Received: 24 February 2020 | Revised: 30 September 2020 | Accepted: 22 November 2020

DOI: 10.1111/vsu.13552

WILEY

ORIGINAL ARTICLE - CLINICAL

Outcome following neurectomy of the deep branch lateral plantar nerve and plantar fasciotomy for hindlimb proximal suspensory desmopathy in western performance horses: 21 cases

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Abstract

Objective: To report the outcome of horses used in western performance disciplines after deep branch lateral plantar neurectomy/fasciotomy surgery for hind limb proximal suspensory desmopathy (PSD).

Study design: Retrospective analysis.

Sample population: Twenty-one client-owned horses.

Methods: Medical records were reviewed (2009-2019) for horses involved in western performance disciplines that had been treated with deep branch lateral plantar neurectomy and plantar fasciotomy for lameness due to hind limb PSD. Follow-up was obtained by reexamination and/or verbal interviews with owners >2 years postoperatively.

Results: Sixteen quarter horses and five paints were used for western pleasure (14/21), barrel racing (2/21), cutting (1/21), steer wrestling (1/21), working cow horse (1/21), team roping (1/21) and reining (1/21). A median duration of 8 months was required before horses were able to resume training or athletic work. Nine horses were able to return to a similar or higher level of athletic use, nine horses returned to a lower level of athletic performance, and three horses could not return to intended function. Owner satisfaction with outcome after the procedure was high (16/21), average (3/21), and low (2/21).

Conclusion: Deep branch lateral plantar neurectomy and plantar fasciotomy allowed most horses to resume some athletic function as western performance horses.

Clinical significance: These results provide evidence of potential outcomes when considering surgical treatment of hind limb PSD in western performance horses.

Results of this study were presented as a scientific abstract at the American Association of Equine Practitioners Annual Conference; December 7-11, 2019; Denver, Colorado.

1 | INTRODUCTION

Proximal suspensory desmopathy (PSD) is a common cause of hind limb lameness in horses of various breeds and disciplines.[1] The hind limb suspensory ligament originates from the proximal-plantar cortex of the third metatarsus. The proximal portion (proximal suspensory ligament [PSL]) is closely bordered by the lateral and medial axial surfaces of the second and fourth metatarsal (splint) bones as well as the plantar third metatarsal bone.[2] In addition, a dense fascia connects the plantar aspect of the second and fourth metatarsals, creating an enclosing boundary along the plantar surface of the PSL.[2] The deep branch of the lateral plantar (DBLP) nerve extends from the lateral plantar nerve and provides sole innervation of the PSL.[2]

The severity of PSD lameness varies, ranging from subtle to marked gait abnormalities at the trot or lope/canter. The prevalence of PSD as a cause of lameness in horses participating in western disciplines reaches to 17.5% of cutting horses, 13% of barrel racing horses, and 5% of team roping horses presenting for poor performance and/or gait abnormalities.[3-5] Several diagnostic methods are used to confirm the condition, such as clinical examination combined with diagnostic analgesia, musculoskeletal ultrasonography, radiography, and MRI.[2] Options for medical management include rest, administration of systemic anti-inflammatory drugs, shockwave therapy, or ligamentous infiltration of biological therapies such as bone marrow or autologous platelet concentrates, autologous conditioned serum, or mesenchymal stem cells.[2] The outcome for horses competing in western disciplines and treated for PSD is unknown. However, conservative management has been associated with inconsistent results, including failure to improve or reinjury.[6] Surgical options to treat PSD include tibial neurectomy, plantar third metatarsal bone microfracture, suspensory ligament splitting, and DBLP neurectomy with concurrent fasciotomy.[2] Deep branch lateral plantar neurectomy/fasciotomy is associated with an estimated prognosis for return to function ranging from 62% to 91%.[7-9] The largest retrospective study published included 155 horses.[7] In that study, 77.8% of horses returned to function when they had presented without concurrent lameness and with normal conformation (lack of straight hock or fetlock hyperextension at physical examination).

Most reports on the outcomes of horses treated with DBLP neurectomy/fasciotomy originate from Europe and focus on warmblood or thoroughbred breeds that compete in dressage, showjumping, eventing, racing, or general riding.[7-9] Toth et al[8] reported the outcome of four quarter horses and one paint in a prospective study of 16 horses concurrently evaluated for outcome and histological changes to the DBLP nerve. However, the intended athletic use of the five western stock breeds was not detailed. The paucity of evidence in the literature regarding the outcome after DBLP neurectomy/fasciotomy to treat hind limb PSD in horses used for western performance disciplines justifies this study. The objective of this retrospective investigation was to provide data regarding the prognosis of horses in western performance work that had been surgically treated for PSD. We hypothesize that DBLP neurectomy/fasciotomy in horses competing in western performance disciplines would allow most to return to intended use, similarly to outcomes previously reported in horses of other breeds and disciplines.

