EQUINE

Injection of platelet- and leukocyte-rich plasma at the junction of the proximal sesamoid bone and the suspensory ligament branch for treatment of yearling Thoroughbreds with proximal sesamoid bone inflammation and associated suspensory ligament branch desmitis

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Objective—To determine the effects of treatment with platelet- and leukocyte-rich plasma (PRP) on future 2-, 3-, and 4-year-old racing performance of yearling Thoroughbreds with proximal sesamoid bone inflammation and associated suspensory ligament branch (SLB) desmitis.

Design—Randomized clinical trial.

Animals—39 yearling Thoroughbreds.

Procedures—Yearling Thoroughbreds with radiographic evidence of performance-limiting proximal sesamoid bone inflammation and ultrasonographic evidence of associated SLB desmitis were identified and randomly assigned to undergo PRP (treatment group) or saline (0.9% NaCl) solution (control group) injection at the affected SLB-proximal sesamoid bone junction. Race records of horses for the 2-, 3-, and 4-year-old racing years were obtained. Data regarding amount of money earned and number of races started were used as outcome measures, and results for groups were compared.

Results—Horses treated with PRP were significantly more likely to start at least 1 race during the 2-year-old racing year than were horses treated with saline solution; no significant differences were detected between groups regarding that variable for the 3- and 4-year-old racing years. No significant differences between groups were detected regarding earnings for any racing year.

Conclusions and Clinical Relevance—Although PRP-treated horses were more likely to start a race during the 2-year-old racing year versus control group horses, results for horses in each group were not significantly different for the 3- and 4-year-old racing years. Therefore, the PRP treatment protocol evaluated in this study did not seem to improve future racing performance of yearling Thoroughbreds with proximal sesamoid bone inflammation and associated SLB desmitis, compared with injection of saline solution. (*J Am Vet Med Assoc* 2013;243:120–125)

Inflammation of the PSB (proximal sesamoiditis) in horses typically involves desmopathy of the insertion of the interosseous muscle (ie, suspensory ligament); this condition is characterized by inflammation and decreased strength of the Sharpey fibers of the suspensory ligament insertion on the abaxial aspects of PSBs. This leads to signs of pain and lameness of horses during high-speed exercise.[1] A diagnosis of proximal sesamoiditis is suspected when radiographic abnormalities, including the presence of radiographically abnormal vascular canals, are detected in the abaxial border of a PSB and confirmed when ultrasonographic abnormalities of the associated SLB are detected. Ultrasonographic findings for horses with proximal sesamoiditis include a hypoechoic to anechoic SLB at the insertion and an irregular contour of the PSB.

Proximal sesamoiditis (defined as radiographic detection of abnormal PSB vascular canals [> 2 mm wide with nonparallel borders]) has been associated with decreased number of race starts and amount of money earned for 2- to 3-year-old Thoroughbred racehorses.[2] Treatment options have included rest; administration of anti-inflammatory drugs, drugs that alter platelet function (such as acetylsalicylic acid), or vasoactive drugs (such as isoxsuprine); and physical treatments such as application of ultrasonographic or shock waves; however, such treatments are typically ineffective. To our knowledge, no effective treatment for proximal sesamoiditis has been reported.

Abbreviations

CI	Confidence interval
PRP	Platelet-rich plasma
PSB	Proximal sesamoid bone
SLB	Suspensory ligament branch

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Platelet-rich plasma is becoming popular as a treatment for various orthopedic injuries of horses. Platelet-rich plasma may promote healing of tissues via release of growth factors from the concentrated platelets. Results of in vitro studies[3–5] indicate that equine PRP has an increased concentration of growth factors, compared with that of whole blood or plasma. When incubated with superficial digital flexor tendon or suspensory ligament explants in vitro, PRP increases expression of genes of various extracellular matrix components, increases the ratio of type I collagen to type III collagen, and decreases expression of genes of various enzymes that catabolize extracellular matrix components.[3,5,6]

Platelet-rich plasma improves tendon healing in rats and rabbits with experimentally induced patellar tendonopathy.[7,8] Results of other in vivo studies[9,10] indicate that PRP increases vascularization, collagen and glycosaminoglycan content, tendon strength, and collagen organization in experimentally induced superficial digital flexor tendon core lesions of horses. However, evidence for the efficacy of PRP for the treatment of naturally developing performance-limiting diseases in horses is typically anecdotal or determined on the basis of results of uncontrolled clinical case series.[11,12]

