ULTRASONOGRAPHIC FINDINGS IN THE LUMBOSACRAL JOINT OF 43 HORSES WITH NO CLINICAL SIGNS OF BACK PAIN OR HINDLIMB LAMENESS

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The transrectal ultrasonographic appearance of the lumbosacral joint was assessed in 43 horses with no history or clinical evidence of back pain or hindlimb lameness. In the majority of horses (34/43, 79.1%) the lumbosacral disc had uniform or mildly heterogeneous echogenicity. However, variation in the ultrasonographic appearance of the lumbosacral joint was also identified, including hyperechogenic regions within the lumbosacral disc with or without an acoustic shadow, and mild or moderate irregularity of the opposing surfaces of the last lumbar and the first sacral vertebral bodies. Marked irregularity of the bony surfaces or marked disruption of the lumbosacral disc was not seen in any horse. The mean distance between the ventral aspects of the last lumbar and first sacral vertebrae was 14.2 mm (range: 7.1–26.5 mm, median: 14.4 mm). The degree of protrusion of the ventral aspect of the lumbosacral disc ranged from 0 to 5 mm (mean: 1.32 mm, median: 1.2 mm). The mean angle between the ventral surfaces of the last lumbar and first sacral vertebrae was 147° (range: 118–165°, median: 150°). There was no significant effect of age, breed, gender, or the size of the horses on either subjective findings in the lumbosacral joint or objective measurements. © 2010 *Veterinary Radiology & Ultrasound, Vol. 51, No. 5, 2010, pp 533–539.*

Key words: equine, lumbosacral, normal, ultrasound.

Introduction

BACK PAIN HAS been recognized as a cause of poor performance in horses for over 30 years.[1–5] However, exact localization of the problem is often difficult because of the limitations of clinical examination, local analgesic techniques, and imaging modalities in the thoracic and lumbosacral regions.

The lumbosacral joint is composed of five separate joints: the intervertebral disc between the last lumbar and the first sacral vertebrae, the medial and lateral synovial joints between the articular processes, and the medial and lateral intertransverse joints[4] (Fig. 1). The ventral aspects of the last lumbar and first sacral vertebrae are not in the same plane; one or both are angled slightly obliquely, resulting in an obtuse angle ($>90^\circ$ and $<180^\circ$) from cranial to caudal. The lumbosacral disc is supported by the dorsal and ventral longitudinal ligaments (Fig. 1).

In the horse, the lumbosacral joint is the most mobile intervertebral joint between the cranial thoracic area and the pelvis,[6,7] which makes it likely to be more susceptible to injury than other intervertebral joints.[8] The lumbosacral disc has greater thickness and smaller height than other intervertebral discs in the caudal thoracic and lumbar spine.[6] Thus, the instant center of rotation is closer to the disc, which results in greater tensile and compressive strain. This contributes to the lumbosacral disc being more susceptible to injury than other intervertebral joints.[8]

The equine lumbosacral joint can be best imaged using transrectal ultrasonography.[3] Ultrasonographic abnormalities of the lumbosacral joint have been documented[3–5,9]; but the features of normal variation in horses with no clinical signs of back pain have not been described. In humans, degenerative changes in the lumbosacral joint occur in asymptomatic patients, especially in older people.[10]

Our aims were to document the ultrasonographic appearance of the lumbosacral joint in horses with no history or clinical signs of back pain or hindlimb lameness and to assess the effect of age, gender, breed, weight, height, and discipline. We hypothesized that there would be little variation in the ultrasonographic appearance of the lumbosacral joint in horses with no evidence of back pain or hindlimb lameness and more variations would be identified in older horses.

Materials and Methods

Transrectal ultrasonographic examination of the lumbosacral joint was performed in 43 mature horses that underwent rectal examination for reasons other than this study. All examinations were performed by the same clinician

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Received October 7, 2009; accepted for publication February 25, 2010.
doi: 10.1111/j.1740-8261.2010.01691.x

