Insertional suspensory ligament injuries in horses: clinical presentation and multimodal imaging features

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Abstract. Insertional suspensory ligament injuries are a frequent cause of lameness and reduced performance in sport horses, often involving both soft tissue and adjacent bone at the osteoligamentous interface, which makes diagnosis challenging. In this retrospective case series of five horses, ultrasonography showed insertional enlargement, heterogeneous echogenicity, and fiber disruption, particularly evident under non-weight-bearing conditions. Radiography identified chronic osseous remodeling, sclerosis, and enthesis-related changes consistent with long-term mechanical stress. MRI provided the most detailed assessment, detecting lesion chronicity, bone marrow edema, and concurrent osseous pathology, reported in up to two-thirds of cases. Overall, lesion location, chronicity, and degree of bone involvement influence prognosis and return to performance, highlighting the importance of multimodal imaging.
Key Words: lameness, MRI, ultrasound, suspensory ligament, sport horse.

Introduction. Suspensory ligament–related pain and lameness are frequent causes of reduced performance in sport horses, and lesions may involve not only the ligament but also the adjacent osseous structures at the osteoligamentous interface. Similar osteoligamentous interactions have been described in distal limb tendon pathology, where deep digital flexor tendon lesions are frequently associated with adjacent osseous and enthesis-related changes (Crișan et al 2013; Crișan et al 2018). Standing MRI studies of the proximal metacarpal/metatarsal region have highlighted the wide range of abnormalities encountered in horses with pain localised to this region and have helped refine interpretation of clinically relevant findings (Murray et al 2020).

Insertional suspensory ligament injuries are commonly discussed under the broader umbrella of proximal suspensory desmitis and distal suspensory branch insertion pathology. These lesions can be chronic and subtle clinically, and multimodal imaging is frequently needed to characterise both soft-tissue injury and associated osseous change. In Warmblood horses examined with MRI, bone and soft-tissue lesions in the proximal metacarpal region are commonly concurrent, and MRI can help differentiate clinically significant patterns from changes seen in control limbs (van Veggel et al 2021).

Ultrasonography remains a first-line imaging tool for suspensory ligament evaluation, but diagnostic sensitivity can depend on technique and limb loading. Non-weight-bearing ultrasonography has been shown to reveal longitudinal fibre disruption ("splits") in suspensory branches that may not be visible on weight-bearing examination, emphasising the value of technique standardisation when characterising insertion-related pathology (Werpy et al 2021).

Radiography provides complementary information about enthesis-related bone response (e.g., sclerosis, cortical change, lucencies), but its ability to predict the presence or severity of proximal suspensory desmopathy is limited. In a retrospective comparison using MRI as the reference standard, radiographic changes of the proximal

third metatarsal bone did not reliably predict the presence or severity of proximal suspensory desmopathy in a predominantly Quarter Horse population (Hinkle et al 2023). In addition, normal anatomic variation can mimic pathology: radiographic linear opacities at the proximal plantar metatarsus may correspond to normal longitudinal cortical ridges visible on CT/MRI, which can increase the risk of false-positive interpretation if projectional and anatomical factors are not considered (Dancot et al 2023).

Computed tomography has also been investigated as an advanced modality for proximal suspensory disease, and controlled data indicate that CT can reliably detect findings consistent with proximal suspensory desmitis and differentiate affected horses from controls (Müller et al 2023). Together, these recent studies support a multimodal approach—integrating clinical examination with ultrasound and radiography and using advanced imaging (MRI/CT) when required—to characterise insertional suspensory ligament injuries and to support more accurate diagnosis and prognosis.

Therefore, the aim of this retrospective case series is to describe the clinical presentation and multimodal imaging findings (ultrasonography, radiography and MRI, where available) of insertional suspensory ligament injuries in sport horses, with emphasis on lesion location, chronicity and associated osseous changes. Recent literature has also highlighted emerging regenerative therapies, including platelet-rich plasma and hyaluronic acid combined with controlled exercise, reflecting the increasing focus on biologically based treatment strategies in equine musculoskeletal disorders (Bungărdean et al 2025a, 2025b; Moldovan et al 2025; Popescu et al 2025).

