Ultrasonographic evaluation of the cervicothoracic junction (C7–T1) and proximal suspensory ligament in a sport horse with forelimb lameness

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Abstract. Cervical musculoskeletal dysfunction is increasingly recognized as a clinically significant contributor to reduced performance and forelimb lameness in sport horses. This case report describes the ultrasonographic assessment of the cervicothoracic junction (C7–T1) and proximal suspensory ligament in a 9-year-old sport horse presented with right forelimb lameness partially responsive to distal diagnostic anesthesia. High-resolution ultrasonography of the caudal cervical region revealed bilateral articular process hypertrophy at the C7–T1 level, characterized by irregular cortical margins, increased surface echogenicity, and periarticular remodeling consistent with chronic degenerative facet arthropathy. Structural changes were more pronounced on the right side, corresponding to the clinical laterality of the lameness. Given the biomechanical role of the cervicothoracic junction in axial–appendicular load transfer, these findings suggest impaired cervical kinematics and altered weight distribution as potential contributors to the locomotor dysfunction. In contrast, ultrasonographic examination of the proximal suspensory ligament demonstrated preserved fibrillar architecture, homogeneous echogenicity, normal enthesis morphology, and absence of fiber disruption or periligamentous edema. These findings excluded ultrasonographically detectable proximal suspensory desmitis as a primary source of pain at the time of evaluation. The combined clinical and imaging findings support a multifactorial etiology of forelimb lameness with a significant cervical component. This case highlights the diagnostic value of ultrasonography in the integrated assessment of axial and appendicular structures and underscores the importance of evaluating the caudal cervical region in horses with partially responsive forelimb lameness.

Key Words: C7–T1 ultrasonography, equine cervical arthropathy, equine sports medicine, suspensory ligament desmopathy.

Introduction. Musculoskeletal disorders of the equine cervical spine are increasingly recognized as clinically significant conditions that may adversely affect performance, welfare, and athletic longevity in sport horses (Story et al 2021). These disorders may manifest through a broad and sometimes non-specific spectrum of clinical signs, including reduced performance capacity, shortened stride length, forelimb lameness, altered head–neck carriage, and resistance to bending or collection under saddle (Koenig et al 2020). In certain cases, horses present with behavioral changes such as reluctance to work, head tossing, evasive responses to rein contact, or signs of discomfort during grooming and saddling, reflecting underlying cervical pain or articular dysfunction (Kernot et al 2022).

The clinical expression of cervical musculoskeletal pathology may vary considerably in intensity, ranging from subtle performance decline detectable only at high levels of competition to overt neurological deficits in more advanced cases (Dyson et al 2024). Importantly, several studies have reported that structural abnormalities of the cervical region may be present in horses without obvious neurologic impairment,

suggesting that the relationship between morphological change and clinical expression is complex and not always linear (Levine et al 2007).

The diagnostic challenge is further compounded by the intricate anatomy of the cervical spine, which encompasses osseous, articular, ligamentous, muscular, and neural components functioning in close biomechanical and neurophysiological integration (Clayton & Townsend 1989). Pain originating from this region may be referred or may alter locomotor patterns in a compensatory manner, potentially mimicking distal limb lameness and complicating clinical interpretation (Dyson 2000). Consequently, accurate identification of clinically relevant cervical pathology often requires a systematic and methodical diagnostic approach that integrates thorough physical examination, dynamic assessment, and appropriate imaging modalities (Hughes et al 2014).

The cervical spine in horses consists of multiple synovial articulations, including the articular process joints (APJs) between adjacent vertebrae, which facilitate motion and bear biomechanical loads during athletic activity (Haussler et al 2019). Degenerative and inflammatory changes in these articulations have been implicated in neck dysfunction and performance decline (Brown et al 2021). Biological systems demonstrate remarkable adaptive and regenerative capacities under conditions of environmental and physiological stress, a phenomenon extensively documented in extremotolerant pioneer species capable of surviving cold, arid, and oligotrophic environments (Bora et al 2025). In a different clinical context, similar principles of tissue resilience and stress adaptation are relevant when evaluating chronic articular and ligamentous pathology in sport horses.