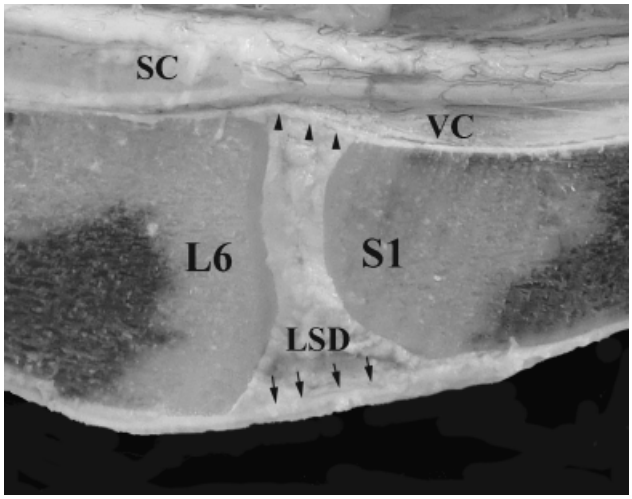

FIG. 1. Anatomic specimen of the lumbosacral joint. Cranial is to the left and dorsal is to the top. The dorsal longitudinal ligament is indicated by the arrowheads and the ventral longitudinal ligament by the arrows. SC, spinal cord; VC, vertebral canal; L6, sixth lumbar vertebra; S1, first sacral vertebra; LSD, lumbosacral disc.

(A.N.). Horses were included if they had no history or clinical evidence of back pain or hindlimb lameness and the owner gave consent. The age, breed, gender, use, and when possible, the height and weight of the horse were recorded. Systematic transcutaneous palpation and manipulation of the thoracolumbar and pelvic regions was performed as described previously.[11] All horses were examined at the walk and when possible, also at the trot.

All horses received intravenous hyoscine* to facilitate rectal examination. If needed, detomidine was also administered.† The rectum was evacuated and a linear rectal transducer††,§ operating at 7.5 MHz frequency and 3.23–5.39 cm scanning depth was used to evaluate the ventral aspect of the lumbosacral joint, including the lumbosacral disc, the opposing surfaces of the last lumbar and first sacral vertebral bodies and the ventral longitudinal ligament. Longitudinal still images in the midline of the ventral aspect of the lumbosacral joint were obtained and archived electronically. Measurements and subjective findings used for statistical analysis were recorded from each midline still image, but real-time ultrasonographic examination of the entire ventral aspect of the lumbosacral joint was performed in all horses. To match the positional anatomy of a standing horse, ultrasonographic images were rotated 180° in all figures. The echogenicity and homogeneity of the lumbosacral disc and presence of hypoechogenic or hyperechogenic areas within the disc were recorded. The caudal aspect of the last lumbar and the cranial aspect of the first sacral vertebral bodies were described as smooth, or mildly or moderately irregular. Mild irregularity was defined as disruption of the smooth bony contour by irregular areas extending <2 mm craniocaudally. Moderate irregularity was defined as irregular areas extending ≥ 2 mm craniocaudally. The echogenicity and the definition of the margins of the ventral longitudinal ligament were recorded. The cranial–caudal width of the ventral aspect of the lumbosacral joint was measured as the distance between the most ventral aspects of the opposing surfaces of the last lumbar and first sacral vertebral bodies (Fig. 2a). Ventral protrusion of the lumbosacral disc was defined as ventral extension of the disc beyond the line drawn between the most ventral aspects of the opposing surfaces of the last lumbar and first sacral vertebral bodies. The degree of protrusion was measured as the distance between the most ventral aspect of the lumbosacral disc and the line drawn between the most ventral aspects of the opposing surfaces of the last lumbar and first sacral vertebral bodies (Fig. 2a). All linear measurements were made digitally using a dedicated software.¶ The angle between the ventral surfaces of the last lumbar and first sacral vertebrae was measured using a protractor (Fig. 2c).

Repeatability of subjective evaluations and measurements was assessed five times on images of five horses. The relationship between age, breed, gender, height and weight and subjective findings, and measurements of the lumbosacral joint was assessed using a chi-square test. Statistical significance was set at $P<0.05$.

One horse was euthanized for unrelated reasons and high-field (1.5 T) magnetic resonance imaging of the lumbosacral joint was performed. Images included T1- and T2*-weighted gradient echo and fast spin echo sequences in transverse and sagittal planes.[12]

Results

Age ranged from 3 to 25 years (mean 11.5 years, median 11 years). There were eight horses ≤ 5 years of age, 10 horses were 6–10 years old, 15 horses were 11–15 years old, and nine were ≥ 16 years old. Height ($n=30$) ranged from 136 to 170 cm (mean: 159.6 cm, median: 160.5 cm) and weight ($n=30$) ranged from 440 to 690 kg (mean: 540.8 kg, median: 537.5 kg). There were 18 Thoroughbreds and Thoroughbred crosses, nine Warmbloods, seven Cobs and Cob crosses, four Irish Draughts and Irish Draught crosses, and five miscellaneous breeds. There were 27 geldings, 15 mares, and one stallion. The majority of horses were used for general purposes or low-level competitions (33/43, 76.7%). There were seven broodmares, two National Hunt racehorses, and one event horse.

