Ex vivo diffusion tensor imaging of the plantar nerves is feasible in the horse

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OBJECTIVE
The objective of this study was to optimize an MRI-based diffusion tensor imaging (DTI) protocol for imaging the plantar nerves at the level of the tarsus in normal equine limbs.

SAMPLE
12 pelvic cadaver limbs from horses without evidence of proximal suspensory pathology were imaged with a 3T MRI system.

METHODS
For diffusion-weighted imaging, b values of 600, 800, and 1,000 s/mm² were tested. Data were processed with DSI Studio. Cross-sectional areas of the medial and lateral plantar nerve along the plantar tarsus were recorded. The length and number of fiber tracts, signal-to-noise ratio, and DTI variables were recorded.

RESULTS
At the level of interest, the mean cross-sectional areas of the plantar nerves ranged from 5.03 to 7.42 mm². The DTI maps consistently generated tracts in the region of the lateral and medial plantar nerves with DTI values in the range of values reported for peripheral nerves in humans. Our findings demonstrate that DTI of the medial and lateral plantar nerves can be performed successfully and used to generate quantitative parameters including fractional anisotropy and mean, axial, and radial diffusivity.

CLINICAL RELEVANCE
Quantitative data generated with this imaging technique can be used to noninvasively characterize the microstructural integrity of neural tissue with possible applications in the evaluation of pathologic changes to the plantar tarsal and metatarsal nerves of horses with proximal suspensory desmopathy.

Keywords: MRI, diffusion tensor imaging, equine, veterinary medicine, tarsus

Proximal suspensory desmopathy of the hindlimbs is a common cause of acute and chronic lameness in middle-aged performance horses. In more chronic cases, a compartment-like syndrome resulting from compression and restriction of the enlarged proximal suspensory ligament by the deep plantar fascia is often described. This may also cause compression and inflammation of the deep branch of the lateral plantar nerve or metatarsal nerves, which have been cited as a possible cause of persistent lameness in horses with proximal suspensory desmopathy. Despite documentation of neural abnormalities in horses with proximal suspensory desmopathy, compression of the plantarolateral neurovascular structures is not always identified on MRI of horses with plantar metatarsal pain, and the association of neuropathy with lameness is disputed. Objective in vivo methods for assessing nerve injury in veterinary medicine are lacking. Peripheral neurography can be performed with high-field MRI and clinical radiofrequency coils, which are now available in the majority of veterinary specialty hospitals. Neural tissues are highly organized, restricting the translational movement and diffusion of molecules such as water along the course of the nerve fibers. This structural property is known as anisotropy and provides the basis for tissue contrast in diffusion-weighted imaging (DWI). Signal changes in DWI can also be used to generate quantitative variables including fractional anisotropy (FA) and mean (MD), axial (AD), and radial (RD) diffusivity that reflect the...
degree and direction of diffusion within imaged tissues. These values can be used as biomarkers for pathologic change once normative values are established. The DWI data can also be used to generate 3-D tracts that map molecular diffusion as a function of spatial location. Diffuse tensor imaging (DTI) is particularly useful for evaluating peripheral nerve tracts and has shown promise in the evaluation of inflammatory and traumatic pathology of the radial, ulnar, and median nerves in humans. Diffusion tensor imaging has not been applied to peripheral nerve evaluation in veterinary medicine in any species. DWI and DTI have potential applications for noninvasive evaluation of the deep branch of the lateral plantar nerve in horses affected with proximal suspensory desmopathy. The proximal medial and lateral plantar nerves of the horse are larger in diameter than the smaller, more obliquely positioned deep branch and traverse in a proximal-to-distal orientation that can more easily be evaluated with MRI using traditional scan planes. The objective of this study was to develop a DWI protocol for imaging the plantar nerves at the level of the tarsus and to report normal values for FA, MD, AD, and RD in equine cadaver limbs without proximal suspensory desmopathy. We hypothesized that DTI would be a useful technique for imaging the proximal medial and lateral plantar nerves with quantitative values for FA, MD, RD, and AD similar to those reported for other peripheral nerves in the human literature.

Methods

Twelve cadaver hind limbs without a previous clinical diagnosis of proximal suspensory desmopathy were collected from 8 horses. Horses ranged from 10 to 28 years of age and included 3 Quarter Horses, 1 Thoroughbred, 2 Arabians, and 2 Warmbloods. Horses were euthanized with sodium pentobarbital (150 mg/kg, IV) for reasons unrelated to the study. Limbs were transected proximal to the hock and imaging was completed within 6 hours of euthanasia. All procedures performed in this experimental study were approved by the university’s IACUC.