Traditional imaging modalities such as radiography remain widely used in equine practice but have limitations, particularly in visualizing soft tissue structures and detailed joint morphology at the base of the neck (including C7–T1) (Estell et al 2018). These limitations are compounded by technical challenges such as head and neck positioning, superimposition of osseous structures, and difficulty obtaining optimal oblique projections (Hughes et al 2014).

Ultrasonography has emerged as a valuable, non-invasive imaging tool for the evaluation of both soft tissues and certain aspects of the equine cervical spine (Story et al 2021; Kernot et al 2022). It allows dynamic assessment of musculoskeletal structures, including joint capsules, facet articulations, and paravertebral soft tissues, without exposure to ionizing radiation (Story et al 2021; Haussler et al 2019). In addition, ultrasonography enables real-time comparison between contralateral structures, facilitating the detection of asymmetry or subtle morphological changes that may not be apparent on static imaging (Story et al 2021; Koenig et al 2020). It can also assist in identifying capsular thickening, periarticular remodeling, and irregularities of the articular process joint margins, thereby supporting the diagnosis of articular facet pathology (Brown et al 2021; Haussler et al 2019). Furthermore, ultrasonography provides a practical and repeatable modality for serial monitoring of cervical lesions and for guiding diagnostic or therapeutic interventions, such as periarticular injections (Story et al 2021; Dyson 2000).

A descriptive reference study by Berg et al 2003 documented the normal ultrasonographic appearance of transverse scans of the equine cervical region from C2 to T1 and provided corresponding post-mortem frozen cross-sections as anatomical reference, thereby supporting interpretation of cervical ultrasonography in clinical practice (Story et al 2021; Haussler et al 2019).

Ultrasonographic evaluation has also been shown to enable visualization of paraspinal soft tissues and articular margins that may not be adequately assessed with radiography alone, contributing to improved detection of subtle degenerative and inflammatory changes (Story et al 2021; Haussler et al 2019; Brown et al 2021).

Beyond the cervical region, musculoskeletal ultrasonography is widely accepted for the evaluation of superficial and deep tendons, ligaments, and other soft tissue structures in equine sport medicine (Dyson 2000; Story et al 2021). Regenerative therapies such as platelet-rich plasma (PRP) and hyaluronic acid have demonstrated promising clinical outcomes in suspensory ligament desmitis when combined with controlled exercise protocols (Bungărdean et al 2025a, 2025b). It allows identification of variations in echotexture, fiber alignment, cross-sectional morphology, and fluid

accumulation, which are critical parameters in diagnosing tendinopathy, desmopathy, and other soft tissue pathologies (Dyson 2000). Taken together, these diagnostic capabilities underscore the clinical relevance of ultrasonographic assessment in sport horses, particularly when integrated into a multimodal imaging approach that also considers radiography and advanced imaging techniques as needed (Story et al 2021; Koenig et al 2020; Hughes et al 2014).

The aim of the present study was to highlight the clinical utility of ultrasonography in the integrated assessment of the cervicothoracic junction (C7–T1) and the suspensory ligament in a 9-year-old sport horse presented for reduced performance and suspected axial musculoskeletal dysfunction. The study sought to characterize ultrasonographic changes affecting the caudal cervical articular process joints, to identify potential structural abnormalities within the suspensory apparatus, and to evaluate the possible relationship between axial pathology and clinical forelimb lameness. Additionally, the objective was to emphasize the role of ultrasonography as a dynamic, accessible, and repeatable imaging modality capable of supporting precise differential diagnosis and contributing to a comprehensive multimodal clinical and imaging approach.

Accurate ultrasonographic characterization of ligamentous and articular pathology is essential not only for diagnosis but also for guiding regenerative intra-articular and intralesional therapies. Recent clinical studies have reported favorable outcomes following the use of PRP and hyaluronic acid in equine stifle lameness and proximal suspensory desmitis when combined with controlled exercise programs (Bungărdean et al 2025a, 2025b).