*Buscopan Ampoules, Boehringer Ingelheim Ltd., Brecknell, Berkshire, UK.

†Domosedan, Pfizer Ltd., Sandwich, Kent, UK.

††Sonosite Titan, BCF Technology Ltd., Livingston, West Lothian, UK.

§DP-6600 Vet, BCF Technology Ltd.

¶Scion Image Release Beta 4.0.2., Scion Corporation, Frederick, MD.

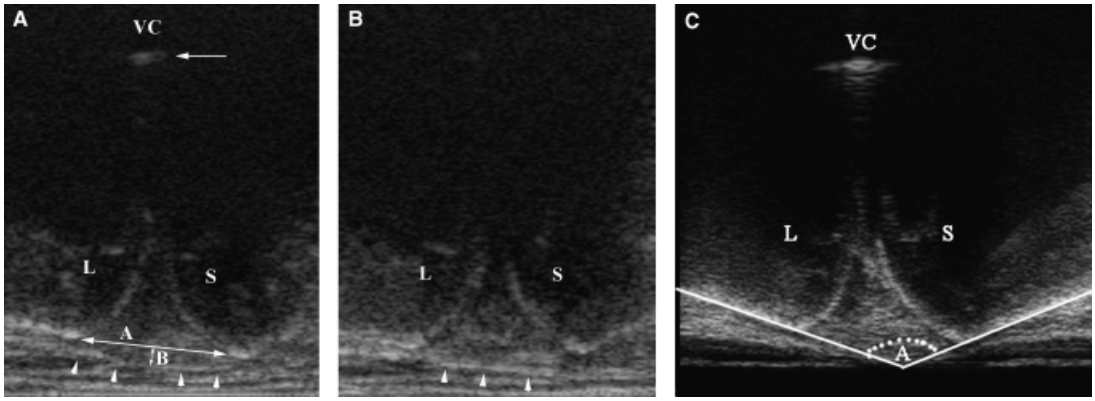

FIG. 2. Transrectal longitudinal ultrasonographic images of the lumbosacral joint of the same horse. Cranial is to the left and dorsal is to the top. The craniocaudal width of the ventral aspect of the lumbosacral joint (A) was measured as the distance between the most caudal aspect of the last lumbar (L) and the most cranial aspect of the first sacral (S) vertebral body. The degree of ventral protrusion (B) was measured as the distance between the most ventral aspect of the lumbosacral disc and the line drawn between the most ventral aspects of the opposing surfaces of the last lumbar and first sacral vertebral bodies. In real-time imaging, the lumbosacral disc was homogeneously echogenic and the bony margins were smooth. Because of the angulation of the lumbosacral joint, it was not possible to evaluate all structures in a single still image. (A) The cranial aspect of the lumbosacral disc is hypoechogenic and the ventral longitudinal ligament (arrowheads) is poorly defined. By slightly changing the craniocaudal angle of the transducer (B), the entire ventral aspect of the lumbosacral disc appeared echogenic and the ventral longitudinal ligament was better defined; however, the osseous margins could not be seen as clearly as on (A) and the dorsal longitudinal ligament (arrow) could no longer be identified. The angle between the ventral surfaces of the last lumbar and first sacral vertebrae (A) was measured with a protractor, using the ventral surfaces of the vertebrae as reference lines (C). VC, vertebral canal.

Repeatability of subjective assessment and measurements was confirmed. In all horses, only the ventral half of the lumbosacral joint could be evaluated in detail, because the convex shape of the opposing vertebral bodies only permitted penetration of the ultrasound beam to the more dorsal structures in the middle part of the joint. The entire ventral aspect of the joint and the opposing surfaces of the vertebral bodies could be imaged in all horses. However, it was not always possible to obtain one single still image with the best diagnostic information of all structures or the entire ventral aspect of the lumbosacral disc, due to the variably convex shape of the ventral aspect of the lumbosacral joint (Figs. 2a and b). The location of the terminal part of the aorta and/or internal iliac artery ventral to the lumbosacral joint prohibited meaningful interpretation of the images in two horses and confounded image interpretation in two other horses.