Results of clinical trials[13,14] indicate that PRP reduces signs of pain and improves function for humans with lateral humeral epicondylitis (an insertional tendonopathy). However, results of other controlled, randomized, blinded trials[15,16] indicate PRP does not affect neovascularization, ultrasonographic appearance, patient-reported pain, or time of return to clinically normal function for humans with Achilles tendonopathy.[15,16]

To the authors' knowledge, no prospective, randomized, controlled clinical trials have been conducted to determine the effects of PRP for treatment of horses with naturally occurring orthopedic injuries. The purpose of the study reported here was to identify an evidence-based treatment option for horses with proximal sesamoiditis and associated SLB desmitis, a performance-limiting condition of horses for which treatments are typically unsuccessful. Although the conditions are not directly comparable, we theorized that PRP treatment would be beneficial for horses with proximal sesamoiditis and associated SLB desmitis (an insertional desmopathy) because PRP treatment is beneficial for humans with lateral humeral epicondylitis (an insertional tendonopathy).[13] We hypothesized that Thoroughbred racehorses with proximal sesamoiditis and associated SLB desmitis that were treated with PRP would start more races and have higher earnings, versus such horses with that problem that were treated with saline (0.9% NaCl) solution.

Materials and Methods

Horses—During the spring of 2006, 1,152 yearling Thoroughbreds underwent survey radiography at Rood and Riddle Equine Hospital. The inclusion criteria for this study were yearling Thoroughbreds from that group without lameness that had ≥ 2 abnormal vascular canals in the abaxial border of ≥ 1 PSB identified in radiographic images. Previously published criteria were used to identify abnormal vascular canals in PSBs in horses in the present study (vascular canals > 2 mm wide with nonparallel borders) because horses with this radiographic finding start fewer races and earn less money, compared with their siblings without those radiographic findings.[2] All horses also underwent ultrasonography to confirm SLB involvement, and only horses with ultrasonographic abnormalities of an SLB and radiographic abnormalities of an associated PSB were included in this study. These inclusion criteria were intended to allow identification of horses that would be expected to perform poorly as racehorses. Permission and informed consent were obtained from owners or their assigned agents for inclusion of horses in the study.

Ultrasonographic images of SLBs were subjectively graded on a scale of 0 to 4. Grade 0 represented an ultrasonographically normal SLB (isoechoic), grade 1 represented a mildly hypoechoic SLB lesion (< 50% decrease in echogenicity, compared with an ultrasonographically normal appearance), grade 2 represented a moderately hypoechoic lesion (approx 50% decrease in echogenicity, compared with an ultrasonographically normal appearance), grade 3 represented a markedly hypoechoic lesion (> 50% decrease in echogenicity, compared with an ultrasonographically normal appearance), and grade 4 represented an anechoic lesion.

Horses were randomly allocated to receive PRP (treatment group horses) or saline solution (control group horses). Pieces of paper with sequential numbers were placed into a container. One piece of paper was drawn for each horse; horses with even numbers were assigned to the control group and horses with odd numbers were assigned to the PRP treatment group. For horses with > 1 affected PSB and SLB, the same treatment was administered for all affected sites.

PRP preparation—Platelet-rich plasma was prepared by use of a modification of previously published protocols[13,a] for preparation of human PRP by use of a commercially available PRP kit[b] and centrifuge. The system used to prepare PRP samples in the present study was validated prior to use with blood samples obtained from 10 yearling Thoroughbreds. The mean ± SD platelet count for the whole blood samples was 214,000 ± 113,000 platelets/µL (range, 113,000 to 508,000 platelets/µL), and the mean ± SD platelet count for the prepared PRP samples was 966,000 ± 189,000 platelets/µL (range, 731,000 to 1,407,000 platelets/µL); preparation of PRP samples led to a mean platelet concentration that was 5.2-fold higher (SD, 1.9) than that for whole blood samples (range, 2.3- to 8.2-fold increase in platelet concentration).[c] The increase in platelet concentration was < 3-fold for only 1 of the 10 blood samples. This PRP preparation system also concentrates platelets effectively in blood samples obtained from adult Standardbreds.[10] After aseptic preparation of skin, 55 mL of blood was obtained from a jugular vein of each horse with a 16-gauge needle and a syringe containing 5 mL of acid citrate dextrose, solution A; minimal negative pressure was applied during collection of blood samples. The syringe was gently inverted to mix the blood and anticoagulant, and the blood sample was then injected gently into a centrifuge canister. The can-