Material and Method. This study was designed as a retrospective case series including horses diagnosed with insertional suspensory ligament injury. Medical records from horses presented for evaluation of lameness associated with the suspensory ligament insertion were reviewed. Cases were selected based on the presence of clinical signs consistent with suspensory ligament insertion pain and confirmation of the diagnosis through diagnostic imaging.

Horses were included if they exhibited forelimb or hindlimb lameness localized to the suspensory ligament insertion based on clinical examination and, when necessary, diagnostic analgesia. Imaging confirmation of insertional suspensory ligament injury was required, consisting of ultrasonographic, radiographic, or magnetic resonance imaging findings consistent with structural abnormalities at the ligament–bone interface. Horses were excluded when lameness was primarily attributed to other orthopedic disorders, including fractures, severe osteoarthritis unrelated to the suspensory ligament, or non-insertional ligament injuries.

All horses underwent a standardized clinical examination. This included static orthopedic assessment, palpation of the suspensory ligament insertion region, and dynamic evaluation at the walk and trot on both straight lines and circles on hard and soft surfaces. Lameness severity was graded using a standard five-point scale. When necessary, regional diagnostic analgesia was performed to confirm localization of pain to the suspensory ligament insertion.

Ultrasonographic examination was performed using a high-frequency linear transducer. Both weight-bearing and, when required, non-weight-bearing techniques were used to assess the suspensory ligament insertion. Ultrasonographic evaluation focused on ligament enlargement, echogenicity changes, fiber disruption, insertional irregularities, and evidence of mineralization or adjacent soft-tissue thickening.

Radiographic examination of the affected regions was conducted using standard projections appropriate to the anatomical site. Radiographs were assessed for cortical sclerosis, enthesophyte formation, periosteal reaction, osteolysis, and other signs of bone remodeling at the osteoligamentous interface. Magnetic resonance imaging was performed in selected cases when available. Imaging was conducted using a standing low-field MRI system, allowing detailed evaluation of both soft-tissue and osseous structures. MRI findings recorded included changes in ligament signal intensity, fiber integrity, bone marrow abnormalities, cortical remodeling, synovial effusion, and peri-ligamentous soft-tissue changes. Clinical and imaging data were reviewed and categorized according to anatomical location of the lesion, limb affected, lesion chronicity,

presence of osseous involvement, and imaging modality used for diagnosis. Due to the descriptive nature of the study and the limited number of cases, data analysis was restricted to descriptive evaluation.

Results and Discussion. Five sport horses diagnosed with insertional suspensory ligament injury were included in this retrospective case series. Lesions involved both forelimbs and hindlimbs and affected proximal as well as distal insertion sites. Clinical presentation ranged from relatively recent onset lameness to chronic conditions associated with insertional remodeling and osseous involvement. All horses exhibited mild to moderate lameness, and clinical examination consistently revealed localized pain upon palpation of the suspensory ligament insertion region. In selected cases, diagnostic analgesia confirmed localization of pain to the osteoligamentous interface.

Ultrasonographic examination revealed insertional structural abnormalities in all cases, including ligament enlargement and heterogeneous echogenicity in transverse sections (Figure 1A) and focal fiber disruption with loss of normal fibrillar architecture in longitudinal views (Figure 1B).