2 | MATERIALS AND METHODS

2.1 | Case selection

Electronic medical records of two hospitals (Iowa State University Lloyd Veterinary Medical Center & Littleton Equine Medical Center) were searched for horses that had undergone DBLP neurectomy/fasciotomy to treat hind limb PSD from 2008 to 2018. Records were further reviewed to include only quarter horse or paint breeds with stated current athletic use in a western performance discipline as listed by the American Quarter Horse Association (AQHA).[10] Horses used for racing, trail riding, or breeding and horses not in athletic use were excluded.

2.2 | Medical records review

Data collected from medical records included signalment at time of surgery, lameness history including prior therapy, unilateral vs bilateral diagnosis of PSD, unilateral vs bilateral DBLP neurectomy/fasciotomy, time of year surgery was performed (spring, March-May; summer, June-August; fall, September-November; winter, December-February), and assigned lameness score based on American Association of Equine Practitioners standardized grading scale.[11] Method of diagnostic analgesia and resolution of clinical signs (ie, positive response, >75% subjective improvement in lameness) were documented. Radiographs of the tarsal region (four projections: lateromedial, dorsoplantar, dorsomedial-palmarolateral, dorsolateral-palmaromedial), when they were available, were evaluated for abnormalities. Radiographs were interpreted by the attending board-certified surgeon (D.M.T., J.A.H., T.M.S., S.S.C., K.D.K.) as well as interpreted by a board-certified veterinary radiologist. Ultrasonographic examinations with a 13-MHz linear transducer (Edge II; Fujifilm Sonosite, Bothell, Washington) were performed by the attending board-certified surgeon.[12]

All ultrasonographic examinations commenced at the proximal suspensory origin (18-24 cm distal to the calcaneal tuber) and extended to the distal insertion of the lateral and medial suspensory branches and included transverse and longitudinal examination. Abnormalities listed in ultrasound reports were recorded and categorized to determine frequency. Ultrasonographic measurements of dorsal to plantar thickness of the PSL were recorded when they were documented within the medical record or labeled on saved images. All ultrasonographic examinations were performed while horses were weight bearing. Postsurgical progress examinations, when they were available in the medical record, were reviewed to note improvement in lameness grade, ultrasonographic appearance of the PSL, and document return to use.

2.3 | Procedures

All horses received perioperative phenylbutazone (2.2 mg/kg IV or orally) and perioperative potassium or procaine penicillin (22 000 IU/kg IV or IM) and gentamicin (6.6 mg/kg IV), or gentamicin alone. Surgery was performed in dorsal recumbency with the tarsus held in partial flexion by taping the foot to an overhead bar. All procedures were performed by surgeons who were American College of Veterinary Surgeons diplomates, with assistance from surgical residents in selected surgeries. A 10-cm surgical incision was made along the lateral superficial digital flexor tendon (SDFT) at the level of the proximal fourth metatarsal bone. Underlying superficial plantar metatarsal fascia was incised, and the SDFT was retracted medially. The deep branch was traced from the lateral plantar nerve, and an approximately 3-cm neurectomy was performed (Figure 1).[7] The deep metatarsal fascia overlying the proximal suspensory ligament was subsequently incised by using a push-cut motion with Supercut Mayo scissors (Sontec Instruments, Centennial, Colorado; fasciotomy, Figure 2).[7] In all surgeries, closure was performed routinely with No. 2-0 poliglecaprone 25 suture in a simple continuous pattern for fascial and subcutaneous apposition and simple interrupted, simple continuous, or intradermal closure for skin. All incisions were covered with a medical bandage (nonadherent dressing, held in place with stretchable gauze dressing; followed by sheet cotton, held in place with nonstretch gauze and cohesive stretchable dressing) until time of or 1 to 2 days after suture removal performed at 10 to 14 days after surgery. Bandage changes were

