almost half of the horses fractured the sesamoid bones in their 2-year-old season. This demonstrates that adaptation to training is necessary in the sesamoid bone and agrees with previous reports that discuss the fact that sesamoid bones adapt to training either more slowly or not as well as the soft tissue aspects of the suspensory apparatus (Bukowiecki *et al.* 1987). As horses matured, the year-by-year representation, as a percentage of horses with fractures, declined in this group. As with Standardbreds, hindlimb apical sesamoid bone fractures were more frequent than forelimb fractures, but only slightly so (64%). Unlike Standardbreds, there was no lateral or medial sesamoid bone predisposition overall in this group, but 60% of forelimb fractures involved the medial sesamoid bone. Only 47% of horses with medial forelimb sesamoid fractures raced post operatively. Conversely, 100% of the horses with lateral forelimb fractures raced. Failures in those that returned to racing following medial forelimb sesamoid fracture accounted for the majority of the failures in the overall 77% that returned to racing.

Since the medial is slightly larger than the lateral sesamoid, as is the entire medial aspect of the fetlock joint, the medial sesamoid presumably carries more weight than does the lateral bone. Since the forelimb carries more weight than the hindlimb, the more heavily loaded medial forelimb fractures would be the most difficult to rehabilitate. It appears that apical fractures of the other sesamoids in the horse can be treated, and affected horses expected to return to racing at a very high level, but the medial sesamoid apical fracture is a much more disabling injury. Unlike some injuries that have a clear predisposition due to the direction of racing, apical sesamoid fractures in our practice had no predisposition from side to side, but were clearly most common in the hindlimbs. It may be that the predisposition seen for many injuries is more dominant in the forelimb and does not apply to the hindlimb, or that there is no side to side predisposition in the adaptation of the sesamoid to training.

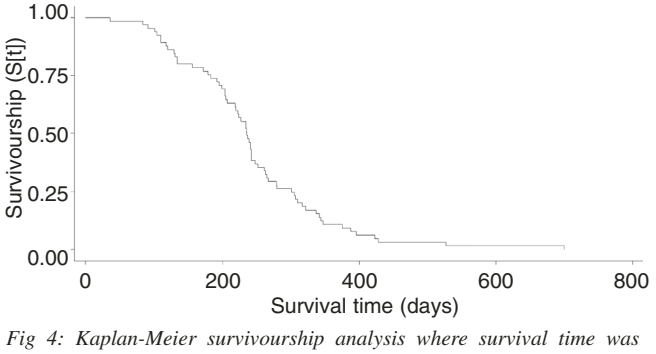

Fig 4: Kaplan-Meier survivourship analysis where survival time was defined as days to the first start post operatively and survivourship (S[t]) as the probability of returning to race after a certain number of days post operatively. Time variable = days; event variable = raced.

Arthroscopic removal in this study had a better prognosis than that described in the literature with removal by arthrotomy, as should be expected from the lesser degree of soft tissue damage incurred via arthroscopic removal.

Numerous studies performed on a total of over 190 Standardbred horses have shown that surgical removal of apical fracture fragments carries the best prognosis for return to racing performance in horses without severe suspensory ligament damage (Spurlock and Gabel 1983; Fretz *et al.* 1984; Palmer 1989; Bouré *et al.* 1999; Woodie *et al.* 1999). In a study of 109 Standardbred horses by Spurlock and Gabel (1983), 80 of the horses had apical fracture fragments removed by means of arthrotomy; 50% of the horses treated surgically raced post operatively. Sixty-four percent of the horses that had raced preoperatively raced post operatively and had significantly better performances than those horses that had not. Number of races, earnings and order of finish score were increased after surgery for horses with fractures in the hindlimbs, while they were decreased for horses with fractures in the forelimbs. Horses treated surgically within 30 days of injury had a significantly better racing performance than those treated after 30 days (Spurlock and Gabel 1983). This finding was in agreement with that of Churchill (1956). Horses with concurrent suspensory desmitis earned less money and had fewer races (Spurlock and Gabel 1983).

