



Partial tear of the long digital extensor tendon in a dog

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ABSTRACT: *The aim of this paper was to describe the clinical and sonographic findings of partial tear at the musculotendinous junction of the proximal long digital extensor tendon during the acute phase and one year after initial presentation. The dog presented with acute, moderate weight-bearing lameness of the right hind limb. During an orthopedic examination of the stifle, the dog expressed pain on extension and flexion of the right knee. Under general anesthesia, no instability was evident. Radiographic images suggested the presence of joint effusion in the right stifle. Ultrasonography revealed that the long digital extensor tendon was hyperechoic, surrounded by an anechoic effusion, and the muscle fibers were disorganized and interspersed with anechoic fluid. Clinical outcome was considered good after conservative treatment. The dog was re-evaluated approximately one year after treatment and did not present with any clinical signs.*

Key words: musculotendinous junction, ultrasound, tendon injury.

Ruptura parcial do tendão extensor digital longo em cão

RESUMO: *O objetivo deste trabalho é descrever os achados clínicos e ultrassonográficos da ruptura parcial do tendão extensor digital longo em sua porção proximal, na junção musculotendínea, durante a fase aguda e um ano após a apresentação inicial. O cão apresentava claudicação aguda e moderada do membro posterior direito. Durante o exame ortopédico, o animal expressou dor na extensão e flexão do joelho direito. Sob anestesia geral, nenhuma instabilidade foi evidente. Imagens radiográficas sugeriram a presença de efusão articular na articulação do joelho direito. A ultrassonografia revelou que o tendão extensor digital longo estava hiperecótico, circundado por efusão anecótica, e as fibras musculares estavam desorganizadas e entremeadas por líquido anecótico. Após o tratamento conservador, a evolução clínica foi considerada satisfatória. O animal foi reavaliado aproximadamente um ano após o tratamento e não apresentou quaisquer sinais clínicos evidentes.*

Palavras-chave: junção musculotendínea, ultrassom, lesão tendínea.

The long digital extensor (LDE) originates from the extensor fossa on the lateral epicondyle of the femur and is protected by a capsular synovial bursa on the lateral aspect of the stifle; it runs through the extensor groove on the craniolateral aspect of the tibia and inserts at the distal phalanx of II-V digits (KENNEDY et al., 2014). This muscle functions to extend the digits and flex the tarsus. Although, the tendon crosses the stifle joint, it has no role in stabilizing the knee (VERHOEVEN et al., 2007). Injuries of the LDE in dogs are rare, but displacements of the proximal tendon, avulsion and mineralization have previously been described (KENNEDY et al., 2014; VERHOEVEN et al., 2007; ROOSTER et al., 2004). There are no reports of a partial tear of proximal LDE tendon at the musculotendinous junction (MTJ) in dogs in the current literature. This paper aimed to

describe the clinical and ultrasonographic findings of this particular injury in a dog at initial evaluation and at the one-year follow-up.

The patient was a 7-month-old female spayed Pitbull, weighing 24.5 kg. She presented moderate and persistent weight-bearing lameness of the right hind limb for 4 days. There was no known history of trauma, and her daily activities included walking and jumping. The dog had a clinical orthopedic examination and underwent general anesthesia for radiography and ultrasonography of both stifles. For anesthesia, the dog was pre-medicated with an intramuscular combination of acepromazine (0.03 mg/kg) and morphine sulfate (0.2 mg/kg). General anesthesia was induced and maintained intravenously with propofol (4 mg/kg for induction and 1 mg/kg for maintenance). Diagnostic

imaging protocols included standard radiographs (VMI Indústria e Comércio Ltd, Lagoa Santa, Brazil) (mediolateral and craniocaudal) and ultrasonographic scanning (GE Ultrasound Korea Limited Company, Songnam, South Korea) of both stifles, using a linear multi-frequency transducer (10-12 MHz).

Upon clinical examination, the dog expressed pain on flexion and extension of the right knee, and there was joint swelling on the cranio-lateral aspect that worsened with flexion. The dog was subjected to an orthopedic examination of the stifle under general anesthesia and had no noticeable medial buttress, patellar luxation, cranial tibial thrust, cranial drawer movement or varus/valgus instability. Radiographs revealed loss of the infrapatellar fat pad radiolucency on right stifle and increased joint space, suggesting effusion (Figure 1A and B). Ultrasound examination revealed the left LDE tendon and MTJ were normal in appearance (Figure 2A); however, in the right stifle, the LDE tendon was hyperechoic and surrounded by an anechoic effusion (Figure 2B). The right LDE muscle fibers were disorganized and interspersed with anechoic fluid as well as with focal hyperechoic and heterogeneous areas (Figure 2C).