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ister was centrifuged (1,744 × g) for 15 minutes. The platelet-poor plasma fraction was removed from the canister and discarded. The canister was agitated for 30 seconds, after which PRP was removed from the canister. Sodium bicarbonate was added to the PRP as a buffer (0.05 mL of 8.4% sodium bicarbonate/mL of PRP). A chemical activator for PRP was not used. Platelet-rich plasma was injected into horses immediately after preparation.

Treatment protocol—The PRP treatments were performed in a manner similar to a previously published method for humans with lateral humeral epicondylitis.[13] Local anesthesia was achieved via SC injection of 3 mL of mepivacaine in an epinephrine-flushed syringe at the PSB-SLB junction. A 19-gauge needle was inserted 5 times into the soft tissues of the abaxial aspect of the PSB at the location of the SLB insertion in a circular pattern, then 3 mL of PRP (treatment group horses) or saline solution (control group horses) was injected into the center of the circular region. Injections were performed without ultrasonographic guidance. The PSB-SLB junction was identified via palpation for horses in the present study, as was the tendon-bone junction in the study[13] of humans. Several modifications of the previously published[13] technique for humans were used for horses in the present study. In the other study[13] including humans with lateral humeral epicondylitis, 22-gauge needles were used for injections because of discomfort reported by patients when larger needles were used; we empirically chose to use a larger-gauge needle for horses in the present study because of the large size of the SLB-PSB junction in such animals. In addition, bupivacaine was used as the control treatment for humans in that other study,[13] whereas saline solution was used as the control treatment for horses in the present study.

The clinician (KSG) who performed the injections was aware of the treatment groups to which horses had been assigned, because PRP and saline solution had different appearances. However, the clinician attempted to use an identical injection technique for each horse. Treated limbs were bandaged for 2 days after performance of injections. Horses had stall rest for 3 days, followed by hand walking or turnout in a small pen for 1 week, and then resumed paddock turnout and regular observation by caretakers. Caretakers were unaware of treatments for each horse. Caretakers were instructed not to administer acetylsalicylic acid or isoxsuprine to horses for at least 60 days following PRP or saline solution injection.

Data and statistical analysis—Race records for each horse included in the study were obtained from a commercial database.[d] Information recorded from the race records of each horse included the number of race starts per year and total amount of money earned during the 2-, 3-, and 4-year-old racing years. Data for amount of money earned were logarithmically transformed for comparisons regarding sex (male vs female) and treatment (PRP vs saline solution) of horses; these analyses were performed with Wilcoxon rank sum tests. Because the data had a large number of zero values (for horses that did not race or did not earn money), data for number of starts and amount of money earned were analyzed as dichotomous categorical variables (ie, horses started or did not start and did or did not earn money) for comparison of control and treatment group horses; these analyses were performed with the χ^2 test. The associations of treatment with the categorical variables for earnings or starts were adjusted for the effects of sex and assessed with multivariable logistic regression analysis. Results of logistic regression analysis were expressed as ORs determined via exponentiation of the coefficients determined with the logistic regression model; 95% CIs were determined with maximum likelihood methods.

The distribution of mean ultrasonographic SLB scores was tested for normality with the Kolmogorov-Smirnov test, and the null hypothesis that the data were normally distributed was not rejected ($P = 0.182$). On the basis of this result, and to account for repeated measures for some horses, linear mixed-effects models were fit to compare the mean ultrasonographic SLB scores of PRP treatment and control group horses prior to the start of the study; individual horse was modeled as a random effect, and treatment group was modeled as a fixed, categorical effect. By use of maximum likelihood methods, 95% CIs were calculated for the mean values estimated by means of linear mixed-effects modeling. Values of $P \leq 0.05$ were considered significant for all statistical tests.