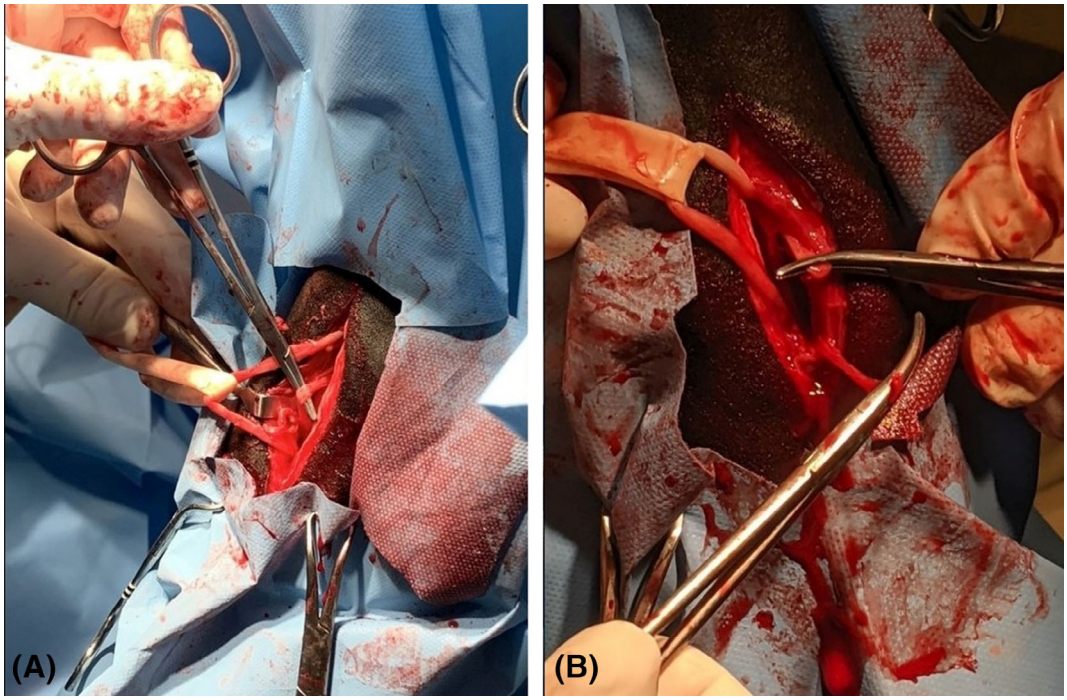

FIGURE 1 Left hind limb, with distal at the top of images and lateral at the right side of images. A, Intraoperative picture illustrating the DBLP nerve (elevated under Halstead mosquito forceps) bifurcating off the lateral plantar nerve (retracted in Penrose drain) and traversing toward the proximal suspensory ligament in a clinical case. B, Partial neurectomy of the DBLP nerve, with the distal excision of the nerve already performed. A proximal transection will complete an approximate 3-cm removal of DBLP nerve. DBLP, deep branch of the lateral plantar

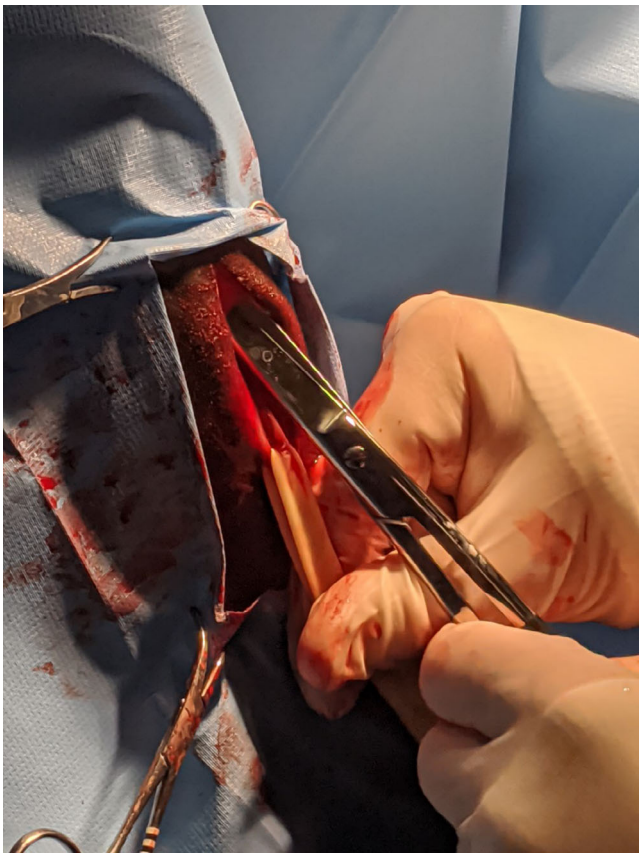

FIGURE 2 Right hind limb, with distal at the top of image and lateral at the right of the image. Intraoperative photograph illustrating performance of the fasciotomy with Supercut Mayo scissors in a proximal-distal direction

performed every 2 to 3 days during this time. Postoperative medications included phenylbutazone (2.2 mg/kg orally twice daily for 3-10 days). Select horses received trimethoprim sulfamethoxazole (25 mg/kg orally twice daily for 7-14 days) according to surgeon preference.