Material and Method

Clinical case and equipment. A 9-year-old sport horse was subjected to a comprehensive ultrasonographic examination following clinical suspicion of musculoskeletal dysfunction involving the caudal cervical region and distal limb suspensory apparatus. All imaging procedures were performed using a high-resolution veterinary diagnostic ultrasound system equipped with broadband convex and linear-array transducers.

Deep cervical structures were evaluated using a 5 MHz multifrequency convex transducer, selected to ensure adequate acoustic penetration and optimal visualization of the cervicothoracic junction (C7–T1) and associated articular process joints. Superficial soft tissue structures, including the suspensory ligament, were examined using a 10 MHz high-frequency linear transducer to maximize spatial resolution and enable detailed assessment of fibrillar architecture. Ultrasound parameters, including gain, imaging depth, focal zones, and dynamic range, were continuously adjusted to optimize image quality and minimize acoustic artifacts.

Patient preparation and positioning. The horse was examined in a standing position without sedation to preserve physiological muscle tone and maintain normal articular alignment. The head and neck were kept in a neutral anatomical position throughout the procedure to prevent artificial alteration of intervertebral spacing or joint congruency.

The cervical and metacarpal regions were clipped and aseptically prepared prior to imaging. Acoustic coupling gel was applied liberally to eliminate air interfaces and enhance sound wave transmission. During evaluation of the suspensory ligament, the limb was maintained in a weight-bearing stance to ensure physiologic tension within the ligamentous fibers.

Ultrasonographic examination of the cervicothoracic junction (C7–T1). A systematic bilateral scanning protocol was employed for assessment of the caudal cervical spine, with particular emphasis on the C7–T1 articulation. Imaging was performed in longitudinal (parasagittal) planes to evaluate dorsal articular process margins, cortical bone continuity, joint capsule contour, and periarticular soft tissues. Transverse imaging planes were subsequently used to assess articular symmetry, capsular thickness, and potential proliferative or degenerative remodeling.

The examination focused on cortical surface regularity, echogenic integrity of osseous margins, presence of osteophytic formations, and periarticular echotexture heterogeneity. Hypoechoic regions suggestive of synovial distension, capsulitis, or inflammatory involvement were carefully documented. Bilateral comparison was performed to identify asymmetry or structural deviations from expected ultrasonographic appearance.

Ultrasonographic examination of the suspensory ligament. The suspensory ligament was examined using a standardized high-resolution protocol. Both transverse and longitudinal imaging planes were obtained at predefined anatomical landmarks, including the proximal origin and mid-body region.

Transverse sections allowed assessment of cross-sectional morphology, symmetry, and fiber distribution, while longitudinal views facilitated evaluation of fibrillar alignment, parallelism, and structural continuity of collagen bundles. The analysis included evaluation of echogenic homogeneity, identification of focal hypoechoic or hyperechoic abnormalities, measurement of cross-sectional area where applicable, and detection of periligamentous fluid accumulation.

Procedures were conducted carefully to minimize anisotropy by maintaining the ultrasound beam perpendicular to the ligament fibers. All images were digitally recorded and archived for subsequent analysis and documentation.

Results and Discussion. Ultrasonographic examination of the caudal cervical region revealed marked structural abnormalities at the level of the C7–T1 articular facet joint (Figure 1). The articular processes appeared enlarged, with irregular cortical margins and increased surface echogenicity, consistent with chronic osseous remodeling. The normally smooth hyperechoic cortical contour was replaced by uneven proliferative changes, suggestive of long-standing degenerative joint disease. Bilateral involvement was observed, with more pronounced hypertrophy on the right side.

These ultrasonographic findings are indicative of chronic articular facet arthropathy affecting the caudal cervical spine. The C7–T1 articulation represents a biomechanically critical transition zone between the mobile cervical spine and the relatively rigid thoracic segment. Degenerative remodeling at this level may substantially alter cervical biomechanics, particularly during extension and lateral bending movements. Reduced articular congruity and osteoproliferative changes can impair normal joint gliding, leading to mechanical pain and adaptive muscular tension.