Conservative treatment was prescribed, including 30 days of rest, 21 days of the non-steroidal anti-inflammatory drug (NSAID), carprofen (2.2 mg/kg), and physiotherapy including therapeutic ultrasound. Due to some financial constraints of the owner, physical rehabilitation was not performed. Despite that, the dog had progressive improvement in gait over 10 days and was completely sound after 30 days. Approximately one year later, the animal returned for evaluation, without lameness or clinical signs on the affected limb. However, ultrasonographic examination revealed the LDE tendon remained hyperechoic, with a loss of the muscular fiber pattern and a focal hyperechoic area within the muscle (Figure 2C).

The etiology of the partial tear of the LDE tendon was not clear. Similar reports could not be reported, but LDE tendon avulsion and luxation have been previously associated with trauma or athleticism, mostly in immature large breed dogs (ROOSTER et al., 2004; BALTZER, 2012). Although, no known trauma had occurred, the dog was very strong and active, frequently playing with others of the same breed. The dog showed moderate

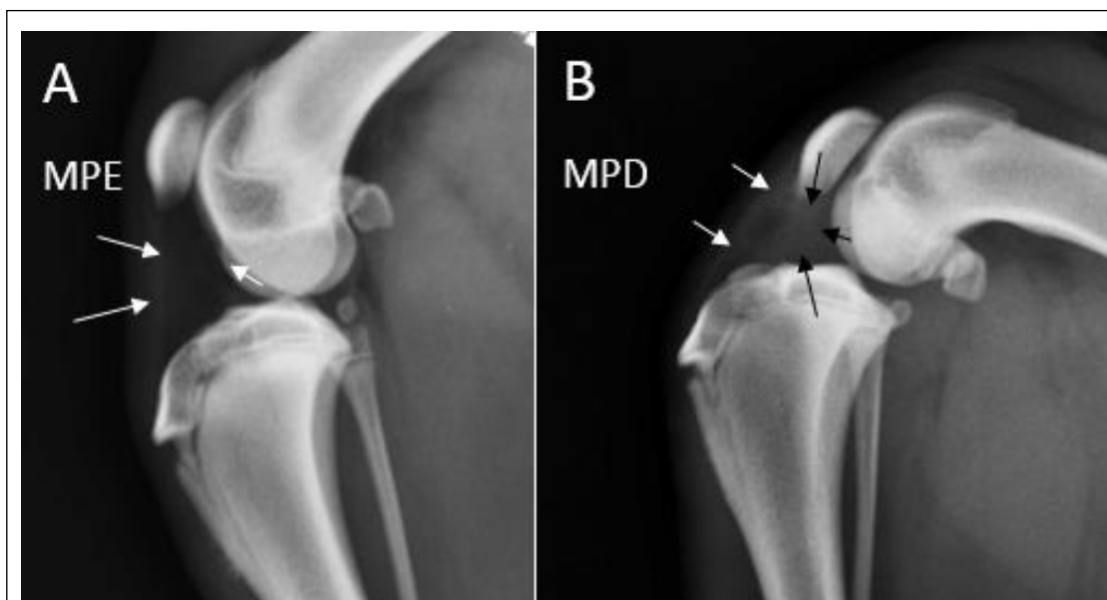


Figure 1 - Mediolateral radiographs of both stifles. A; on the normal stifle (left) the infrapatellar fat pad is represented by a dark radiolucency (white arrows) that reaches the femoral condyles. B; on the right stifle, the smaller dark radiolucency (white arrows) does not reach the femoral condyles. Increased soft-tissue density (black arrows) caudal to the radiolucency is noticed, caused by increased volume of synovial fluid or fat pad edema.

