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Original article

Desmopathy of the collateral ligaments of the equine distal interphalangeal joint – a prevalence in Poland between 2016-2019

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Abstract

Desmopathy of the collateral ligaments of the equine interphalangeal joint is caused by a combination of factors, including hoof shape, excessive loading and ground surface. This complex problem poses a diagnostic challenge due to the non-specificity of perineural analgesia and the limitations associated with the most popular imaging methods such as radiography and ultrasonography. The aim of this study was to retrospectively determine the prevalence of desmopathy of the collateral ligaments of the equine distal interphalangeal joint in Poland between 2016 and 2019, and to establish the frequency and type of the associated pathologies. Desmopathy of the collateral ligaments of the distal interphalangeal joint was diagnosed in 14% of 152 horses examined by magnetic resonance imaging (MRI). In 64% of the cases, other changes were observed in the equine digit, and in 36% of the cases, desmopathy was the only diagnosed problem. Desmopathy of the collateral ligaments is not a frequently reported pathology in the distal part of the equine limb. The diagnostic difficulties described in this article suggest that considerable caution should be exercised when formulating the final diagnosis, prognosis and treatment options.

Key words: horses, MRI, collateral ligaments of the distal interphalangeal (DIP) joint

Introduction

The distal interphalangeal joint is a hinge joint with clearly defined movement in the dorsopalmar/dorsoplantar view. The collateral ligaments of the distal interphalangeal joint originate from small depressions in the distal lateral and medial parts of the middle phalanx. The ligaments proceed in the palmar and distal direction and insert at the dorsolateral and dorsomedial aspect of the distal phalanx and the dorsal aspect of ungual cartilages (Denoix 1998). Collateral ligaments are embedded in the articular capsule and are covered with the synovial membrane in the middle part. In the palmar aspect, collateral ligaments are attached

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to the dorsal portion of ungual cartilages by a layer of fibrous tissue. The dorsolateral edge of the ligament is covered by fibrocartilage that separates the lateral and dorsal recesses of the distal interphalangeal joint (Gutierrez-Nibeyro et al. 2011). Collateral ligaments support the distal interphalangeal joint during movement in the sagittal, dorsal and transverse plane (Denoix 1999).

Injuries of the collateral ligaments of the distal interphalangeal joint are caused by asymmetric positioning of the digit, in particular differences in heel height which lead to lateral or medial rotation of the distal phalanx relative to the middle phalanx (movement in the dorsal plane) (Dyson and Murray 2010). Asymmetrical positioning of the digit also leads to the rotation of the middle phalanx, and the upper part of the middle phalanx moves in the palmar direction (movement in the transverse plane), which increases the stress on the collateral ligaments of the distal interphalangeal joint (Dyson and Murray 2010). Horses that frequently jump obstacles, make sharp turns and come to a quick stop are at risk of collateral ligament desmopathy. Dyson et al. (2010) reported a relationship between the degree of hoof cartilage ossification and the prevalence of desmopathy of the collateral ligaments of the distal interphalangeal joint and distal interphalangeal joint injuries. Advanced ossification decreases the elasticity of hoof cartilage and its ability to absorb energy. As a result, the forces acting on the hoof during movement are transferred to the surrounding tissues, which contributes to adaptive changes and injuries (Rouhoniemi et al. 1997).

Ultrasound examination produce diagnostically valuable images, but do not support accurate evaluation of the distal part of the ligaments (Zubrod and Barrett 2007). In ultrasound examination, ligaments are viewed through the coronary band. Due to a relatively narrow acoustic window, only the proximal part of the ligaments can be visualized, which can produce false negative results in diagnoses of desmopathy of the distal attachment. In ultrasound scans, ligament healing and the abolition of lameness are observed after 4.67 months on average (Turner and Sage 2002).

Radiological examination support evaluation of bone surface at the point of ligament attachment, changes in bone structure and enthesophyte detection (Gutierrez-Nibeyro et al. 2009). However, a radiological examination may not produce reliable findings in the early stages of disease after primary injury to the collateral ligaments. Desmopathy of the collateral ligaments of the distal interphalangeal joint was diagnosed by magnetic resonance imaging (MRI) in 31% of 199 horses where hoof injuries had not been detected during ultrasound and radiological examinations (Dyson et al. 2005). The shape, cross-section and structure of entire ligaments can be reliably assessed during MRI examinations.