Rehabilitation instructions varied according to preference of the individual attending surgeon. Four differing protocols were provided. The first protocol recommended 3 weeks stall rest with hand-walking (10 minutes twice per day), 3 weeks stall rest with walking and light trotting (10 minutes twice per day) while lunging or under saddle, and return to light work at 6 weeks. The second protocol recommended 4 weeks stall rest with hand-walks (10 minutes twice per day), 4 weeks small paddock turn-out, and return to light work at 8 weeks. The third protocol recommended 2 weeks stall rest, 2 weeks small paddock, and return to light work at 4 weeks. The fourth protocol recommended 4 weeks stall rest, 8 weeks small paddock rest, and return to light work at 12 weeks.

2.4 | Follow-up

Horses were evaluated postoperatively by the attending board-certified surgeon with medical records detailing lameness and ultrasonographic examinations available for review. All owners were contacted for a follow-up interview via phone or email. Owners were asked to confirm the athletic discipline of their horse and confirm the medical history of the horse prior to surgery (duration of lameness, prior medical therapy attempted). Owners were questioned regarding status of horse after surgery (return to intended/same use, lower level use, or nonuse), duration of rehabilitation prior to returning to training or athletic use, and complications associated with the procedure and/or the surgical site. Intended use was defined as the same level of athletic work as prior to surgical intervention within the same discipline. Lower level use was defined as a reduction in level of athletic work within the same discipline as prior to surgical intervention. Nonuse was defined as the horse was not used for athletic work after surgery. For horses that returned to a lower level of use or were not used for athletic work after surgery, owners were questioned whether this was due to inability of the horse (for any medical reason) or was the owner's choice not to pursue same level of work. Owners were also asked whether the horse improved in lameness fully but then was reinjured. Owners were asked to report their satisfaction level with the procedure (high satisfaction, willingness to repeat surgery if presented a similar situation again; average satisfaction, satisfaction with surgery but conditional whether they would pursue surgery if presented a similar situation again; and low satisfaction, dissatisfaction with outcome and unlikely to pursue surgery if presented a similar situation again). Descriptive statistics (mean, median, mode; calculated in Prism 7; GraphPad Software, La Jolla, California) are used to describe data.

3 | RESULTS

3.1 | Demographics

In total, 86 and 21 medical records of DBLP neurectomy/fasciotomy were identified across all breeds and disciplines from, respectively. Twenty-one horses in western performance disciplines underwent DBLP neurectomy/fasciotomy consisting of 16 quarter horses and five paints, which included 13 geldings, seven mares, and one stallion. The median age at time of diagnosis and subsequent surgery was 8 years (range, 3-14). Western disciplines included western pleasure (14/21), barrel racing (2/21),

cutting (1/21), steer wrestling (1/21), working cow horse (1/21), team roping (1/21), and reining (1/21). All horses were currently involved in athletic competition at the time of lameness examination and diagnosis of PSD.

3.2 | Preoperative findings

Hind limb PSD was bilateral in 12 horses and unilateral in nine horses (six left hind and three right hind). Median grade of lameness prior to surgical intervention was recorded as 3 of 5 (range, 1 to 3; mode, 3). Median duration of hind limb lameness prior to surgery was 8.5 months (range, 1 week to >24 months). Lameness duration was 24 months or more in three horses, as estimated by owners.

In all horses, pain causing lameness was localized to the PSL by using diagnostic analgesia. Eighteen horses had a positive diagnostic response to perineural analgesia of the DBLP nerve, and three horses had a positive diagnostic response to local infiltration of the PSL. In all horses, positive response to a PSL diagnostic block followed a negative response to distal limb analgesia (low 4 or 6 point, or abaxial nerve blocks). Horses with confirmed or suspected concurrent tarsometatarsal or distal intertarsal osteoarthritis had previously undergone joint injection with methylprednisolone acetate with no improvement (10 horses) or had negative response to intra-articular analgesia of the tarsometatarsal or distal intertarsal joint (8 horses).