Magnetic resonance imaging and DTI protocol

All hindlimbs were imaged with a 3 Tesla MRI system (Philips Ingenia magnet, Highland Heights, OH 44143) and 16-channel extremity coil. Routine clinical sequences including 3-plane proton density-weighted (PDw) DIXON in-phase (IP) and water images and a transverse 3-D volume isotropic turbo spin echo acquisition sequence (VISTA; Philips) were acquired in addition to a DTI protocol. The DTI sequence was acquired in the transverse plane and parameters included 32 diffusion gradient encoding directions with 2 b factors, fat suppression of spectral presaturation with inversion recovery, number of sequence averages of 2, and maximum b factor of 600, 800, or 1,000 s/mm². Data were obtained with a b value of 1,000 s/mm² on 8 limbs, a b value of 800 s/mm² for 3 limbs, and a b value of 600 s/mm² for 4 limbs. Echo times ranged from 80 to 90 ms, and repetition times ranged from 3,300 to 4,100 ms. Additional parameters include a water-fat separation/bandwidth of 12.973/33.5 pixel/Hz, SENSE factor of 2.0, partial sampling factor of 0.76, and echo planar imaging factor of 37. The field of view was centered at the proximal intertarsal joint. The default field-of-view was 15 X 15 cm but was adjusted as needed based on the size of the horse to include the tarsus and proximal metatarsus. The in-plane resolution was 2 X 2 mm, and slice thickness was varied between 1, 2, and 3 mm. Scan times ranged from 8 minutes 30 seconds to 10 minutes 11 seconds.

Magnetic resonance imaging analyses

All measurements in the study were performed by 1 operator (AS). The medial and lateral plantar nerves and deep branch of the lateral plantar nerve were measured on PDw DIXON IP transverse images using a free-hand region of interest (ROI) using Horos software (https://horosproject.org/). Measurements were made on 3 consecutive slices at the level of the proximal intertarsal joint for the medial and lateral plantar nerves and at the level of the tarsometatarsal joint for the lateral plantar nerve.

The signal-to-noise ratio (SNR) was calculated for a b factor of 0, 600, 800, or 1,000 s/mm² with a method modified from Bolen et al. In brief, 3 free-hand ROIs were drawn around the lateral plantar nerve in each scan, 1 each at the level of the proximal intertarsal joint, distal intertarsal joint, and tarsometatarsal joint. The SD of the background in each slice was calculated using a 2.5-cm² ROI placed along the plantarolateral aspect of the limb.

For tractography, transverse PDW DIXON IP and DWI DICOM files were converted to NIFTI files with MRICroGL (https://www.nitrc.org/projects/mricrogl). Analysis was performed with DSI Studio (https://dsi-studio.labsolver.org/) with methods modified from Novikov et al. The transverse PDw DIXON IP images were geometrically coregistered to the DTI data and used as an anatomical reference. Three distinct regions of interest were assessed in each DTI acquisition. Two ROIs were placed on the lateral plantar nerve and 1 on the medial plantar nerve. The ROIs were drawn on the medial and lateral plantar nerves at the level of the proximal intertarsal joint and on the lateral plantar nerve at the level of the tarsometatarsal joint. The ROIs were used to seed tracts that met the following criteria: minimum FA of 0.3, maximum angle change of 27°, minimum fiber length of 30 mm, and maximum length of 200 mm. The FA, MD, AD, and RD were obtained from the nerve fibers generated by each ROI. Number of tracts, tract length, and SNR were also recorded.

Histologic examination

Histology was performed on 8 of the 11 lateral plantar nerves used for analysis. Nerves were dissected immediately following MRI, and a 3- to 4-cm segment was removed just proximal to the
bifurcation of the deep branch of the lateral plantar nerve. The nerve samples were fixed in 4% paraformaldehyde and embedded in paraffin via standard techniques. Histologic images were interpreted by a board-certified veterinary pathologist.

**Statistical analysis**

Data analysis of the cross-sectional areas was performed using Descriptive Statistics in Microsoft Excel. The data analysis and model fit were performed using R 4.3.1 (R Core Team, 2023). Significant statistical effects were declared at a P value less than .05 based on the denominator degrees of freedom estimated by the Kenward-Roger approximation. Tracts were not consistently identified for sequences using a 1-mm slice thickness, particularly at the more distal location over the tarsometatarsal joint. For this reason, the data obtained with a 1-mm-slice thickness was excluded from most of the analysis.