In the present case, the predominance of structural changes on the right side (Figure 1) is clinically relevant given the concurrent right forelimb lameness. Although distal limb diagnostic anesthesia resulted in partial improvement, incomplete resolution suggests a multifactorial origin of the locomotor dysfunction. Caudal cervical pain may manifest as apparent forelimb lameness due to altered weight distribution, asymmetric cervical posture, and compensatory neuromuscular recruitment patterns.

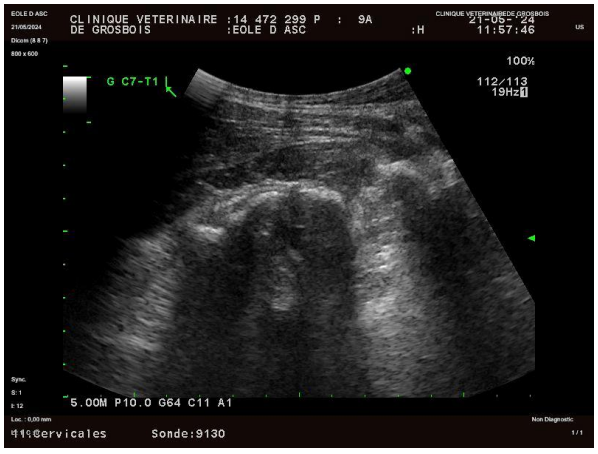

Figure 1. Ultrasonographic examination of the C7–T1 articular facet joint showing hypertrophy and osseous remodeling of the articular processes.

The ultrasonographic appearance of the C7–T1 facet joint (Figure 1) provides structural evidence of clinically significant cervical arthropathy and underscores the importance of evaluating the caudal cervical region in horses with forelimb lameness only partially responsive to distal diagnostic anesthesia. The identification of articular process hypertrophy, cortical irregularity, and altered periarticular echogenicity at this biomechanically critical junction suggests chronic degenerative remodeling capable of influencing load transfer between the axial skeleton and thoracic limbs. Given the transitional nature of the cervicothoracic segment, even moderate articular incongruity may disrupt normal cervical kinematics, potentially leading to compensatory neuromuscular recruitment patterns and altered forelimb loading dynamics.

Ultrasonographic evaluation of the proximal suspensory ligament in the forelimbs (transverse and longitudinal views) demonstrated preserved fibrillar architecture, homogeneous echogenicity, and a structurally regular enthesis, without evidence of fiber disruption, hypoechoic core lesions, enlargement, periligamentous edema, or enthesopathy (Figure 2; Figure 3). Bilateral assessment revealed symmetrical morphology and comparable cross-sectional appearance, with no detectable asymmetry suggestive of early or subclinical desmitic change. Fiber alignment remained linear and continuous throughout the examined segment, and ligament margins were clearly defined against the surrounding soft tissues.

The adjacent cortical bone surface maintained a smooth and uninterrupted hyperechoic contour, without irregularities, proliferative changes, or periosteal reaction. No abnormal fluid accumulation or increased periligamentous echogenicity was identified, and the enthesis appeared structurally uniform, without signs of mineralization or structural distortion.

In the context of forelimb lameness, proximal suspensory desmitis is typically associated with structural alterations such as focal hypoechogenic regions, fiber disorganization, ligament enlargement, or periligamentous soft tissue changes. The complete absence of these ultrasonographic abnormalities significantly decreases the likelihood of intrinsic suspensory ligament pathology acting as the primary pain generator.

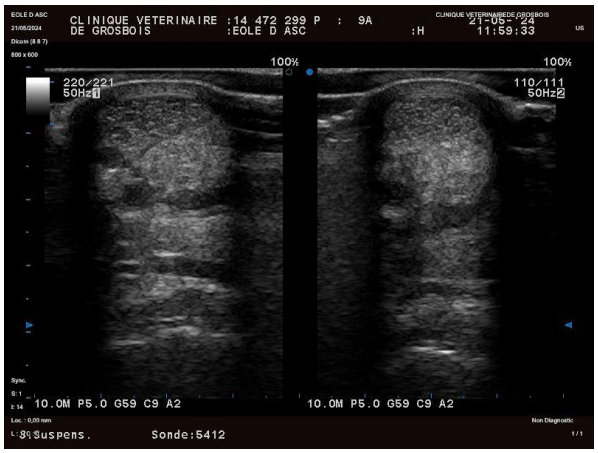

Figure 2. Ultrasonographic evaluation of the proximal suspensory ligament insertion (forelimb), demonstrating normal fiber architecture without evidence of structural disruption.