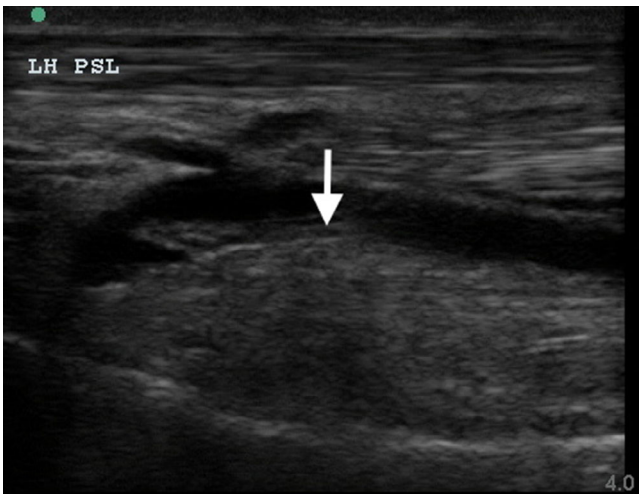

FIGURE 3 Static ultrasound image of proximal suspensory ligament approximately 12 cm distal to point of the hock (left hind), sagittal (proximal-distal) orientation. The proximal suspensory ligament (arrow) is irregular in fiber pattern and diffusely enlarged

All 21 horses had ultrasonographic imaging (Figure 3) performed as an initial diagnostic or repeated (when the case was referred) prior to surgery by the attending surgeon. Varying degrees of abnormal appearance to the PSL were apparent. The PSL was described as diffusely enlarged or thickened in 29 of 33 ligaments examined. Ligament fiber architecture was subjectively assessed as irregular in 18 of 33 ligaments examined. A hypoechoic core defect was apparent in two of 33 ligaments, and a linear tear was present in one of 33 ligaments. Abnormal surrounding bone (avulsion or exostosis) was present in two of 33 ligaments. The dorsal to plantar thickness of the ligament was recorded in 14 of 33 ligaments, with median distance measuring 1.35 cm (range, 1.2-1.5 cm; normal, <1 cm).

Tarsal radiographs were available for review in nine horses and seemed normal in 3. Concurrent mild osteoarthritis of the tarsometatarsal and/or distal intertarsal joints was present in five horses bilaterally. Other radiographic abnormalities included increased opacity consistent with periosteal exostosis along the axial aspect of the second metatarsal bone (1 case), increased opacity consistent with sclerosis of the proximal-plantar third metatarsus (1 case), and proximal-plantar third metatarsus bone avulsion (10-mm fragment) associated with the PSL origin (1 case).

Previous medical treatments included multiple shockwave therapy sessions to the affected PSL in three horses, autologous bone marrow-derived mesenchymal stem cell therapy in two horses (one case via direct injection into PSL, one case via regional limb perfusion), and stall rest (>6 months) in conjunction with other medical therapies or alone in six horses. In all six of these horses, lameness was refractory to medical treatment. In 15 horses, DBLP neurectomy/fasciotomy was recommended and pursued as the initial treatment after diagnosis of PSD.

3.3 | Surgery

Surgery was performed as a unilateral procedure in nine horses and as a bilateral, simultaneous procedure in 12 horses, representing 33 treated ligaments. Time of year for surgery was spring (7), summer (7), fall (4), and winter (3). Five different attending surgeons performed surgery. In one case, the horse was reevaluated 11 months after unilateral DBLP neurectomy/fasciotomy because of lameness in the contralateral hind limb. Clinical investigation confirmed PSD, and a second DBLP neurectomy/fasciotomy was performed on the opposing hind limb. No minor or major intraoperative complications were reported in any horses. Two horses had concurrent

surgery performed with DBLP neurectomy/fasciotomy at the discretion of the attending surgeon. One of these horses had the proximal-plantar portion of the third metatarsus foraged with a 2.5-mm drill bit, and the other horse had 2 mL of platelet-rich plasma injected directly into the PSL at the time of surgery.

Distribution of rehabilitation protocols prescribed was protocol 1, nine horses; protocol 2, four horses; protocol 3, five horses; and protocol 4, three horses. The median duration from time of surgery until the owner elected to start light work and/or could resume meaningful training was 8 months (range, 4-24). The time until reported return to work for most horses was noted as prolonged compared to the recommended aftercare that was provided. Median rehabilitation duration based on time of year that surgery was performed was 12 months for spring, 6 months for summer, 5 months for fall, and 8 months for winter.

3.4 | Follow-up

Follow-up was obtained for all 21 horses (range, 2-10 years postsurgery). In total, 18 of 21 horses were able to return to some level of athletic use postsurgery (Table 1). Follow-up duration for horses in athletic use ranged from 16 months to 9 years (median, 5 years). Nine of 21 horses were able to return to work at the previous level of higher. Return to the same level of intended use included horses involved in western pleasure (5), cutting (1), steer wrestling (1), barrel racing (1), and team roping (1). Another nine horses were able to return to athletic use but at a lower level than before lameness. Return to lower level use included horses involved in western pleasure (7), barrel racing (1), and reining (1). In all horses engaged in lower level use, owners stated that this was due to the inability of the horse to achieve the same level of use as prior to injury vs the owner redefining the level of work that the horse competed in.