The lumbosacral disc appeared as echogenic material between the last lumbar and first sacral vertebrae (Fig. 3). The lumbosacral disc was homogeneous in 18/41 (43.9%) (Fig. 3) and mildly heterogeneous in 16/41 (39%) horses (Fig. 4). In two horses (4.9%), the lumbosacral disc was homogeneous, but subjectively seemed hypoechogenic compared with the other horses. Moderate heterogeneous echogenicity or a focal, well-defined area of altered echogenicity within the lumbosacral disc were seen in seven horses (17.1%). There was a large hyperechogenic area within the disc in 5/41 (12.2%) of horses (aged 11 years [$n = 2$], 14 years [$n = 1$], and 20 years [$n = 2$], respectively) (Fig. 5). In 2/41 horses (4.9%) (12 and 20 years of age, respectively) there was a focal hyperechogenic area with acoustic shadowing (Fig. 6). In one of these two horses there was both a large hyperechogenic area without an acoustic shadowing artifact, and a small hyperechogenic area with acoustic shadowing. There was an oblique or vertical hyperechogenic line in the lumbosacral disc in five horses (12.2%) (Fig. 7). One of these horses was subsequently euthanized for reasons other than this study and no structural changes were seen in the lumbosacral disc in magnetic resonance images of the region.

The ventral longitudinal ligament was a hyperechogenic structure of variable thickness running over the ventral aspect of the lumbosacral joint from cranial to caudal (Figs. 2–7). It could be imaged in all horses, but it was not always possible to evaluate it in its entirety over the lumbosacral joint in a single still image. The dorsal longitudinal ligament was identified in all horses as a hyperechogenic area dorsal to the lumbosacral joint (Figs. 2a, 3–7).

Mild irregularity of the caudal aspect of the last lumbar vertebral body was observed in 18/43 (41.9%) horses (Figs. 5 and 7) and mild irregularity of the cranial extremity of the first sacral vertebra in 10/43 (23.2%) horses. In 7/43 (16.3%) horses there was mild irregularity of both of the opposing surfaces. Moderate irregularity of both opposing vertebral surfaces was seen in one horse. In 20/43 (46.5%) horses no irregularities of either the last lumbar or first sacral vertebra were indentified.

There was no significant effect of age, gender, breed, height, and weight on either the echogenicity or homogeneity of the lumbosacral disc, or on the presence of a hyperechogenic area within the disc, or irregularity of the opposing surfaces of the last lumbar and first sacral vertebrae. Marked irregularity of the bony surfaces or marked