The aim of this study was to determine the prevalence of desmopathy of the collateral ligaments of the equine distal interphalangeal joint in Poland between 2016 and 2019. Diagnostic difficulties, the specificity of diagnostic analgesia, and the presence of accompanying injuries in the equine digit were also evaluated.

Materials and Methods

Magnetic resonance imaging (MRI) scans of 152 horses were examined in a retrospective study. The horses were admitted to the Clinic of the Department of Surgery and Radiology of the Faculty of Veterinary Medicine at the University of Warmia and Mazury in Olsztyn. Horses with diagnosed desmopathy of the collateral ligaments of the distal interphalangeal joint were selected for further analysis. The animals were transported to the clinic from different regions of Poland. The patients were aged 5 to 10 years, and they weighed 450 kg to 600 kg. All horses presented with unilateral forelimb lameness. The distal part of the lame limb was examined by MRI. The evaluated area was determined based on the results of a clinical examination and diagnostic analgesia.

Results

Desmopathy of the collateral ligaments of the distal interphalangeal joint was diagnosed in 22 (14%) of the 152 horses examined by MRI. In two cases (9%), only ligament thickening without changes in signal intensity within ligament fibers was observed. Pathological changes were noted in the left forelimb in 16 cases (73%) and in the right forelimb in six cases (27%). In all horses, only the lame limb was analyzed. In 16 cases (73%), lameness was abolished by palmar digital analgesia in the middle pastern region, and in six cases (27%) – by palmar digital analgesia at the level of sesamoid bones. In 18 horses (82%), desmopathy was diagnosed in the lateral collateral ligament, and in four horses (18%) – in the medial collateral ligament (Fig. 1). Desmopathy was the only pathological change in eight horses (36%), whereas accompanying injuries were identified in 14 horses (64%), including degenerative changes in the navicular bone, deep digital flexor tendinopathy, distension of the navicular bursa and impar ligament desmopathy (Fig. 2). Increased filling of the distal interphalangeal joint recesses was observed in six cases (27%).