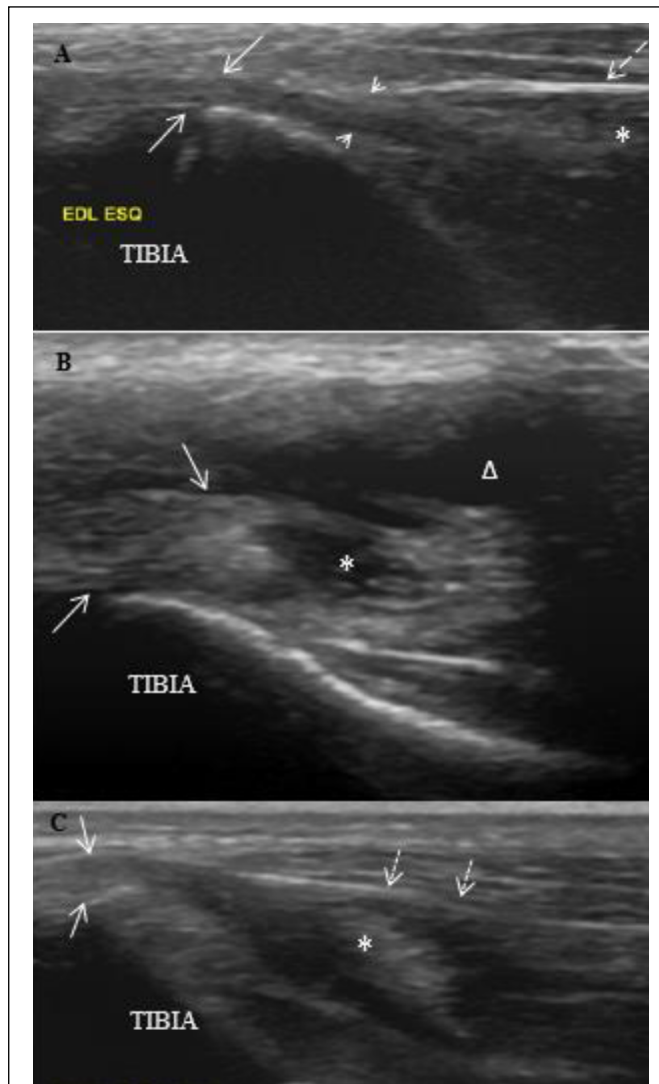


Figure 2 - A; Longitudinal sonographic appearance of left LDE tendon (normal), using a 12 MHz linear transducer. The thin hypoechoic structure (arrowhead) runs delineated by a hyperechoic tendon sheath (solid arrows). On the distal aspect, the MTJ is homogenous and the parallel muscular fibers are seen (*) limited superficially by the hyperechoic muscular fascia (dotted arrows). B; Longitudinal sonographic appearance of the right LDE tendon, using a 10 MHz linear transducer. The tendon is thickened, hyperechoic and the tendon sheath is slightly irregular (solid arrows); an anechoic area, with loss of tissue continuity, is visible in the MTJ (*) evidencing a partial rupture. The anechoic area surrounding the MTJ is notable more superficially (Δ) and the muscular fascia is indefinable. C; Sonographic appearance of the right LDE tendon with a 10 MHz linear transducer one year after the first examination. The tendon is more hypoechoic (solid arrows) than that on the same side one year prior (Fig. 2B) and in the MTJ a focal hyperechoic area is seen with partial loss of continuity and unorganized muscular fibers (*). Although, the hyperechoic fascia is visible (dotted arrows), the muscular fiber parallelism is not observed.

lameness, similar to previous reports of LDE injury, which described pain and hind limb lameness ranging from mild to severe (VERHOEVEN et al., 2007; BALTZER, 2012). There were no pathognomonic clinical manifestations of an LDE disorder noted, unlike the signs of intermittent luxation of LDE (HASIUK et al., 2017). Similar to LDE avulsion, swelling of the lateral part of the stifle joint was evident in this case. In cases of chronic avulsion, this type of swelling can become firm, but in this patient only soft swelling was palpated (VERHOEVEN et al., 2007). Trauma or instability could be secondary to cranial cruciate ligament (CCL) rupture and could also result in injury of LDE tendon, leading to chronic inflammation and mineralization (KENNEDY et al., 2014). Other authors also describe LDE disorders in association with popliteal tendon avulsion and lateral patellar luxation (BARDET & PIERMATTEI, 1983). Therefore, the stifle stability was tested under general anesthesia. The stifle was stable, increasing the suspicion for a primary LDE disorder with or without a popliteal disorder. Radiographs were obtained to evaluate for tendon avulsion and the presence of mineralization, metaplasia, or any other joint abnormalities (KENNEDY et al., 2014; VERHOEVEN et al., 2007). The only abnormalities seen were compatible with joint effusion (FITCH et al., 1997; MARINO & LOUGHIN, 2010).