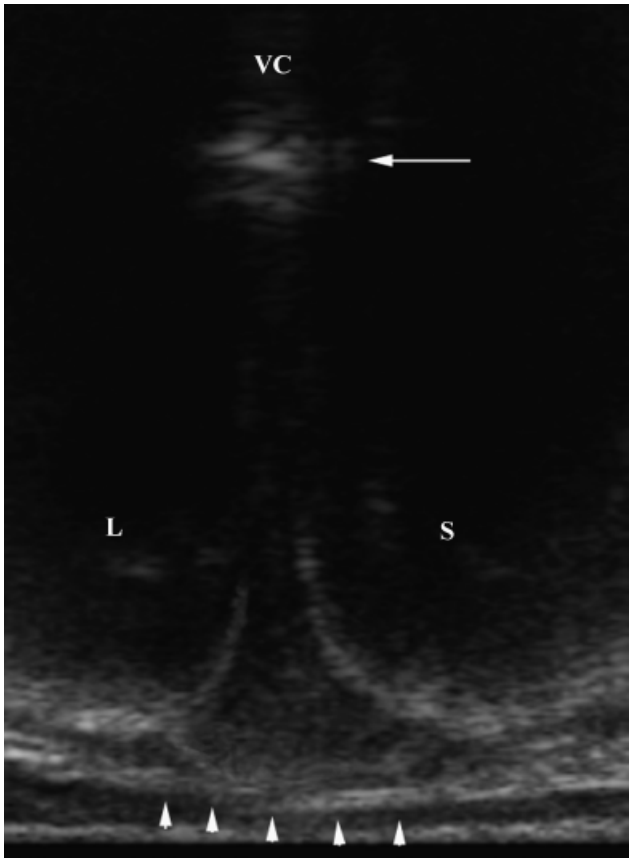

FIG. 3. Transrectal longitudinal ultrasonographic image of the lumbosacral joint of an 11-year-old Arab cross gelding. Cranial is to the left and dorsal is to the top. The lumbosacral joint is homogeneously echogenic and the opposing surfaces of the last lumbar (L) and first sacral (S) vertebral bodies are smooth. Note the moderately convex shape of the ventral aspect of the lumbosacral disc. In this image, the ventral longitudinal ligament (arrowheads) is better defined over the caudal aspect of the lumbosacral joint than over the cranial aspect. In real-time ultrasonographic imaging, there was uniform echogenicity of the ventral longitudinal ligament. The dorsal longitudinal ligament is indicated by the arrow. VC, vertebral canal.

disruption of the lumbosacral disc were not seen in any horse.

The mean distance between the ventral aspect of the last lumbar and first sacral vertebrae was 14.2 mm (range: 7.1–26.5 mm, median: 14.4 mm). The degree of protrusion of the ventral aspect of the lumbosacral disc ranged from 0 to 5 mm (mean: 1.32 mm, median: 1.2 mm). The mean angle between the ventral surfaces of the last lumbar and first sacral vertebrae was 147° (range: 118–165°, median: 150°). There was no ventral protrusion of the lumbosacral disc in 16/41 horses (39%). In the remainder the degree of protrusion ranged from 0.8 to 5 mm. Protrusion was $\leq$2 mm in 18/41 horses (43.9%) and $>$2.5 mm in 12/41 (29.3%). There was no significant effect of age, gender, breed, height, or weight on the distance between the ventral aspect of the last lumbar and first sacral vertebrae, or on the degree of ventral protrusion of the ventral aspect of the lumbosacral disc.

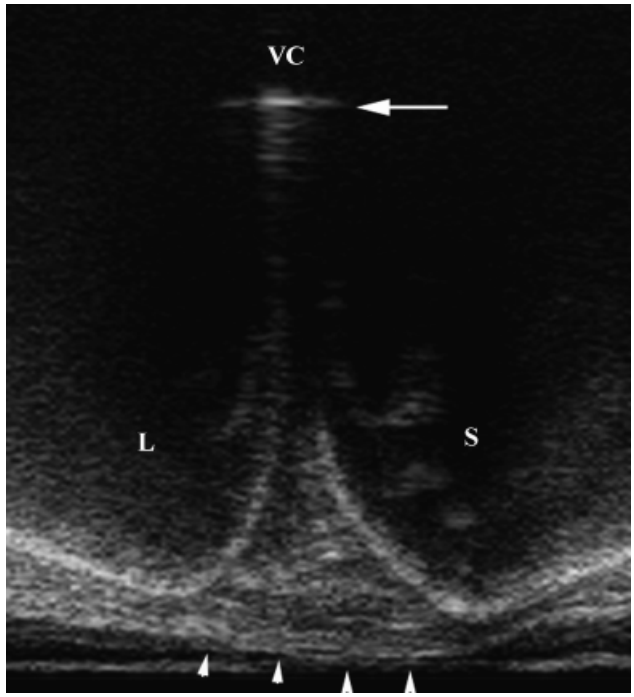

FIG. 4. Transrectal longitudinal ultrasonographic image of the lumbosacral joint of an 11-year-old Quarter Horse cross gelding. Cranial is to the left and dorsal is to the top. The lumbosacral joint has multiple small hyperechogenic foci. The opposing surfaces of the last lumbar (L) and first sacral (S) vertebral bodies are smooth. Note the slightly convex appearance of ventral margin of the lumbosacral disc. The ventral longitudinal ligament is indicated by arrowheads and the dorsal longitudinal ligament by the arrow. VC, vertebral canal.

As the majority of horses were used for general purposes, statistical analysis on the effect of discipline was not performed.