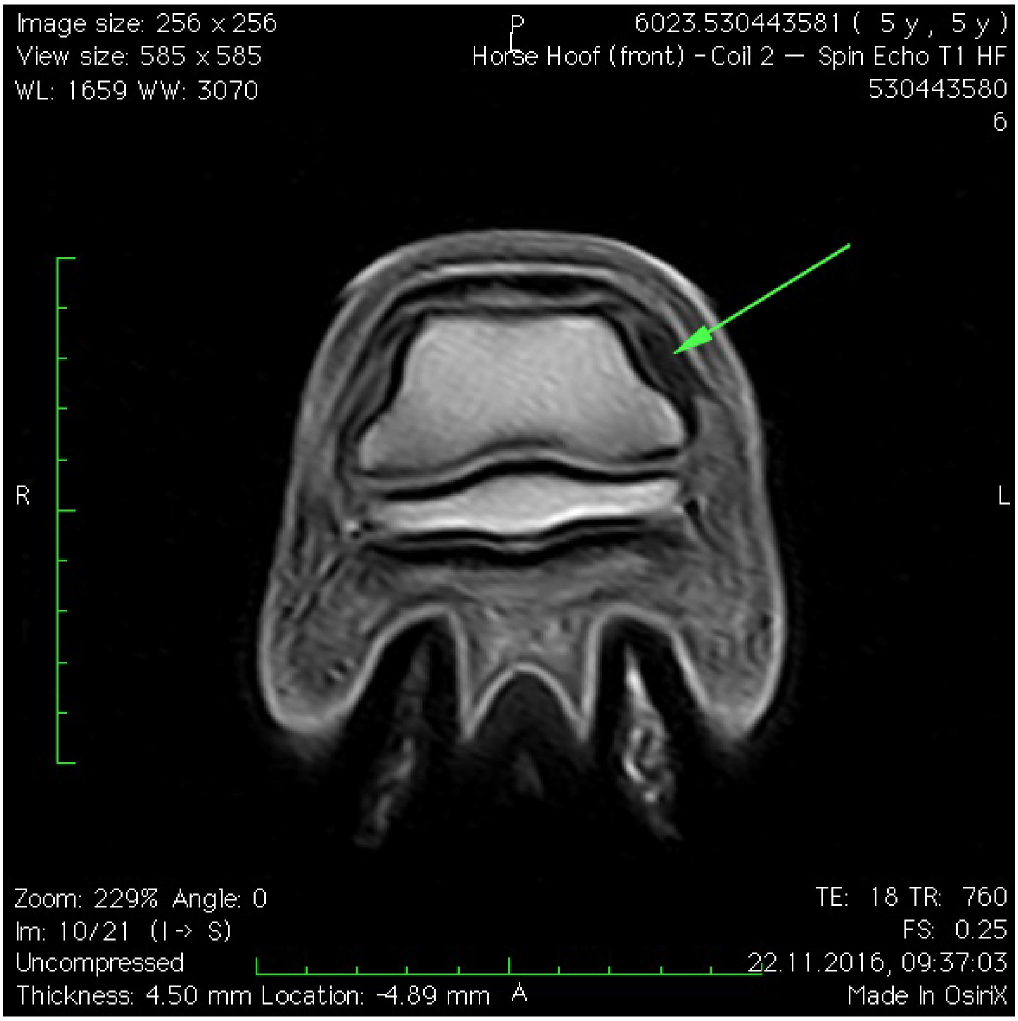

Fig 1. T1-weighted image of the left front limb of the horse. Thickening of the lateral collateral ligament of the distal interphalangeal joint (arrow) with high signal intensity. Bone surface is smooth without visible changes in bone structure.

Discussion

Desmopathy of the collateral ligaments of the distal interphalangeal joint does not produce clear clinical symptoms (Turner and Sage 2002). Lameness is observed when a horse is lunged in a circle on a hard surface. The third phase of the gait cycle, when the interphalangeal joint is in a straight position and the articular capsule and ligaments undergo the greatest stress, is shortened (Denoix 2005). In some cases, swelling is observed in dorsolateral and dorsomedial aspects of the middle phalanx, directly above the coronary band along the ligament line. Increased filling of the distal interphalangeal joint recesses is more frequently reported (Turner and Sage 2002, Dyson et al. 2004), and it is not a specific symptom, but could be indicative of synovial membrane inflammation caused by ligament injury (Ross 2003). In the current study, all horses presented with lameness that was effectively abolished by digital analgesia in the middle pastern region. Desmopathy was accompanied by multiple other pathological changes, which suggests that pain originated mostly from navicular apparatus and, to a smaller extent, from the ligament itself. It is also possible that changes in the collateral ligaments were diagnosed accidentally, whereas navicular injuries were the main source of the problem. Pathological changes were observed mainly in the lateral collateral ligament which is generally more overloaded when hooves are deformed and when the digit is misaligned relative to the hoof axis. Increased filling of the distal interphalangeal joint (in 27% of the cases) suggests that inflammation of the distal interphalangeal joint might be related to collateral ligaments desmopathy.

Lameness caused by desmopathy of the collateral ligaments of the distal interphalangeal joint is usually abolished by perineural block of palmar nerves. Perineural nerve block is a non-specific type of analgesia that can also eliminate lameness caused by other pathologies of the equine digit. Horses respond differently