In order to investigate soft tissue injury, more sensitive techniques were necessary. Ultrasonography is useful for cartilage abnormalities, meniscal tears, muscle, tendon, and ligament abnormalities (MARINO & LOUGHIN, 2010). Although, specific details of LDE tendon sonography have not been described, it is known that the normal tendon runs through the joint surrounded by a tendon sheath. The tendon appears as a thin hypoechoic structure with hyperechoic parallel fibers that can be followed to the MTJ (KRAMER et al., 1999; COOK, 2016). The ultrasound findings showed a large hypoechoic area communicating with the stifle capsule, compatible with a great amount of joint effusion. Disruptions of many of the fibers were evident, seen as a lack of continuity of fiber pattern near the MTJ. Thickening of the tendon and increased echogenicity was noticeable in the muscular fibers around the lesion. Disruption of the fibers and thickening of the tendon are commonly seen in the acute phase of such lesions (COOK, 2016). The ultrasound exam showed an anechoic area where there was acute bleeding secondary to a muscular tear. The tear may be classified as partial or complete and with or without tendinous involvement (MARINO &

LOUGHIN, 2010; KRAMER & GERWING, 1996). The ultrasound findings were compatible with an acute LDE partial tear at the MTJ. The MTJ is the weakest part of the muscle due to the inherent ability of the tendon to withstand higher tensile and strain loads than muscle. Therefore, the MTJ is a common site of injury. Most commonly, tensile overload or overuse results in MTJ injury, which could explain the lesions in the dog in this report (LIN et al., 2004).

Confirmation of muscle rupture can be obtained by ultrasonography and magnetic resonance imaging (MRI), since clinical findings of swelling and local pain only suggested nonspecific muscle damage (MARINO & LOUGHIN, 2010; KIMMENADE et al., 2015). Ultrasound is a safe, non-invasive and low-cost procedure. It can be useful and clinically applicable for the evaluation of most intraarticular structures, tendons and muscles (KRAMER et al., 1999). Although, some authors refer to MRI as having a superior resolution and soft tissue contrast in comparison to ultrasound, others suggested that all the anatomical structures of the stifle identified in the cross-sections correlate between US and MRI (MARINO & LOUGHIN, 2010; SOLER et al., 2007). The depth of the structure and the overlay of osseous structures may limit musculoskeletal US evaluation, but the LDE tendon and its MTJ are relatively superficial structures, which can be easily differentiated, increasing the diagnostic accuracy of the ultrasound technique (COOK, 2016). Because MRI was not available at the institution, the diagnosis was made based on ultrasonographic findings.

Although, surgical treatment has been cited for complete rupture of the distal LDE tendon, in cases of partial muscle tears, conservative management has been recommended (SABIZA et al., 2016; MUELLER et al., 2009; MISTIERI et al., 2018). A retrospective study of 22 cases of hind limb muscle strain injuries showed clinical improvement in most of the dogs with conservative therapy based on rest, physical therapy and NSAID administration (NIELSEN & PLUHAR, 2005). The dog in this case had a good clinical recovery despite not having physical rehabilitation. One year after the initial diagnosis, the dog underwent clinical and ultrasonographic examination. The clinical outcome was excellent. The US findings showed signs of a chronic muscular lesion, with increased tendon echogenicity and muscular heterogeneity with hyperechoic and anechoic areas (COOK, 2016; KRAMER & GERWING, 1996).

Although, LDE displacement and tendon avulsion or mineralization have been previously

described and reports of other muscle tears have been found, no reports refer to clinical and sonographic findings of a partial tear of the LDE (KENNEDY et al., 2014; VERHOEVEN et al., 2007; ROOSTER et al., 2004; BALTZER, 2012; MISTIERI et al., 2018).

Some authors believe that the apparent low prevalence of muscle injury in dogs is related to a failure to diagnose the condition (NIELSEN & PLUHAR, 2005). The identification of muscle injuries in canine patients may be challenging, but imaging tools should be more widely used in conjunction with relevant clinical findings for accurate diagnosis.

DECLARATION BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

We authors of the article entitled "Partial tear of the long digital extensor tendon in a dog" declared, for all due purposes, the project that gave rise to the present data of the same has not been submitted for evaluation to the Ethics Committee of the Universidade Federal do Pampa (UNIPAMPA), but we are aware of the content of the Brazilian resolutions of the National Council for Control of Animal Experimentation - CONCEA "http://www.mct.gov.br/index.php/content/view/310553.html" if it involves animals.

Thus, the authors assume full responsibility for the presented data and are available for possible questions, should they be required by the competent authorities.

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DECLARATION OF CONFLICT OF INTERESTS

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

AUTHORS' CONTRIBUTIONS

Maria Ligia A. Mistieri, Etiele M. Gomes, Endreo A. P. dos Santos and Igor C. K. da Cruz were responsible for veterinary professional conduct. Etiele M. Gomes and Maria Ligia A. Mistieri were also responsible for writing the manuscript. All authors critically revised and approved the submitted manuscript.

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