Three horses were categorized as nonuse. One horse (western pleasure) initially improved for approximately 3 months and then regressed back to original baseline lameness on one of the two surgically treated limbs. In the second horse (western pleasure), no improvement was noted at any point after surgery. The third horse (working cow horse) sustained a catastrophic fracture on a forelimb during pasture turn-out and was euthanized 6 months after surgery and prior to any return to training or work.

Medical records documenting reevaluation by the referring veterinarian (9 horses) or the attending surgeon postoperatively (10 horses) were available for 19 of 21 horses. The median duration to veterinary reexamination was 183 days (range, 55-365). Among the 19 horses reevaluated, 17 were able to return to the same or lower level athletic use. The median grade of lameness at veterinary reexamination after DBLP neurectomy/fasciotomy was 1 of 5 (range, 0-3; mode, 0). Eight of these 19 horses were considered completely sound (no observed lameness). In the two horses defined as nonuse, persistent lameness was present, and grade of lameness was unchanged when compared to preoperative grade (grade 2/5 and 3/5). Two horses experienced improvement followed by reoccurrence of hind limb lameness. In one case, the contralateral hind limb PSL became clinical; subsequent surgery was performed, and return to lower level use was achieved. In the second case, pain was believed to persist from the PSL on the basis of exclusion of lower tarsal joints, stifle joint, and the distal limb by using diagnostic analgesia.

Four horses had mild postoperative swelling of the incision/surgical site. In three limbs, postoperative swelling was present for the initial 14 days and then subsided. In the fourth limb, swelling along the proximal-plantar aspect of the third metatarsus remained permanent despite the horse returning to athletic work. In three limbs, incisional infection with partial incisional dehiscence developed. In two of these limbs, basic wound therapy and systemic antimicrobials (trimethoprim sulfa 20-25 mg/kg orally twice daily) were administered. In the third limb, the horse was reanesthetized 7 days after original surgery for deep incisional lavage, wound debridement, and repeat primary closure of the skin. Two of the three limbs in which incisional infection developed had white hair formation subsequently develop. In one case, non–weight-bearing lameness was present in the treated limb for 24 hours after surgery. The non–weight-bearing lameness completely resolved after treatment with additional opioid analgesia (butorphanol 0.1 mg/kg IM). The cause for excessive postoperative pain in this case was unclear. No association between outcome or incidence of complications and attending surgeons was found.

Loss of structural integrity (core or linear tear) or concurrent osseous abnormalities observed on diagnostic imaging did not seem associated with a negative postoperative outcome. The appearance of the ligament was improved in eight of nine horses reevaluated with ultrasonography as determined by a reduction in ligament size (six ligaments) and/or subjective assessment of ligament fiber architecture (five ligaments). The appearance of the ligament was unchanged in one horse. Seven of nine horses that returned to intended use underwent bilateral DBLP neurectomy/fasciotomy compared with three of nine horses that returned to lower-level performance. Two of the three horses that were not useful for athletic work underwent bilateral DBLP neurectomy/fasciotomy.