Discussion

In the majority of horses the lumbosacral disc had uniform or mildly heterogeneous echogenicity and the opposing bony surfaces were smooth or mildly irregular. However, there was also variability in the ultrasonographic appearance of the lumbosacral joint in horses with no history or clinical evidence of back pain or hindlimb lameness. Contrary to our hypothesis, there was no effect of age on either subjective evaluation of the lumbosacral joint or objective measurements. There was also no effect of breed, gender, or size of the horses. However, the relatively low numbers have to be taken into account.

Diagnostic tools that can be used to identify lumbosacral lesions in horses are limited. Clinically, it is not possible to differentiate lumbosacral pain from other sources of pain in the caudal thoracic or lumbosacral region.[5] Local analgesia of the lumbosacral joint is not possible. Radiography of the lumbosacral area in adult horses is problematic. Nuclear scintigraphy has been used to diagnose injuries in the thoracolumbar and pelvic region.[5,7,13–15] It can be use-

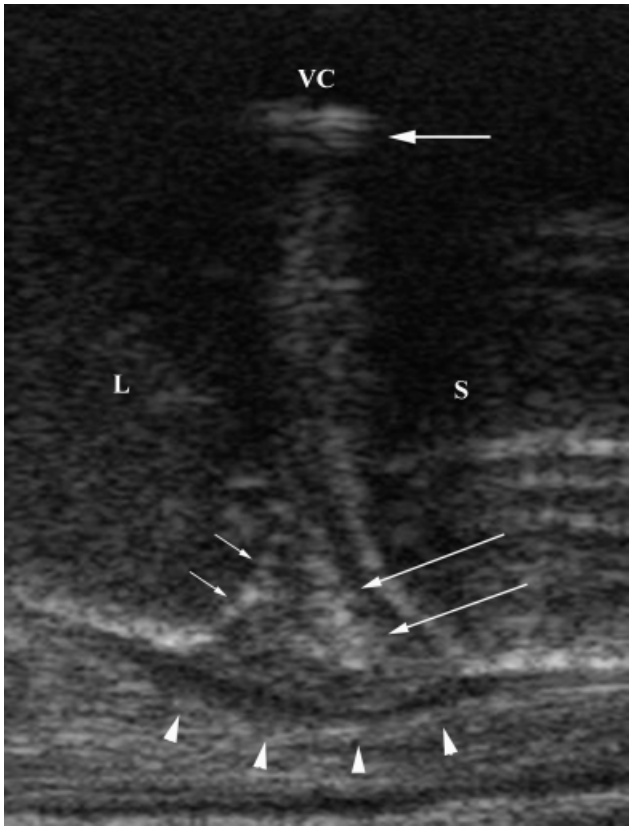

FIG. 5. Transrectal longitudinal ultrasonographic image of the lumbosacral joint of an 11-year-old Thoroughbred gelding. Cranial is to the left and dorsal is to the top. Note the large area of increased echogenicity within the lumbosacral disc (large arrows). The caudal aspect of the last lumbar vertebral body (L) is mildly irregular (small arrows). The ventral longitudinal ligament (arrowheads) is better defined over the caudal aspect of the lumbosacral disc than the over the cranial aspect. By changing the craniocaudal angle of the probe, the ventral longitudinal ligament was also well defined over the cranial aspect of the disc. There is a hypoechogenic line between the lumbosacral disc and the ventral longitudinal ligament. The dorsal longitudinal ligament is indicated by the arrow. S, first sacral vertebral body; VC, vertebral canal.