**Number of tracts**

The effect of b value and slice thickness on the number of tracts was investigated using a generalized linear mixed model under Poisson distribution. The model consisted of the number of tracts as the outcome, the b values, slice thickness, and their interaction term as fixed effects and the location nested within the horse identification as the random effect. The model fit excluded side of horse as a random effect and data with 1-mm-slice thickness to avoid model singularity. Multicollinearity was detected based on the variance inflation factor using the R package `performance`, and model fit was assessed using the Akaike Information Criterion and Pearson χ² test. The estimated marginal means of the number of tracts for each combination of slice thickness and b value were reported and compared by performing post hoc pairwise comparisons, where the P value was corrected for multiple tests using Bonferroni adjustment. The model-estimated ratio was interpreted as the fold change of the number of tracts for each combination of slice thickness and b value.

**Tract length, SNR, FA, MD, AD, and RD**

The effect of b value and slice thickness on the tract length, SNR, FA, MD, AD, and RD was investigated separately using 6 linear mixed models, ie, 6 models for 6 outcomes. Similar to the number of tracts model, each model included the b values, slice thickness, and their interaction term as fixed effects and the location nested within the horse identification as the random effect. Data exclusion, multicollinearity diagnosis, model fit assessment, and post hoc pairwise comparison followed the number of tracts model. The normal distribution assumption of the model residual was tested by histogram plots. The model-estimated ratio was interpreted as the fold change of 6 outcomes between combinations of slice thickness and b value.

**Expected FA, MD, AD, and RD at each location**

The expected FA, MD, AD, and RD for each of the 3 locations (lateral plantar nerve at the level of the proximal intertarsal joint, lateral plantar nerve at the level of the tarsometatarsal joint, and medial plantar nerve at the level of the proximal intertarsal joint) were estimated using 4 linear mixed models, ie, 4 models for 4 outcomes. Besides the outcomes, each model included location and a combination of slice thickness and b value as fixed effects and the horse identification as the random effect. Likewise, data exclusion, multicollinearity diagnosis, model fit assessment, post hoc pairwise comparison, and residual normality assumption testing followed the tract length model. The model-estimated ratio was interpreted as the fold change of FA, MD, AD, and RD between locations.

**Results**

The mean cross-sectional areas of the lateral plantar nerve at the level of the proximal intertarsal joint and tarsometatarsal joint were 6.53 ± 0.82 and 5.03 ± 1.13 mm², respectively. The mean cross-sectional area of the medial plantar nerve at the level of the proximal intertarsal joint was 7.42 ± 1.16 mm². On PDW Dixon IP images (b = 0), signal intensity of the lateral plantar nerve was 820.14 ± 126.59 and 819.40 ± 174.85 at the level of the proximal intertarsal joint and tarsometatarsal joint. In the acquired imaging planes, the deep branch of the lateral plantar never was identified along the plantarolateral tarsus in an oblique orientation (Figure 1).

Data from 1 horse were excluded due to poor image registration between anatomical images and DWI. A total of 11 cadaver hind limbs were analyzed for tractography. Sample imaging data are shown (Figure 2). Tractography was successfully performed using DWI for the medial and lateral plantar nerves with tracts traversing in a proximal-to-distal direction.

![Figure 1](image_url)  
Figure 1—Transverse and sagittal images of the equine tarsus at the level of the tarsometatarsal joint, as indicated by the green line. The images are magnified and cropped to display the plantar aspect of the limb. Lateral is to the right, White arrows indicate the deep branch of the lateral plantar nerve, and the broken white arrow indicates the lateral plantar nerve. Note the small size and oblique course of the deep branch of the lateral plantar nerve in the sagittal volume isotropic turbo spin echo acquisition (VISTA) image.
direction in a location compatible with the reported anatomy (Figure 3). Tracts with a blue color indicate diffusion of water in a proximal-to-distal direction in the color FA map and 3-D dataset.

Model-estimated tractography results are summarized (Table 1). All reported b values are in units of seconds per millimeter squared (s/mm²). There was a significant association between the number of tracts and all combinations of slice thickness and b value ($P < .001$). At a slice thickness of 2 mm, $b = 800$ generated 1.17 times more tracts than $b = 600$, $b = 1,000$ generated 1.83 times more than $b = 600$, and $b = 1,000$ generated 1.56 times more than $b = 800$. At a slice thickness of 3 mm, $b = 800$ generated 1.14 times more than $b = 600$, $b = 1,000$ generated 1.56 times more than $b = 600$, and $b = 1,000$ generated 1.37 times more than $b = 800$. The model estimated that a slice thickness of 2 mm and a b value of 1,000 generated 124,103 tracts, the highest among all combinations. There were no significant associations ($P > .05$) between b value, slice thickness, and length of tracts or b values, slice thickness, and SNR.