TABLE 1 Western performance horse outcome data after DBLP neurectomy/fasciotomy

Horse	Signalment	Discipline	Affected limb	Preop lameness grade[a]	Postop lameness grade[a]	Outcome group	Duration of rehab, mo	Client satisfaction
1	Paint, 7 y, gelding	Western pleasure	LH	3/5, LH	Sound, 0/5	Intended use	6	High
2	QH, 4 y, mare	Western pleasure	Bilateral	3/5, (LH; RH, unknown	Sound, 0/5	Intended use	6	High
3	QH, 5 y, mare	Western pleasure	Bilateral	3/5, LH; 2/5, RH	Sound, 0/5	Intended use	16	High
4	QH, 6 y, gelding	Barrel racing	Bilateral	unknown	Sound, 0/5	Intended use	6	High
5	QH, 9 y, gelding	Team roping	Bilateral	3/5, RH; LH unknown	Sound, 0/5	Intended use	5	High
6	QH, 9 y, gelding	Western pleasure	LH	3/5, LH	1/5, LH	Intended use	6	High
7	QH, 14 y, gelding	Cutting	Bilateral	unknown	Sound, 0/5	Intended use	6	High
8	QH, 14 y, gelding	Steer wrestling	Bilateral	unknown	Sound, 0/5	Intended use	8	High
9	QH, 9 y, mare	Western pleasure	Bilateral	2/5, bilaterally	Sound, 0/5	Intended use	9	High
10	QH, 13 y, gelding	Barrel racing	RH	3/5, RH	2/5, RH	Lower level use	6	Average
11	QH, 4 y, gelding	Western pleasure	Bilateral	3/5, RH; LH, unknown	Sound, 0/5	Lower level use	10	High
12	Paint, 5 y, gelding	Western pleasure	LH	3/5, LH	1/5, LH	Lower level use	9	High
13	QH, 9 y, mare	Western pleasure	RH	2/5, RH	1/5, RH	Lower level use	8	High
14	QH, 9 y, gelding	Western pleasure	RH	2/5, RH	1/5, RH	Lower level use	6	High
15	Paint, 6 y, gelding	Western pleasure	LH	3/5, LH	Sound, 0/5	Lower level use	12	High
16	QH, 10 y, gelding	Western pleasure	Bilateral	3/5, RH; 2/5, LH	Sound 0/5, RH; 1/5, LH	Lower level use	12	Average
17	QH, 7 y, mare	Reining	LH	2/5, LH	1, LH	Lower level use	4	Average
18	QH, 12 y, gelding	Western pleasure	Bilateral	3/5, bilaterally	1/5, bilaterally	Lower level use	12	High
19	Paint, 5 y, mare	Western pleasure	LH	1/5, LH	1/5, LH	Nonuse	6	Low
20	Paint, 3 y, stallion	Western pleasure	Bilateral	2/5, bilaterally	3/5, bilaterally	Nonuse	9	Low
21	QH, 13 y, mare	Working cow horse	Bilateral	3/5, bilaterally	2/5, bilaterally	Nonuse, euthanized	6	High

Abbreviations: LH, left hind; Postop, postoperative; Preop, preoperative; QH, quarter horse; rehab, rehabilitation; RH, right hind.

[a]0, Lameness not perceptible under any circumstances; 1, lameness is difficult to observe and is not consistently apparent; 2, lameness is difficult to observe at a walk or when trotting in a straight line but consistently apparent under certain circumstances; 3, lameness is consistently observable at a trot under all circumstances; 4, lameness is obvious at a walk; 5, lameness produces minimal weight bearing in motion and/or at rest or a complete inability to move.

Owner satisfaction with outcome after the DBLP neurectomy/fasciotomy was recorded as high in 16 horses, average in three horses, and low in two horses. Among the owners who were highly satisfied, nine had horses that returned to the same level of intended use, six had horses that returned to lower level of intended use, and one had a horse that did not return to function and was euthanized during rehabilitation because of a fractured limb. Owners who rated their satisfaction as average owned three horses that returned to lower level use and had residual lameness. Horses of the two owners that rated their satisfaction as low were unable to return to use because of persistent lameness.

4 | DISCUSSION

Results of this study are in line with prior reports that document a favorable outcome after DBLP neurectomy/fasciotomy for return to athletic use. In our study, the total number of horses that were able to successfully return to athletic use was 18 of 21, which is comparable to outcomes reported for nonwestern performance disciplines.[7] In our study, only nine of 21 horses were able to return to the same level of athletic use as prior, and complete soundness was achieved in only eight of 19 horses. Although a high percentage of horses return to athletic use after surgery, it appears that residual lameness or performance limiting deficits can remain. Regardless, owners generally were satisfied with the decision to pursue surgery, with 16 of 21 stating high satisfaction with the procedure.

Rehabilitation was recommended for 4 to 12 weeks in our population, compared with 8 weeks in the literature.[7,9] Most recommended protocols involved a rehabilitative plan that increased in intensity. However, according to correspondence with owners, the median duration of time from surgery to beginning meaningful riding or athletic work was 8 months. Seasonality and inability to use the horse year-round due to weather constraints may have influenced the decision to prolong rehabilitation for some owners, although no such correlation was detected in our study. In general, intrinsic healing of tendons and ligaments can take up to 6 to 8 months.[2] However, PSD has been suggested as a region that can be refractory to rest alone.[6] In one prior study, only 14% of 42 horses with unilateral or bilateral hind limb PSD returned to the same level of use after confinement and incremental increase in exercise.[6] In our study, six horses had failed prior attempts at medical therapy after diagnosis of PSD. For the remaining 15 horses, the decision for surgery as an initial intervention was determined after discussion with the client and prolonged lameness (median 8.5 months for this population). The outcomes of the horses included in our study are, therefore, unlikely to result from rest alone. Regardless, outcome results identified in this study may be partially influenced by prolonged periods of rest and/or turnout as part of the postsurgical rehabilitation program. It is important to consider that surgical intervention improves the lameness by removing sensory innervation and decompressing constricting fascia but does not directly influence the healing response in the damaged ligament.