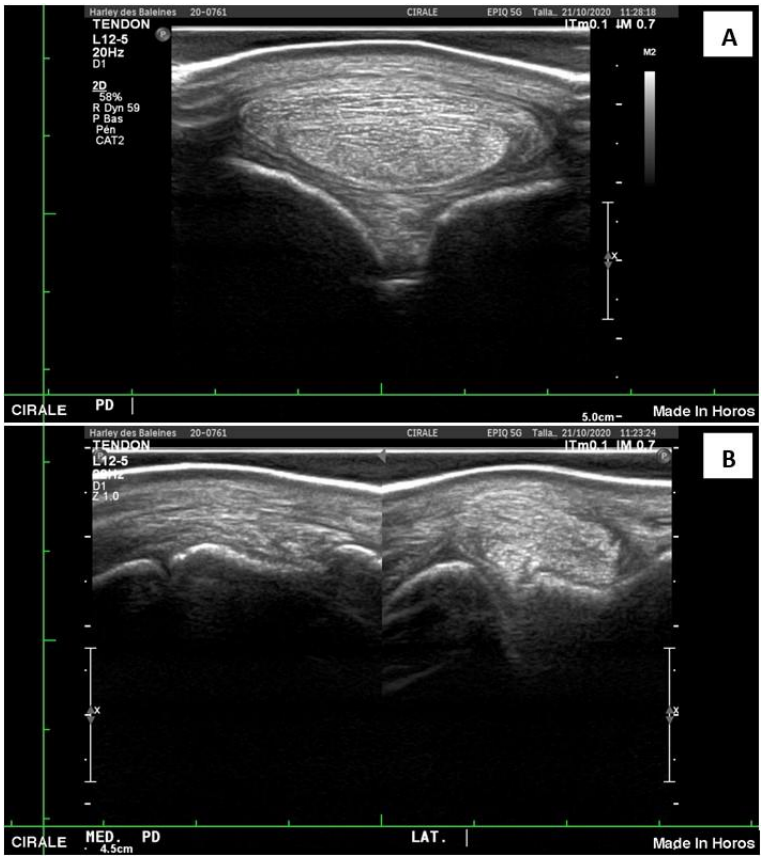

Figure 1. Ultrasonographic findings of insertional suspensory ligament injury. (A) Transverse ultrasonographic image of the proximal suspensory ligament branch demonstrating ligament enlargement and heterogeneous echogenicity at the insertional region. (B) Longitudinal ultrasonographic image showing focal disruption of the normal fibrillar architecture and peri-ligamentous thickening consistent with chronic insertional remodeling.

Chronic cases showed persistent heterogeneity, fibrosis-like patterns, and peri-ligamentous thickening, suggesting chronic remodeling in response to repetitive mechanical stress. These findings are consistent with current literature indicating that ultrasonography remains the primary imaging modality for suspensory ligament evaluation and that specific examination techniques can improve detection of longitudinal fiber disruption in suspensory branches (Werpy et al 2021).

Radiographic evaluation provided complementary information regarding osseous response at the enthesis. In chronic cases, radiographs demonstrated cortical sclerosis, insertional remodeling, and occasional focal osteolysis at the ligament–bone interface, particularly evident in the lateromedial projection (Figure 2A) and more clearly delineated

in oblique views (Figure 2B). Interpretation of radiographic findings requires careful consideration, as certain cortical changes may represent normal anatomical variations rather than pathological remodeling.

Figure 2. Radiographic findings of insertional suspensory ligament injury. (A) Lateromedial radiographic projection of the metacarpophalangeal region showing cortical sclerosis and remodeling at the insertional site of the suspensory ligament. (B) Oblique radiographic projection demonstrating insertional irregularity and focal osseous changes involving the proximal sesamoid region.

Recent studies have demonstrated that longitudinal cortical ridges at the suspensory ligament enthesis may occur in normal limbs and can lead to false-positive interpretations if not correlated with advanced imaging findings (Dancot et al 2023). Additionally, radiographic changes of the proximal metatarsal region have limited predictive value for the presence or severity of proximal suspensory desmopathy when compared with MRI findings (Hinkle et al 2023).