Results

Thirty-nine yearling Thoroughbreds were enrolled in the study, including 20 horses (8 males and 12 females) in the PRP treatment group and 19 horses (10 males and 9 females) in the control (saline solution–treated) group. Three horses in the PRP treatment group underwent injection of 2 sites, and 17 horses in that group underwent injection of 1 site (total number of sites injected, 23). The sites injected for horses in the PRP treatment group included left forelimb lateral (n = 3), left forelimb medial (4), right forelimb lateral (5), right forelimb medial (2), left hind limb lateral (3), left hind limb medial (1), right hind limb lateral (4), and right hind limb medial (1) PSB-SLB junctions. For the control group, 1 horse underwent saline solution injection of 4 sites, 2 horses underwent injection of 3 sites, 2 horses underwent injection of 2 sites, and 14 horses underwent injection of 1 site (total number of sites injected, 28). The sites injected for horses in the control group included left forelimb lateral (n = 5), left forelimb medial (7), right forelimb lateral (4), right forelimb medial (3), left hind limb lateral (3), right hind limb lateral (3), and right hind limb medial PSB-SLB (3) PSB-SLB junctions; none of the horses in that group underwent injection of the left hind limb medial PSB-SLB junction.

All horses with radiographic PSB abnormalities included in the study had ultrasonographic SLB abnormalities; therefore, no horses were excluded because of negative results of ultrasonographic examinations for detection of SLB desmitis. No significant ($P = 0.123$) difference was detected regarding ultrasonographic SLB scores between horses in the PRP treatment group

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(mean score, 1.8; 95% CI, 1.5 to 2.2) and horses in the control group (mean score, 1.5; 95% CI, 1.0 to 1.9). All horses were treated in the spring of their yearling year. None of the horses had lameness and all were able to begin training in the autumn of their yearling year.

Effect of sex on number of races started—The numbers of races started for male and female horses during 2-, 3-, and 4-year-old racing years were summarized (**Table 1**). Male horses started significantly more races than did female horses during 2-, 3-, and 4-year-old racing years and during the 2- through 4-year-old racing period.

Effect of treatment on likelihood of starting a race—Horses treated with PRP were significantly (P = 0.034) more likely to start at least 1 race during the 2-year-old racing year versus horses in the control group (**Table 2**). No significant effect of treatment was detected regarding whether horses did or did not start at least 1 race during the 3- and 4-year-old racing years or during the 2- through 4-year-old racing period. Because male horses had significantly more race starts than did female horses and male horses were underrepresented in the PRP treatment group, an analysis was performed to determine the effect of treatment after adjustment for the effect of sex. Results of this analysis indicated horses in the PRP treatment group were 3.7 times as likely to start at least 1 race as were control horses during the 2-year-old racing year (95% CI, 1.3 to 11.1; P = 0.023). No significant effect of treatment on odds of starting at least 1 race was detected for 3- and 4-year-old racing years. During the 2- through 4-year-old racing period, horses in the PRP treatment group were 2.1 times as likely to start at least 1 race as were control group horses, but this difference was not significant (95% CI, 0.9 to 5.2; P = 0.097).

Effect of sex on amount of money earned—Male horses earned significantly more money than did female horses during the 3- and 4-year old racing years and during the 2- to 4-year-old racing period (**Table 3**). During the 2-year-old racing year, the median amount of money earned by male horses was greater than that for female horses, but this result was not significant (P = 0.074).

Effect of treatment on earnings—No significant differences in amount of money earned (**Table 4**) or the proportion of horses that earned any of amount of money (**Table 5**) were detected between PRP treatment group horses and control group horses for any racing year. Results of analysis performed after adjustment for the effects of sex indicated PRP-treated horses were 2.1 times as likely to have nonzero earnings (amount of money earned, $0) as were control horses when they were 2 years old, but this difference was not significant (95% CI, 0.9 to 4.5; P = 0.076). No effect of treatment on earnings was detected for 3- or 4-year-old racing years. For the 2- through 4-year-old racing period, PRP treatment group horses were 2.1 times as likely to have nonzero earnings as were control group horses, but this difference was not significant (95% CI, 0.9 to 5.2; P = 0.097).

Table 1—Median (range) number of races started during the 2-, 3-, and 4-year-old racing years and during the 2- through 4-year-old racing period for 18 male and 21 female Thoroughbreds with proximal sesamoiditis and associated SLB desmitis as yearlings.

Age (y)	Males	Females	*P* value*
2	2 (0–5)	0 (0–3)	0.008
3	4.5 (0–12)	0 (0–10)	0.050
4	4 (0–13)	0 (0–16)	0.024
2–4	10 (0–28)	2 (0–26)	0.008

*Data were significantly ($P \leq 0.05$) different between male and female horses for all ages.