The reason for treatment failure in two horses is unclear but may have resulted from several factors. Large tarsal angles and fetlock hyperextension have been associated with a poor prognosis, likely associated with progressive degeneration of the suspensory apparatus.[7] Accurate documentation of hind limb conformation was not present in the records. Concurrent conformation deficits may have predisposed to a poor outcome regardless of surgical intervention. Adhesion formation between the PSL and surrounding soft tissue structures or third metatarsal bone was also previously identified during gross postmortem pathology in a subset of horses euthanized because of recurring lameness after DBLP neurectomy/fasciotomy.[13] Other potential causes for treatment failure when neurectomy is performed for distal limb lameness include neuroma formation at the site of nerve transection or reinnervation.[8] Theoretically, these general neurectomy complications could also occur with transection of the DBLP. The ability to clearly rule in or out the influence of concurrent hind limb pathologies could have also influenced interpretation of outcome. All diagnoses involved use of anesthetic techniques that localize to the proximal suspensory region after negative analgesia of the lower limb or lower tarsal joints (in select horses) or with historical negative response to lower tarsal joint injection with corticosteroid. All horses had an abnormal appearing PSL at ultrasonographic examination, with enlargement of the PSL a consistent ultrasonographic feature.[12] However, a false positive result after PSL diagnostic analgesia is well recognized because of potential diffusion of adjacent soft tissue or synovial structures, such as the lower tarsal joints or tarsal sheath.[14] Comorbidity with other hind limb pathologies may have partially influenced outcome results of this study. One potential limitation to consider is that complete antemortem diagnosis may best be obtained with MRI.[15] Magnetic resonance imaging can be used to more reliably detect adhesions between the PSL and adjacent anatomical structures as well as to provide excellent delineation between ligament, muscle, and adipose tissue within the body of the PSL.[15] Ultrasound has been shown to be reliable for detection of PSD compared with histopathology.[13] It is also important to consider that horses

in this study were examined with ultrasound while they were weight bearing. Performing angle contrast ultrasonography in a flexed limb position may have further improved characterization of the suspensory ligament prior to surgical intervention, providing more information regarding severity of PSD.[16]

Limitations of this study include the small sample, which precluded statistical comparison of recorded variables. Ultrasound reports alone were available for interpretation, and some cases did not have objective measurements of PSL size recorded. Having ultrasonographic videos available for review could have allowed for standardized grading of lesion severity. Conformation of the hind limb was insufficiently documented in the medical records. Owners were not asked to further qualify whether their horse was in high- or low-level competition for each individual western performance discipline. Some horses received alternative postoperative therapy that may have influenced outcome results. Recall bias can occur when owners are questioned years after surgical intervention. Owners' appreciation of what constitutes same level vs lower level of athleticism is subjective. The level of athletic competition horses were engaged in as well as the specific intensity of each individual western discipline may have varied greatly.

Deep branch lateral plantar neurectomy/fasciotomy resulted in a favorable outcome for return to athletic use in most western performance horses enrolled in this study, with return to athletic work similar to previous reports for other disciplines and breeds. Future investigations of a larger population of treated horses are required to validate this conclusion.

ACKNOWLEDGMENTS

Author contributions: Tatarniuk DM, DVM, MS, DACVS-LA: Conception/design of study, acquisition of data, analysis and interpretation of data, manuscript preparation, revision, and final approval of manuscript; Hill JA, DVM, DACVS-LA: Acquisition of data, analysis and interpretation of data, manuscript preparation, revision, and final approval of manuscript; Modesto RB, DVM, DACVS-LA: Acquisition of data, analysis and interpretation of data, manuscript preparation, revision, and final approval of manuscript; Swor TM, DVM, DACVS-LA, DACVECC: Analysis and interpretation of data, manuscript preparation, revision, and final approval of manuscript; Caston, SS DVM, DACVS-LA: Analysis and interpretation of data, manuscript preparation, revision, and final approval of manuscript; Kersh KD, DVM, DACVS-LA: Analysis and interpretation of data, manuscript preparation, revision, and final approval of manuscript.

The authors thank referring veterinarians for referral and collaboration of enrolled horses.

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this report.

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How to cite this article: Tatarniuk DM, Hill JA, Modesto RB, Swor TM, Caston SS, Kersh KD. Outcome following neurectomy of the deep branch lateral plantar nerve and plantar fasciotomy for hindlimb proximal suspensory desmopathy in western performance horses: 21 cases. *Veterinary Surgery*. 2020;1–10. https://doi.org/10.1111/vsu.13552