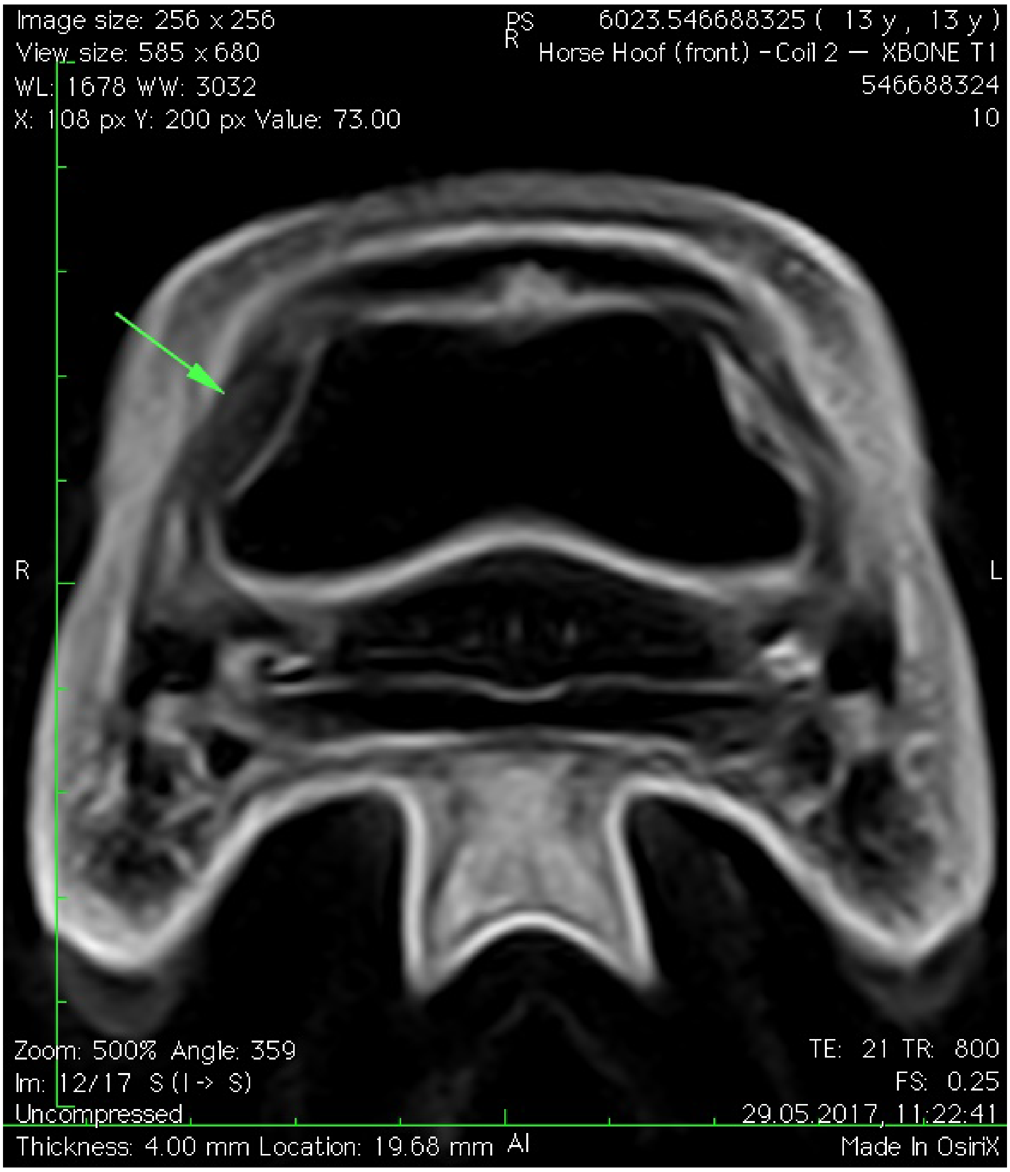

Fig 2. Fat-suppressed image in the XBone T1 sequence of the right front limb of the horse. Thickening of the lateral collateral ligament of the distal interphalangeal joint with an irregular increase in signal intensity (arrow). Small irregularities are visible on the surface of the middle phalanx by the affected ligament.

to palmar digital analgesia, which can be attributed to proximal diffusion of the anesthetic and analgesic effects outside the targeted area. According to estimates, 40% (Dyson et al. 2004) to 90% (Turner and Sage 2002) horses with desmopathy of the collateral ligaments of the distal interphalangeal joint respond to perineural palmar digital analgesia. The anesthetic can be administered to the navicular bursa to determine whether lameness and pain are caused by an injury of the collateral ligaments of the distal interphalangeal joint or the injury of navicular apparatus. However, diagnostic analgesia has certain limitations. The anesthetic can be diffused between the navicular bursa and the distal interphalangeal joint; therefore, the evidence of analgesic efficacy may be unreliable (Gough et al. 2002). Due to the presence of multiple pathologies, desmopathy does not appear to be the main clinical problem. Precise adjustment of diagnostic analgesia combined with a detailed clinical evaluation may be required to determine the further course of action and formulate a prognosis. In the present study, as many as 73% of horses responded to perineural digital analgesia in the middle pastern region, which could suggest that navicular apparatus pathology might be the important cause of lameness. In the work of Gutierrez-Nibeyro et al. (2009), desmopathy of the collateral ligaments of the distal interphalangeal joint was accompanied by increased filling of the interphalangeal joint (in 50% of horses), sesamoid pathologies (45%) and injuries of the deep digital flexor tendon (15%). The results of the present study were partially similar, and desmopathy was the only observed pathology in 22 (36%) of the 152 analyzed horses. These findings indicate that desmopathy of the collateral ligaments of the distal interphalangeal joint is not a frequent problem.