Table 2—Number (%) of horses with proximal sesamoiditis and associated SLB desmitis that were treated with PRP (treatment group; n = 20 horses) or saline (0.9% NaCl) solution (control group; 19) that started at least 1 race during the 2-, 3-, and 4-year-old racing years and during the 2- through 4-year-old racing period.

Age (y)	Treatment	Control	*P* value
2	12 (60)	5 (26)	0.034*
3	12 (60)	11 (58)	0.649
4	9 (45)	8 (42)	0.856
2–4	16 (80)	12 (63)	0.243

*Value is significantly ($P \leq 0.05$) different between PRP-treated and control horses.

Table 3—Median (range) amount of money earned by 18 male and 21 female Thoroughbreds with proximal sesamoiditis and associated SLB desmitis during the 2-, 3-, and 4-year-old racing years and during the 2- through 4-year-old racing period.

Age (y)	Males	Females	*P* value
2	$615.50 ($0–$21,520)	$0 ($0–$23,400)	0.074
3	$14,929.50 ($0–$181,090)	$0 ($0–$46,040)	0.028*
4	$3,966.50 ($0–$77,150)	$0 ($0–$373,156)	0.036*
2–4	$31,133.50 ($0–$195,365)	$100 ($0–$442,956)	0.005*

*Value is significantly ($P \leq 0.05$) different between male and female horses.

Table 4—Median (range) amount of money earned by horses with proximal sesamoiditis and associated SLB desmitis that were treated with PRP (treatment group; n = 20 horses) or saline solution (control group; 19) during the 2-, 3-, and 4-year-old racing years and during the 2- through 4-year-old racing period.

Age (y)	Treatment	Control	*P* value
2	$302 ($0–$23,400)	$0 ($0–$14,930)	0.163
3	$2,143 ($0–$55,930)	$2,340 ($0–$181,090)	0.874
4	$0 ($0–$373,156)	$0 ($0–$52,960)	0.887
2–4	$18,881 ($0–$442,956)	$14,390 ($0–$195,365)	0.580

Data were not significantly ($P > 0.05$) different between groups of horses for any age.

Table 5—Number (%) of horses with proximal sesamoiditis and associated SLB desmitis that were treated with PRP (treatment group; n = 20 horses) or saline solution (control group; 19) that had nonzero earnings during the 2-, 3-, and 4-year-old racing years and during the 2- through 4-year-old racing period.

Age (y)	Treatment	Control	*P* value
2	10 (50)	5 (26)	0.129
3	13 (65)	11 (58)	0.649
4	8 (40)	8 (42)	0.894
2–4	16 (80)	12 (63)	0.243

Data were not significantly ($P > 0.05$) different between groups of horses for any age.

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Discussion

The finding of the present study that male horses had more race starts and higher earnings than did female horses was expected.[17] This finding was likely attributable to a bias for more aggressive training of male racehorses than for female racehorses, because race purses for male horses are typically larger than those for female horses (especially for races in which 2- and 3-year-old horses compete), and female horses have potential alternate careers as broodmares. As a result, male horses tend to be trained for racing for a longer period of time than female horses.

Our hypothesis was largely not supported by findings of the present study; no significant differences were detected between PRP-treated and saline solution–treated horses regarding median amount of money earned, whether horses had nonzero earnings at any age, or whether horses had started at least 1 race when they were 3 or 4 years old. However, after adjustment for the effects of sex, horses treated with PRP were significantly more likely (3.7 times as likely) to have started at least 1 race during the 2-year-old racing year as were control group horses. Horses treated with PRP had a greater likelihood (2.1 times as likely) of having nonzero race earnings when they were 2 years old, but this result was not significant. Horses treated with PRP had a greater likelihood of having nonzero earnings from the time they were 2 years old through the time they were 4 years old, although that result was not significant; this finding was attributed to the data for the 2-year-old racing year. A larger sample size would have increased the power of the study and may have led to detection of a stronger association between PRP treatment and amount of money earned when horses were 2 years old; however, because of the low incidence of proximal sesamoiditis of a severity that causes a decrease in earning potential of Thoroughbred racehorses, only 39 horses met the inclusion criteria for the study. Inclusion of yearling Thoroughbreds for > 1 year would have introduced variability among horses attributable to the calendar year, so yearlings born in a single year were evaluated in this study. In addition, because the percentage of Thoroughbreds that race as 2-year-olds is < 50%,[18] we considered the data for the 3- and 4-year-old racing years more important than data for the 2-year-old racing year for assessment of PRP for treatment of horses with proximal sesamoiditis and associated SLB desmitis. Although horses with radiographic evidence of proximal sesamoiditis may be less desirable to potential purchasers and may undergo less demanding training schedules as 2-year-old horses, compared with their peers without proximal sesamoiditis, all horses in the present study had radiographic evidence of sesamoiditis. Therefore, the effects of the investigated PRP treatment protocol were compared with the effects of a control treatment for horses with proximal sesamoiditis and SLB desmitis, and results for horses with proximal sesamoiditis and SLB desmitis were not compared with those for horses without that problem.