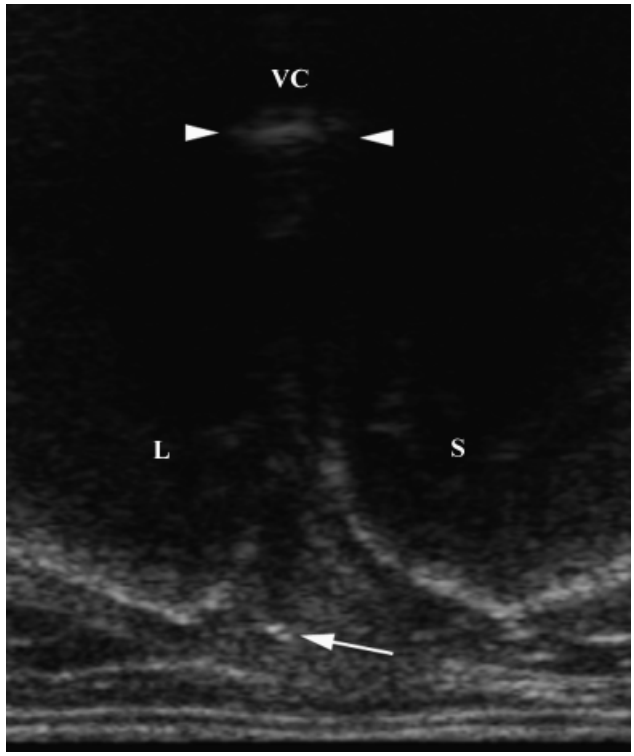

FIG. 6. Transrectal longitudinal ultrasonographic image of the lumbosacral joint of a 12-year-old Thoroughbred gelding. Cranial is to the left and dorsal is to the top. There is a small hyperechogenic area in the lumbosacral disc (arrow) resulting in acoustic shadowing artifact dorsal to it. The ventral longitudinal ligament cannot be evaluated in this image. The dorsal longitudinal ligament is indicated by the arrowheads. L, last lumbar vertebral body; S, first sacral vertebral body; VC, vertebral canal.

ful to detect increased osteoblastic activity in the lumbosacral region,[5] but it does not provide information on the lumbosacral disc or other soft tissue structures. Magnetic resonance imaging of the equine thoracolumbar spine is currently not possible.

Ultrasonography has been used to image the lumbosacral joint in man[16] and in dogs.[17] In horses transrectal ultrasonography can be used to image the lumbosacral joint from the ventral aspect.[4] Abnormalities of the lumbosacral joint and disc have been documented, but they have not been directly correlated with clinical signs.[3–5,8] Variation in anatomy of the lumbosacral region has been described.[3,4,18] These studies focused on the entire lumbosacral region (number of lumbar and sacral vertebrae, angulation, sacralization, and transitional vertebrae) and not on the lumbosacral joint in detail, and did not assess variability in its ultrasonographic appearance. Normal ultrasonographic appearance of the lumbosacral disc has been described in isolated horses[3]; but there was no information on the normal pattern of variation in horses with no history of back pain, or the influence of age, gender, breed, height, and weight.

In our population, the lumbosacral disc appeared completely homogeneous or mildly heterogeneous in the majority of the horses (34/43, 79.1%), of all ranges of age, breed, and size. This suggests that mildly heterogeneous echogenicity is a normal variation. A normal lumbosacral disc has been described as homogeneously echogenic.[4] In our study homogeneous was used to describe completely uniform echogenicity, therefore it is possible that what had been described as homogeneous in previous studies was recorded as mildly heterogeneous echogenicity in the current study.

In two horses there was a relatively reduced, but homogeneous echogenicity of the entire lumbosacral disc. This is more likely to be associated with technical factors such as dry rectal mucosa, or insufficient amount of lubricant between the probe and the rectal wall, rather than real changes in the disc material. The degree of echogenicity of