When interpreted alongside the clinical examination findings and the absence of distal limb structural lesions, this normal ultrasonographic profile strengthens the hypothesis that the observed lameness may be predominantly influenced by axial dysfunction. Consequently, the imaging findings refine the diagnostic hierarchy, shifting clinical suspicion toward a cervical or cervicothoracic source of pain and supporting a broader, integrated assessment of axial–appendicular interaction in this sport horse. These findings exclude ultrasonographically detectable proximal suspensory desmitis as a primary source of pain at the time of examination.

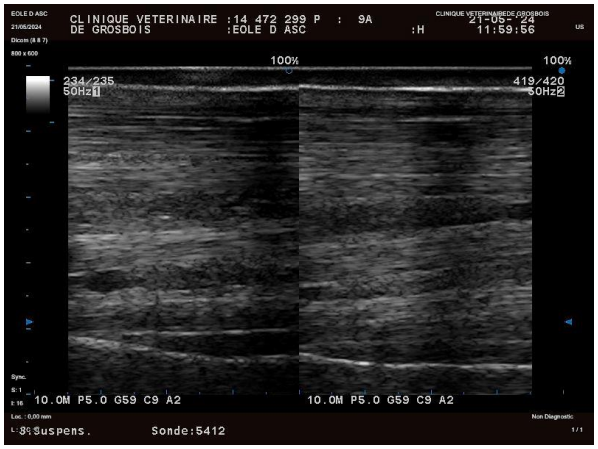

Figure 3. Longitudinal ultrasonographic views of the proximal suspensory ligament (forelimb), demonstrating preserved fiber alignment and normal echogenicity.

Considering the partial improvement following distal metacarpal nerve block and the concurrent cervical and articular abnormalities identified elsewhere, the absence of structural suspensory pathology supports the hypothesis that distal ligamentous injury was not the principal contributor to the forelimb lameness.

In summary, the findings support a multifactorial etiology of the right forelimb lameness with a significant cervical contribution.

Conclusions. The comprehensive clinical, ultrasonographic, radiographic, and diagnostic anesthesia findings support a multifactorial etiology of the right forelimb lameness, with a significant contribution from the caudal cervical region. Chronic degenerative changes affecting the C7–T1 articular facet joint, characterized by hypertrophy and osseous remodeling (Figure 1), are consistent with clinically relevant cervical arthropathy. Given the biomechanical role of the cervicothoracic junction in load transfer between the axial skeleton and thoracic limbs, these structural alterations likely disrupted normal cervical kinematics and contributed to asymmetric weight distribution. The predominance of right-sided changes correlates with the clinical laterality of the lameness, reinforcing the functional significance of the cervical pathology.

The partial improvement following distal metacarpal nerve block indicates that distal limb structures contributed to the pain profile; incomplete resolution, however, excludes an exclusively distal origin. Radiographic evidence of distal articular remodeling supports appendicular involvement, while the absence of ultrasonographic abnormalities within the proximal suspensory ligament insertions excludes clinically significant suspensory desmitis.

Importantly, the preserved fibrillar architecture and normal enthesis morphology suggest that compensatory biomechanical overload had not yet induced detectable structural adaptation within the suspensory apparatus. This finding strengthens the hypothesis that axial pathology—particularly caudal cervical facet arthropathy—played a primary biomechanical role in the development and maintenance of the locomotor asymmetry.

Overall, the data indicate that the lameness was not attributable to a single isolated lesion but rather resulted from the interaction between cervical arthropathy and distal articular changes. This case underscores the necessity of a comprehensive axial and appendicular diagnostic approach in horses presenting with partially responsive forelimb lameness, as failure to evaluate the caudal cervical region may lead to underestimation of the primary pain generator and suboptimal therapeutic targeting.

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Conflict of interest. The author declares that there is no conflict of interest.

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