Magnetic resonance imaging, available in selected cases, allowed detailed characterization of both ligamentous and osseous components of insertional injury. MRI demonstrated increased signal intensity and structural disruption within affected suspensory branches, consistent with insertional fiber injury. The transverse T2-weighted image (Figure 3A) illustrates hyperintensity and fiber disruption within the affected branch, while the frontal T2-weighted image (Figure 3B) demonstrates insertional extension and peri-ligamentous edema, providing comprehensive visualization of osteoligamentous involvement.

These MRI findings are consistent with recent studies demonstrating that MRI frequently identifies concurrent osseous abnormalities in horses with suspensory ligament injury and provides superior lesion characterization compared with conventional imaging modalities (Murray et al 2020). The ability of MRI to detect subtle alterations in signal intensity within both ligamentous fibers and adjacent bone marrow allows differentiation between active inflammatory change, chronic remodeling, and clinically irrelevant structural variation. This distinction is particularly important in insertional pathology,

where the osteoligamentous interface represents a biomechanically complex region subjected to repetitive stress and microtrauma.

Comparative MRI studies have shown that abnormal signal patterns in lame limbs can be distinguished from normal anatomical variations when control limbs are examined, improving diagnostic accuracy (van Veggel et al 2021). This comparative approach is especially valuable in sport horses, in which adaptive remodeling may mimic pathology on conventional imaging. MRI therefore enhances specificity by enabling assessment of lesion distribution, symmetry, and tissue response patterns, reducing the risk of overinterpretation of incidental findings.

Furthermore, advanced imaging research supports the concept that suspensory ligament injury represents a disease of the osteoligamentous unit rather than an isolated soft-tissue disorder (Müller et al 2023). Structural alterations frequently involve cortical bone, subchondral regions, and peri-entheseal tissues, indicating that chronic mechanical overload affects the entire functional unit. This integrated view explains why prognosis and response to treatment may depend not only on fiber disruption but also on the degree of osseous involvement and enthesis remodeling.

Comparison between proximal and distal insertional lesions revealed distinct imaging patterns in the present series. Proximal lesions were more frequently associated with pronounced osseous remodeling, cortical sclerosis, and peri-entheseal changes, reflecting chronic mechanical stress at the osteoligamentous interface. These findings suggest a longer-standing adaptive response to repetitive loading in the proximal metacarpal or metatarsal region. In contrast, distal insertional lesions were characterized primarily by ligament fiber disruption and proximal sesamoid involvement, indicating a different biomechanical environment within the fetlock region. The distribution of forces across the suspensory branches and sesamoid apparatus likely contributes to this variation in imaging appearance.

From a clinical perspective, these findings emphasize the importance of a multimodal imaging approach in the diagnosis of insertional suspensory ligament injuries. Ultrasonography provides essential information regarding ligament integrity, fiber architecture, and insertional thickening (Figure 1). Radiography identifies chronic insertional bone changes, including sclerosis and enthesophyte formation (Figure 2), although interpretation must be performed cautiously due to potential anatomical variation. MRI allows comprehensive evaluation of lesion severity, activity, and extent of osteoligamentous involvement (Figure 3). By combining structural assessment of soft tissue with evaluation of osseous response, clinicians can more accurately determine lesion chronicity and guide therapeutic planning.

The main limitations of this study include its retrospective design, limited sample size, and incomplete availability of advanced imaging in all cases. The absence of uniform MRI examination in every horse may have led to underestimation of subtle osseous changes. Additionally, the descriptive nature of the study does not allow statistical evaluation of prognostic indicators. However, these conditions reflect real clinical practice, where MRI is not routinely performed in every case due to logistical and financial constraints. Despite these limitations, the present study highlights the heterogeneity of insertional suspensory ligament injuries and reinforces the diagnostic value of multimodal imaging, consistent with current evidence in equine diagnostic imaging literature (Murray et al 2020; van Veggel et al 2021; Werpy et al 2021; Dancot et al 2023; Hinkle et al 2023; Müller et al 2023).