The model showed a significant association between FA and combinations of slice thickness and b values. For a slice thickness of 2 mm, $b = 1,000$ had an FA value that was 0.035 lower than $b = 600$ ($P < .0001$), and $b = 1,000$ had an FA value that was 0.042 lower than $b = 800$ ($P < .0001$). The difference in FA value between $b = 800$ and $b = 600$ was not significant ($P = .891$). For a slice thickness of 3 mm, $b = 1,000$ had an FA value 0.019 lower than $b = 600$ ($P = .041$), and $b = 1,000$ had an FA value 0.035 lower
than \( b = 800 \) (\( P < .0001 \)), whereas a nonsignificant difference was reported between \( b = 600 \) and \( b = 800 \) (\( P = .104 \)). Overall, \( b = 1,000 \) had a lower FA than \( b \) values of 600 and 800, regardless of slice thickness. The MD and AD had no statistical association with slice thickness and \( b \) value. At a slice thickness of 2 mm, \( b = 1,000 \) had a higher RD than \( b = 800 \). Data are summarized (Figure 4).

The predicted values for FA, MD, AD, and RD of the lateral plantar nerve at the level of the proximal

<table>
<thead>
<tr>
<th>Slice thickness (mm)</th>
<th>( b ) Value (s/mm(^2))</th>
<th>Number of tracts</th>
<th>95% CI Span (mm)</th>
<th>95% CI SNR</th>
<th>95% CI FA</th>
<th>95% CI MD (* 10(^{-3}) mm(^2)/s)</th>
<th>95% CI AD (* 10(^{-3}) mm(^2)/s)</th>
<th>95% CI RD (* 10(^{-3}) mm(^2)/s)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>600</td>
<td>67,786</td>
<td>25.674–176,974</td>
<td>26.6</td>
<td>21.4–51.3</td>
<td>0.48–0.96</td>
<td>0.89–1.51</td>
<td>1.37–1.64</td>
<td>0.64–0.74</td>
</tr>
<tr>
<td>800</td>
<td>79,498***</td>
<td>30,110–290,895</td>
<td>26</td>
<td>20.8–51.1</td>
<td>0.49–0.92</td>
<td>0.85–1.45</td>
<td>1.32–1.66</td>
<td>0.61–0.70</td>
<td></td>
</tr>
<tr>
<td>1,000</td>
<td>124,103***</td>
<td>47,004–327,666</td>
<td>29.5</td>
<td>24.4–66.6</td>
<td>0.45–0.95</td>
<td>0.88–1.45</td>
<td>1.31–1.70</td>
<td>0.66–0.75</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>600</td>
<td>55,905</td>
<td>21.174–147,606</td>
<td>22.4</td>
<td>17.1–68.6</td>
<td>0.46–0.96</td>
<td>0.89–1.48</td>
<td>1.35–1.75</td>
<td>0.65–0.75</td>
</tr>
<tr>
<td>800</td>
<td>63,853***</td>
<td>24,184–168,590</td>
<td>22.4</td>
<td>17.0–75.6</td>
<td>0.46–0.94</td>
<td>0.86–1.46</td>
<td>1.33–1.68</td>
<td>0.63–0.73</td>
<td></td>
</tr>
<tr>
<td>1,000</td>
<td>87,402***</td>
<td>35,105–230,766</td>
<td>25.5</td>
<td>18.2–44.2</td>
<td>0.44–0.95</td>
<td>0.88–1.45</td>
<td>1.31–1.71</td>
<td>0.66–0.76</td>
<td></td>
</tr>
</tbody>
</table>

Values given represent the mean. Additional statistical relationships are described (see Results). 
AD = Axial diffusivity. FA = Fractional anisotropy. MD = Mean diffusivity. RD = Radial diffusivity. SNR = Signal-to-noise ratio. 
*** \( P < .001 \).
interartals and tarsometatarsal joint and medial plantar nerve to the level of the proximal interartals joint. There were no significant differences in the variables between locations. Histopathologic evaluation of the proximal segments of the lateral plantar nerve confirmed normal peripheral nerve tissue in all subjects. Two of the horses demonstrated bilateral multifocal neutrophilic and lymphoplasmacytic perivascular inflammation. These horses were not excluded from the analysis.