In MRI scans of desmopathy of the collateral ligaments of the distal interphalangeal joint, signal intensity increases within the ligament. However, such scans should be interpreted with caution because asymmetric signal intensity within both ligaments could be related to the magic angle artifact (Spirit and McKnight 2009). The collateral ligaments of the distal interphalangeal joint run obliquely from the proximal attachment to the distal attachment in the lateral and medial aspects of the distal phalanx; therefore, their position relative to the magnetic field can produce the magic angle effect. The magic angle artifact occurs in sequences with short echo time (TE) in tendons and ligaments where fibers are positioned at an angle of 55°±10° relative to the main magnetic field B^0 (Hayes and Parellada 1996, Spiret and Zwingenberger 2009). This position is usually achieved when MRI is performed on a recumbent horse under general anesthesia, and it is less frequently observed in standing equine MRI. However, in standing MRI, limb deformities, in particular valgus and varus alignment, can contribute to changes in signal intensity within the examined structure. When the distal part of the limb is rotated outward, signal intensity increases within the lateral collateral ligament, and when the limb is rotated inward, signal intensity increases within the medial collateral ligament (Spiret and Zwingenberger 2009). Signal intensity within the lateral collateral ligament also increases when the coronary band is raised on the side and when the limb is rotated externally by more than 15° (Spiret and Zwingenberger 2009). Presumably, signal intensity within the medial collateral ligament would also be higher in a limb where the coronary band is raised above the medial line.

Spin echo sequences with long echo time are less susceptible to the magic angle artifact and are more suitable for diagnosing desmopathy (Spiret and McKnight 2009, Werpy et al. 2010, Gutierrez-Nibeyro et al. 2011). The ligament signal can vary. A detailed analysis demonstrated that the center of the proximal part of the ligament is characterized by higher signal intensity than the center of the distal part of the ligament. Higher signal intensity along the edge of the ligament at the level of the attachment to the middle phalanx is a normal phenomenon (Gutierrez-Nibeyro et al. 2011). Increased signal intensity at the proximal and distal attachment is indicative of adaptive fibrocartilaginous metaplasia which is not a pathological process.

Asymmetry of the collateral ligaments of the distal interphalangeal joint can be observed in one or both limbs, and it is not always indicative of ligament injury (Dyson and Murray 2007). However, in most cases, the signal within the lateral and medial ligament is characterized by the same shape, size and intensity. The cross-sectional area of a normal lateral ligament is larger by the proximal attachment to the middle phalanx, and it decreases gradually in the direction of the distal attachment to the distal phalanx (Gutierrez-Nibeyro et al. 2011).

T1- and PD-weighted images support evaluations of ligament anatomy, whereas STIR sequences provide information about ligament inflammation and abnormalities in ligament attachments within the bone (Zubrod and Barrett 2007, Jaskólska et al. 2013). Desmopathy of the collateral ligaments of the distal interphalangeal joint is most effectively visualized as a structural thickening in the cross-sectional view, and it is characterized by higher signal intensity in T1- and T2-weighted images and the STIR sequence (Gutierrez-Nibeyro 2009). Ligament injury can be accompanied by a periosteal reaction at the site of the attachment. A modified signal of the cortical bone and the bone marrow is visualized as areas with lower signal intensity in T1-weighted images and as areas with higher signal intensity in T2*-weighted images and STIR sequences, surrounded by an area with low signal intensity in T1- and T2-weighted images and STIR sequences (Gutierrez-Nibeyro 2009) Bone structure is evaluated with the STIR sequence (Busoni et al. 2005). In fat-suppressed MRI, an increase in bone signal intensity can be indicative of hemorrhage, the presence of synovial fluid, bone necrosis, bone marrow fibrosis or inflammation (Widmer et al. 2000, Busoni et al. 2005, Schramme et al. 2005). In T1- and T2-weighted images and STIR sequences, a decrease in signal intensity can point to bone sclerosis.

Summary

Advanced diagnostic tools are required when lameness associated with digital pain cannot be diagnosed with the involvement of basic imaging modalities. Desmopathy of the collateral ligaments of the distal interphalangeal joint poses a serious clinical problem and a diagnostic challenge in horses where lameness is abolished by palmar digital analgesia. This condition was observed in 31% of 199 horses examined by MRI, but only 29% of the patients returned to functional use for a minimum period of six months (Dyson et al. 2005). In another study of horses with desmopathy of the collateral ligaments of the interphalangeal joint, 60% of the affected animals returned to use for a minimum period of nine months (Gutierrez-Nibeyro 2009).

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