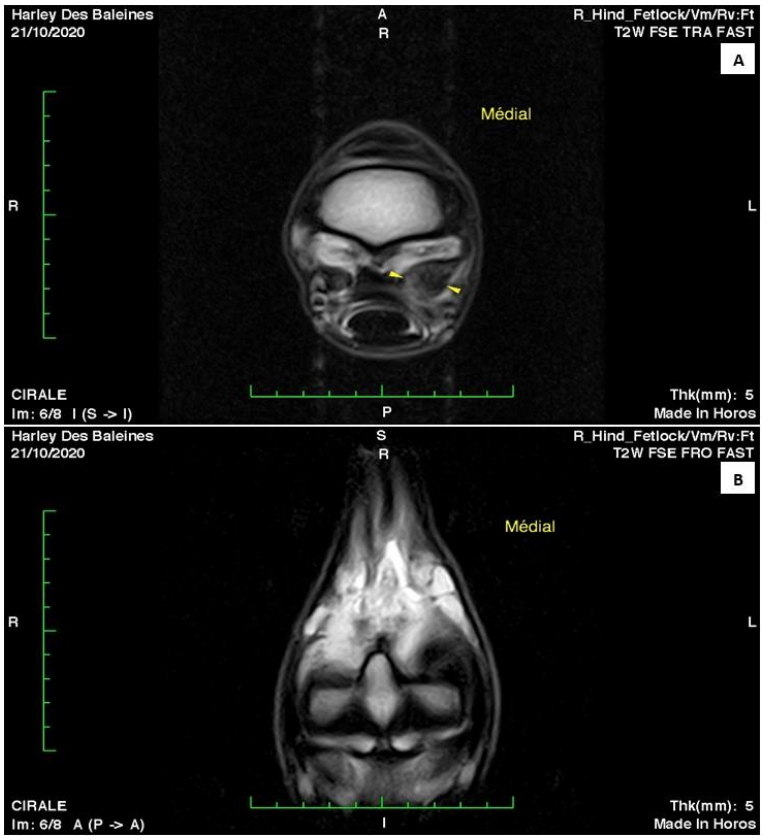

Figure 3. Magnetic resonance imaging findings of insertional suspensory ligament injury. (A) Transverse T2-weighted image of the metacarpophalangeal region showing increased signal intensity and structural irregularity within the affected suspensory ligament branch, consistent with insertional fiber disruption. (B) Frontal T2-weighted image demonstrating insertional hyperintensity and peri-ligamentous edema at the osteoligamentous interface.

Conclusions. Insertional suspensory ligament injury in sport horses represents a complex osteoligamentous disorder involving both ligamentous and osseous structures at the enthesis. The present case series demonstrates that clinical presentation is often characterized by mild to moderate lameness, with imaging findings varying according to lesion chronicity and anatomical location.

Ultrasonography remains the primary imaging modality for initial assessment, allowing identification of structural ligament abnormalities and insertional fiber disruption. Radiography provides essential complementary information regarding chronic osseous remodeling at the osteoligamentous interface, although its diagnostic specificity is limited when used as a standalone modality.

Magnetic resonance imaging enables comprehensive characterization of both soft-tissue and osseous components of insertional injury, allowing detection of subtle ligament signal alterations, insertional edema, and associated bone involvement. These findings support the concept that insertional suspensory ligament injury should be considered a disease of the osteoligamentous unit rather than an isolated ligament disorder.

A multimodal imaging approach integrating ultrasonography, radiography, and advanced imaging techniques when available is therefore essential for accurate diagnosis, lesion characterization, and prognostic evaluation in horses with suspected insertional suspensory ligament pathology.

Despite the limitations related to the retrospective design and small sample size, this study highlights the variability of insertional suspensory ligament injuries and underscores the importance of comprehensive imaging assessment in the clinical management of sport horses.

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