**Discussion**

In proximal suspensory desmopathy, a compartment-like syndrome may result from the restriction of the proximal suspensory ligament by the plantar fascia. The deep branch of the lateral plantar nerve may also be displaced or compressed between the enlarged ligament, restrictive fascia, and lateral splint bone. Inflammation of the deep branch of the lateral plantar nerve has been cited as a reason for persistent lameness in horses with proximal suspensory desmopathy despite appropriate rest and rehabilitation.\(^4\) Plantar fasciotomy with or without neurectomy of the deep branch has rapidly become the standard procedure for horses with persistent lameness associated with proximal suspensory desmopathy with more than 75% of horses returning to athletic function if proximal suspensory desmopathy was the sole contributor of lameness.\(^10,21\) Resected nerves may show inflammatory and degenerative changes including the presence of Renaut bodies, myxomatous expansion of the subperineurium, axonal swelling and necrosis, and myelin degeneration.\(^4\) Although histopathologic changes of the deep branch of the lateral plantar nerve have been documented,\(^2,4\) current protocols limit assessment of the plantarolateral neurovascular structures. Furthermore, from a clinical standpoint, the causation of neurovascular pathologies to lameness and the contribution of neuropathy to lameness localized to the plantar metatarsal region remains unclear.\(^5\)

Advanced imaging techniques can be used to help resolve diagnostic discrepancies in patients with ambiguous imaging findings. Despite the increased recognition of peripheral neuropathies in veterinary species,\(^2,21,22\) there is limited, published research on the normal or pathologic imaging characteristics of peripheral nerves.\(^23,24\) The DTI techniques have been performed in human and rodent species for over a decade with new applications in patients with symptoms of sciatic or carpal tunnel neuropathy.\(^5-8\) However, these techniques have not been translated into veterinary patients. The primary objective of this paper was to validate a novel imaging technique for noninvasive assessment of the plantar nerves of the horse that holds promise for noninvasive evaluation of the deep branch of the lateral plantar nerve in horses with proximal suspensory desmopathy.

Although imaging the deep branch of the lateral plantar nerve is the ultimate goal of this research, the medial and lateral plantar nerves are more easily identified on routine imaging scans. A recent paper\(^25\) reported that the deep branch of the lateral plantar nerve arises 3.7 ± 1.5 cm proximal to the head of the fourth metatarsal bone and spans 5.8 ± 1.7 cm. As the majority of this nerve segment spans the plantarodistal tarsus (Figure 1), the proximal interartals and tarsometatarsal joints were used as landmarks to place ROIs on the plantar nerves to improve consistency of measurements. Quantitative variables were compared between 3 locations, 2 on the lateral plantar nerve and 1 on the medial plantar nerve, and showed no significant differences.

In humans, anatomical MRI and tractography have shown similar sensitivity and specificity for the diagnosis of carpal tunnel syndrome and are thought to be most effective when used in combination.\(^26\) Quantitative DTI metrics can be used to complement qualitative data and provide an objective method for evaluating nerve tissue. This study tests and optimizes a protocol that can be used to perform DTI for the plantar nerves of the horse at the level of the tarsus and reports normative values for diffusion parameters.

Optimizing sequence parameters for DWI studies is important to maximize signal in the tissue of interest and ensure accuracy and repeatability of measurements.\(^27,28\) In clinical veterinary medicine, DWI protocols used for the brain routinely employ a slice thickness of 3 to 4 mm with a high b value of 1,000 s/mm\(^2\). However, peripheral nerve studies\(^27\) have been performed with b values ranging from 700 to 1,300 s/mm\(^2\) with slice thickness ranging from 2 to 4 mm and in-plane resolution ranging from 0.12 to 1.8 mm. A recent paper\(^28\) evaluating the sciatic nerve showed that lower b values ranging

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**Table 2**—Expected values for quantitative DTI parameters of the lateral and medial plantar nerves at the level of the tarsus.