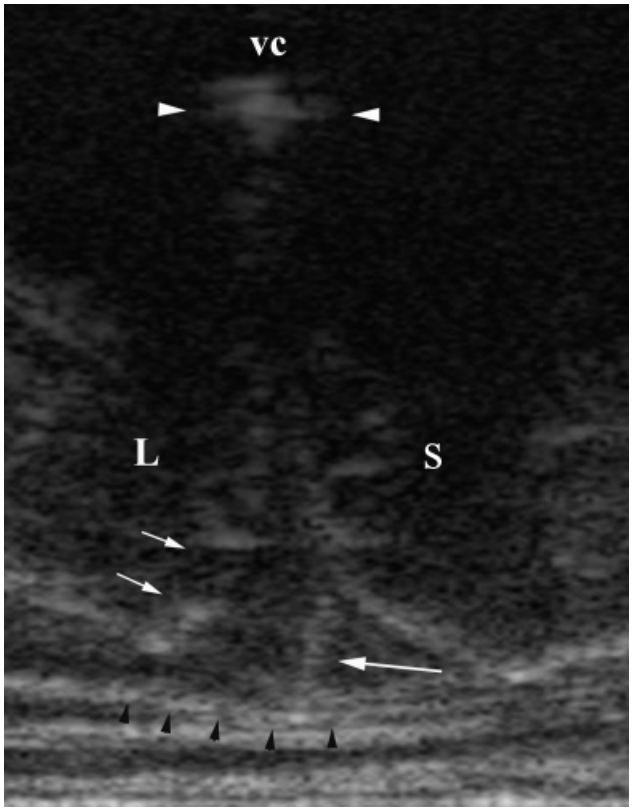

FIG. 7. Transrectal longitudinal ultrasonographic image of the lumbosacral joint of a 7-year-old Thoroughbred cross mare. Cranial is to the left and dorsal is to the top. There is an oblique hyperechogenic line within the lumbosacral disc (arrow). Note the mild irregularity of the caudal aspect of the last lumbar vertebral body (L) (small arrows). The ventral longitudinal ligament (black arrowheads) can only be evaluated in this image over the cranial aspect of the lumbosacral joint. Note the hyperechogenic focus within the ligament corresponding to the location of the ventral extension of the hyperechogenic line in the disc. The dorsal longitudinal ligament is indicated by the white arrowheads. S, first sacral vertebral body; VC, vertebral canal.

the lumbosacral disc varied between horses, which may be related to physical properties of the tissues and materials between the transducer and the lumbosacral disc, such as the amount of lubricating gel, ultrasound gel, or the contents in the rectum and moisture of the rectal mucosa.

Focal or larger areas of hyperechogenicity were recorded in seven horses. Increased echogenicity without acoustic shadowing artifact is likely to be associated with fibrous tissue formation[19] or mineralization.[20] Age did not have a significant effect on the presence of hyperechogenic regions; however, the small number of horses must be considered when interpreting the statistical results. All horses with hyperechogenic areas were at least 11 years of age, which suggests that alterations in disc material may be age related. Age-related vertebral and disc changes have been widely described in humans[9,21] and abnormalities in the lumbar spine are seen in asymptomatic patients.[9]

Although the vertical or oblique hyperechogenic lines in the lumbosacral disc observed in some horses could always be reproduced, they are most likely to be the result of an artifact. They extended from the ventral aspect of the lumbosacral disc toward its center and at their most ventral extent the opposing surface of the ventral longitudinal ligament also appeared hyperechogenic. In postmortem magnetic resonance imaging of one of these lumbosacral discs, there were no structural changes in the disc material. Verification using histology is warranted.

The opposing surfaces of the last lumbar and first sacral vertebrae were smooth or mildly irregular in the majority (42/43, 97.7%) of horses. Moderate irregularity was identified in only one horse, a 10-year-old Warmblood gelding, used for general purposes. Mild ventral protrusion of the lumbosacral disc was seen in 32/43 (74.4%) of horses. Prior description of a normal lumbosacral joint included ventral protrusion of the lumbosacral disc.[4] In our horses, the greatest degree of protrusion was 5 mm, as measured from the line drawn between the most ventral aspects of the opposing surfaces of the last lumbar and first sacral vertebrae.

The location of the terminal part of the aorta and the internal iliac arteries is variable between horses and can potentially make ultrasonographic examination of the lumbosacral joint difficult. However, the proportion of horses in which it was difficult to acquire diagnostic quality images was higher in this study than in our clinical experience (unpublished data).

Although to our knowledge the horses did not have overt back pain or hindlimb lameness, a previous injury to the lumbosacral region cannot be excluded. No high-level performance horses were evaluated in this study. It is possible that horses with the abnormalities described here could perform at low level without obvious back pain, but would have difficulties in performing more demanding athletic functions. Broodmares comprised approximately 16% of the horses; they were not in work at the time of examination and therefore may not have exhibited abnormal clinical signs. The majority of the horses were examined during investigation of abdominal pain, therefore lameness examination was limited. None of the horses were evaluated on the lunge or ridden and not all horses could be evaluated at the trot, therefore hindlimb lameness or back pain that may be have been manifest under these circumstances cannot be excluded. Nonetheless the owners of those horses, which had been in regular work had not been aware of any clinical problems.

Although in most horses the lumbosacral disc had uniform or mildly heterogeneous echogenicity and the bony surfaces had smooth or mildly irregular margins, there was variability in the ultrasonographic appearance of the lumbosacral joint in horses with no back pain or hindlimb lameness. Interpretation of the clinical significance of

ultrasonographic abnormalities in the lumbosacral joint remains a challenge. However, the results of this study can aid diagnosis by providing reference images.

ACKNOWLEDGMENT

We are grateful to BCF Technology Ltd. for providing an ultrasound machine for this study.

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