In a study of 43 Standardbreds by Woodie *et al.* (1999), 81% had apical fracture fragments removed by means of arthrotomy and 19% by arthroscopy. Sixty-seven percent raced post operatively and 88% of the horses that had raced preoperatively raced post operatively. Horses with fractures in the forelimbs (14%) earned less money per start post operatively (Woodie *et al.* 1999). In a study of 18 Standardbreds by Bouré *et al.* (1999), racing results were similar.

Because of the 2-year-old predisposition in the present study, only 58% of the horses had raced prior to fracturing their sesamoid bones. Overall, 77% of the horses raced post operatively, and nearly the same percentages of horses that had and had not raced preoperatively (78 and 77%, respectively) raced. This is in contrast to Standardbred studies, in which horses that had raced preoperatively had a substantially higher percentage return to racing post operatively. The reason for this is not obvious, but, in view of the fact that the median number of starts for the 59% of

the horses that raced preoperatively was one start, it appears that the most vulnerable time for a sesamoid bone in the TB racehorse is just as they reach racing fitness. Therefore, there may be less difference in the fitness levels of the TB racehorses that fractured or did not fracture the sesamoid bone.

The return to racing in our study ranged 36–700 days, although there was probably an interfering event that caused the one horse to be away from racing for 2 years. Horses that are injured during their 2-year-old season are almost always held until their 3-year-old season to resume serious racing. The high number of 2-year-olds in this group probably influenced the time to return to racing in this study.

The period to return to racing for horses that had raced preoperatively was approximately 2 months shorter than for horses that had not raced preoperatively. This is logical, since many of the horses that fractured sesamoids prior to initiating racing would not have completed the training process fully before being stopped by the sesamoid fracture. Therefore, although the probability of return is not affected by having raced preoperatively, the speed of return to start a race is affected. The median of 7–8 months before the first start probably represents the amount of suspensory ligament convalescence required and the schedule of racing year to year. The return to racing of 12/19 (63%) of horses with suspensory desmitis was a reduction from the 77% overall return. Of these 12 horses, 6 had medial forelimb sesamoid fractures. Of these, only 2 (33%) returned to race. The combination of a medial forelimb sesamoid fracture and suspensory desmitis is especially difficult to overcome and those that race do so at a lower quality with fewer starts and lower earnings.

Sesamoiditis present at surgery had little effect on the number or quality of starts after treatment. These horses did not decline further after arthroscopic removal of the apical sesamoid fracture. Post arthroscopic removal, number of starts for each horse increased, level of race class tended to increase and the average earnings per start decreased, as it does with age in all horses, because the purse structure is richer for young horses (Martinelli *et al.* 1996). The rate of return to racing for males was 81%, and for females 74%. Fillies are normally retired at a more rapid rate than males, due to their valuable second career as a broodmare, but the difference was not great in this group. This tendency to retire fillies more rapidly than colts was probably mitigated by the distribution of the fractures early in the horse's career, which increased the number of fillies who still needed to prove themselves as racehorses.

In summary, arthroscopic removal of apical proximal sesamoid fracture fragments is highly successful in Thoroughbred racehorses without evidence of severe suspensory desmitis. As an overall group, parameters of racing performance post operatively are comparable to those preoperatively, with the exception of horses with fractures of the medial sesamoid of the forelimb. Horses with hindlimb and lateral forelimb fractures have an excellent prognosis, with an 86% probability of return to racing. This study established that a medial apical sesamoid fracture of the forelimb carries the worst prognosis, has the most difficult rehabilitation and decreases the quality of the injured horse's race career. However, the effects of apical proximal sesamoid fractures in the other sesamoids can virtually be negated via arthroscopic removal if the suspensory ligament is not concurrently damaged.

Acknowledgements

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Manufacturers' addresses

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[2]The Jockey Club Information Systems Inc., Lexington, Kentucky, USA.
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