Treatment of horses with proximal sesamoiditis and associated SLB desmitis via the PRP treatment protocol used in the present study did not seem to improve performance, compared with that for saline solution–treated horses; therefore, this protocol may not be a clinically useful treatment option for yearling Thoroughbreds with proximal sesamoiditis and SLB desmitis. The median amount of money earned by horses in the control group during the 2-year-old racing year was $0, and the amount of money earned during that year by the PRP-treated horses was $302. That difference was a small amount, not significant, and smaller than the cost of the PRP treatment (approx $500 to $1,000).

Although cosmetic effects of treatments were not systematically or objectively assessed for horses in the present study, 6 of the 20 PRP-treated horses developed persistent soft tissue swelling at the injection site within 1 to 2 months after treatment, whereas no horses in the control group developed such cosmetic blemishes. Cosmetic appearance of treatment sites may be important for some owners or trainers when considering potential resale value of horses. The PRP preparation system used in this study concentrates leukocytes in addition to platelets[10]; leukocytes may be a potential source of inflammatory mediators, leading to development of fibrous tissue at injection sites.

The effects of PRP may depend on the preparation method.[3–6,19] The effects of dose, timing of treatment, number of treatments administered, use of platelet activators, and concurrent leukocyte concentration on outcome after clinical application of PRP are unknown, to the authors' knowledge. An optimal PRP preparation method and treatment protocol has not been determined and may depend on the condition being treated. We chose to use a commercially available system for preparation of PRP and a modification of a treatment protocol that was beneficial for humans with lateral humeral epicondylitis (an insertional tendonopathy)[13] because we believed that such procedures would be appropriate for determination of the potential benefit of PRP treatment for horses with proximal sesamoiditis and associated SLB desmitis (also an insertional desmopathy); however, substantial benefits for such horses were not identified in this study. Importantly, lateral humeral epicondylitis in humans has different characteristics than proximal sesamoiditis and associated SLB desmitis in yearling horses; these diseases affect patients with different signalments and have different clinical signs and pathogenesis. Another important factor was that PRP and saline solution were injected in SLBs of horses without ultrasonographic guidance in the present study; therefore, treatments may not have been injected into injured areas. Ultrasonographic guidance would have enabled injection of treatments directly into injured areas of SLBs.

Other authors have reported that PRP treatment is beneficial for treatment of horses with acute superficial digital flexor tendonopathy and chronic desmitis of the proximal aspects of suspensory ligaments,[11] Standardbred racehorses with desmitis of the middle aspects of suspensory ligaments,[12] and horses with experimentally induced superficial digital flexor tendon core lesions.[9,10] However, the clinical studies[11,12] did not include control horses, and quantitative performance data was not determined in any of those studies. Because the pathogenesis of proximal sesamoiditis and associated SLB

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desmitis and that for the conditions treated in those other studies may be different, comparison of results of the present study with results of those other studies regarding effects of PRP treatment may be inappropriate. Platelet-rich plasma may be effective for treatment of conditions other than insertional desmopathies (eg, proximal sesamoiditis and associated SLB desmitis).

Horses included in the present study had a disease that is known to affect racing performance[2] and for which an effective treatment has not been identified, to the authors' knowledge. However, outcomes for yearling Thoroughbreds with proximal sesamoiditis and associated SLB desmitis that were treated via the PRP treatment protocol used in the present study were not substantially better than those for control horses treated with saline solution.

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