<table>
<thead>
<tr>
<th>Location</th>
<th>FA</th>
<th>95% CI</th>
<th>MD ($X \times 10^{-3}$ mm$^2$/s)</th>
<th>95% CI</th>
<th>AD ($X \times 10^{-3}$ mm$^2$/s)</th>
<th>95% CI</th>
<th>RD ($X \times 10^{-3}$ mm$^2$/s)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral plantar nerve, proximal interartals joint</td>
<td>0.472</td>
<td>0.453–0.490</td>
<td>0.938</td>
<td>0.861–1.02</td>
<td>1.45</td>
<td>1.32–1.59</td>
<td>0.68</td>
<td>0.631–0.730</td>
</tr>
<tr>
<td>Lateral plantar nerve, tarsometatarsal joint</td>
<td>0.474</td>
<td>0.455–0.493</td>
<td>0.946</td>
<td>0.869–1.02</td>
<td>1.47</td>
<td>1.33–1.60</td>
<td>0.686</td>
<td>0.636–0.736</td>
</tr>
<tr>
<td>Medial plantar nerve, proximal interartals joint</td>
<td>0.46</td>
<td>0.442–0.479</td>
<td>0.961</td>
<td>0.884–1.04</td>
<td>1.48</td>
<td>1.35–1.62</td>
<td>0.7</td>
<td>0.651–0.750</td>
</tr>
</tbody>
</table>

Values given represent the mean.

AD = Axial diffusivity. DTI = Diffusion tensor imaging. FA = Fractional anisotropy. MD = Mean diffusivity. RD = Radial diffusivity.
from 600 to 800 s/mm$^2$ may be more appropriate for use in peripheral nerve evaluation due to non-Gaussian diffusion that is associated with their tissue microstructure. In our study, we demonstrated optimal performance with a $b$ value of 1,000 s/mm$^2$ and slice thickness of 2 mm with marginal improvements in SNR when the $b$ value was 800 s/mm$^2$. Although the variation in $b$ values affected the SNR and ease of detecting tracts, manipulation of the $b$ values had minimal impact on the quantitative values obtained in the study.

Quantitative parameters including FA and MD have great potential for the identification, quantification, and serial assessment of peripheral nerves, particularly those susceptible to inflammatory or degenerative injuries. The DTI parameters have been compared to electrophysiologic parameters and nerve conduction studies in the sciatic and ulnar nerves, demonstrating high diagnostic value when compared to the gold standard. In our study, mean FA for the medial and lateral plantar nerves ranges from 0.46 to 0.47. These FA values are similar to normal DTI values reported for the peripheral nerves in the upper arm in humans, which have a pooled mean of 0.59 according to a recent meta-analysis. Although higher FA values of up to 0.8 have been reported for the median nerve in human patients, the values obtained in our cadaver limbs were repeatable and are near those values reported for normal peripheral nerve tissue. Similarly, our mean values for MD are reported as 0.938 to 0.961 $\times 10^{-3}$ mm$^2$/s compared to a pooled mean of 1.03 $\times 10^{-3}$ mm$^2$/s for the peripheral nerves of the upper arm. Small differences in DTI parameters may be present when evaluation is performed postmortem or due to variation in the local magnetic field, level of noise, MRI manufacturer, or sequence parameters.

A decrease in FA, an increase in the apparent diffusion coefficient, and an increase in RD of the ulnar and median nerves have been reported in patients with carpal tunnel syndrome. These changes are consistent with a trend from anisotropy to isotropy that may be secondary to demyelination or perineural edema. Although the pathophysiology of carpal tunnel syndrome is complex, we hypothesize that chronic compression of the deep branch of the lateral plantar nerve in the horse will result in similar changes to these parameters. Future research will aim to optimize DTI of the deep branch of the lateral plantar nerve in normal horses and horses with proximal suspensory desmopathy, which may improve our understanding of associated lameness.

Several limitations to this study exist. As mentioned previously, optimizing signals and reducing variation in the magnetic field are essential for DWI. Limbs were positioned in the scanner at the isocenter to increase the signal and reduce inhomogeneity in the magnetic field, which would be challenging to achieve in a live horse. To limit the effects of postmortem evaluation, the limbs were imaged within several hours of euthanasia. However, variation between parameters in cadaver and live tissue will likely occur. Postprocessing of the image data is also time-consuming and requires technical skill, which may limit clinical translation.

Our findings suggest that DTI of the plantar nerves of the horse is possible with a $b$ value of 1,000 s/mm$^2$ and slice thickness of 2 mm. The DTI can be used to produce quantitative parameters including FA, RD, AD, and MD for the plantar nerves of the horse that are similar to values reported in the human literature. The new sequences and variables outlined in this MRI-based assessment of the plantar nerves show promise for future evaluation of the deep branch of the lateral plantar nerve in horses with proximal suspensory desmopathy.

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### Disclosures

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