Opis przypadku *Case report*

Application of different physiotherapy techniques in treating the accessory ligament of the deep digital flexor tendon in the horse: A case report*

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Summary

Tendon and ligament injuries in horses, particularly those of the flexor tendons, are common and can lead to lameness and impaired performance. Healing is typically slow and incomplete, highlighting the importance of early detection and appropriate therapy. This case report presents an 18-year-old Polish Warmblood mare with an injury of the accessory ligament of the deep digital flexor tendon (ALDDFT). The rehabilitation program combined magnetotherapy, laser therapy, and shock wave therapy and was monitored by clinical examination involving ultrasonography and thermography. The integrated therapy effectively reduced swelling, improved tendon echogenicity, and promoted tissue regeneration. Despite the horse's advanced age and delayed initiation of treatment, the outcomes were satisfactory, emphasizing the value of combined therapeutic modalities and complementary diagnostic methods in equine tendon and ligament injury management.

Keywords: equine physiotherapy, lameness, injury, tendon

Tendons and ligaments in horses are strong anatomical structures that can withstand significant loads and tensions both at rest and in motion. They act as force carriers, shock absorbers and have the ability to store and release energy, which makes them susceptible to injury (23, 26).

Interest in injuries to the tendons and ligaments of limbs in horses is rising, as they are an increasingly common issue, causing challenges in working with sports and recreational horses. Injuries to the flexor tendons and ligaments are a major cause of lameness in horses and significantly impact their performance, health, and well-being. Horse owners and trainers believe that tendon and ligament injuries are potentially more dangerous for a horse than fractures (3, 12, 23, 31, 32, 39). Injuries to tendons and ligaments frequently terminate the career of horses of all ages, despite the application of various treatment methods (1, 9, 26, 32). Tendons are slow-healing and poorly regenerating tissues, which is why detecting early stages of pathology quickly and implementing an appropriate therapy can lead to better outcomes in terms of treatment, recovery, and restoration of health and function (23).

Diagnosing and treating tendon injuries requires multi-profile procedures. One of them is ultrasonography, a diagnostic method used to detect and monitor tendon injuries at the metacarpal/metatarsal bone level (12, 32). The use of ultrasonography to detect and monitor tendon injuries in horses greatly increases the ability of veterinarians to accurately diagnose soft tissue injuries and monitor the healing progress (3, 28, 32, 33). Thermography is a non-contact diagnostic imaging method based on detecting infrared radiation emitted in real-time from the surface of the body (7, 8, 10, 11, 36). Color gradients in the image reflect differences in emitted heat. Deviations from the norm can be used to detect inflammatory conditions in horses (8, 11, 13, 34), to monitor the progress of healing (7, 11), and to assess changes in body temperature before and after physical exertion (37). Thermography often provides information about an injury before clinical signs appear. However, it cannot determine the etiology of pathological changes, so it is necessary to complement it with other diagnostic methods (7, 11, 18, 20, 24), such as ultrasonography (7, 34), radiography, or scintigraphy

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(8). A thorough evaluation of tendon injuries requires the application of various diagnostic techniques, each providing complementary information about the condition of the affected structures. In this case report, ultrasonography and thermography were employed to assess and monitor the accessory ligament of the deep digital flexor tendon.

The key characteristics of a laser include the monochromaticity, collimation, and coherence of the beam. Thanks to these features, a large amount of energy can be delivered to a specific location within a short time (16, 25, 30, 41). Laser biostimulation involves applying a laser beam to tissue to facilitate healing and regenerative processes. The interest in laser therapy among physiotherapists and veterinarians continues to grow steadily. This trend is mainly associated with promising research results, the non-invasiveness and safety of the therapy, low treatment costs, and the simplicity of the technique. The introduction of laser therapy into veterinary medicine, especially in pain management for horses, has the potential to improve the quality of life for patients with chronic pain, such as that caused by degenerative joint disease or injuries to tendons and ligaments (41). Laser therapy accelerates regenerative processes in damaged tissues (16, 29, 41). It has been demonstrated that low-level laser therapy (LLLT) facilitates the healing of slow-healing or non-healing wounds in animals, reduces pain and swelling (16, 25, 30), increases collagen synthesis (25, 26), accelerates nerve regeneration (21), and stimulates the development of new muscle fibers (29). The application of LLLT in animals can be an alternative to anti-inflammatory drugs (2).

Extracorporeal shock wave therapy (ESWT) in human medicine has a wide range of applications. In veterinary medicine, the usefulness of ESWT is not fully explored. Some of the earliest documented reports claim that ESWT is a safe and non-invasive method of therapy without serious side effects. Further research in this field may reveal more useful applications of ESWT in horses (4). Extracorporeal shock wave therapy is used in the treatment of many musculoskeletal disorders, such as desmitis or tendonitis (15, 19, 22, 38, 40).

The field of magnetotherapy, especially its applications in equine health, suffers from a significant gap in robust scientific studies. This lack of comprehensive research is particularly evident in the context of its use for tendon and ligament injuries, such as those involving the accessory ligament of the deep digital flexor tendon (ALDDFT) in horses. Variability in the strength of magnetic field, application techniques, and physiological differences between species add layers of complexity that have not been thoroughly explored in equine studies. The current body of literature on the effects of magnetotherapy on equine ligament and tendon injuries is scattered and lacks consistent, conclusive results. In many cases, the exact mechanisms through which magnetotherapy might benefit biological tissues are still poorly understood. Unlike laser therapy or shockwave therapy, which has been supported by a growing number of controlled studies, magnetotherapy lacks a unified protocol and a widely accepted evidence base in the veterinary community. This limited understanding and lack of extensive, controlled research in equine applications underscore a crucial need for further investigation. Well-designed studies could help determine whether magnetotherapy could be an effective, reliable addition to rehabilitation protocols for horses. Given its non-invasive nature and potential therapeutic benefits, a deeper exploration of magnetotherapy could not only improve treatment outcomes, but also broaden options for veterinarians and horse owners seeking holistic rehabilitation methods.

Tendon and ligament injuries, particularly those involving the accessory ligament of the deep digital flexor tendon (ALDDFT), continue to pose diagnostic and therapeutic challenges despite the use of modern physiotherapeutic methods. While individual modalities, such as magnetotherapy, laserotherapy, and extracorporeal shock wave therapy, have shown promise in supporting tissue regeneration, their combined and comparative application in equine patients remains poorly documented. This gap highlights the need for further investigation into integrated physiotherapeutic approaches that could enhance recovery and shorten rehabilitation time in horses suffering from such injuries.

The aim of the study was to evaluate the effectiveness of an integrated physiotherapy protocol for the treatment of ALDDFT injuries in horses, with a particular focus on magnetotherapy, a complementary method whose efficacy in equine tendon and ligament healing remains insufficiently explored.

Material and methods

An eighteen-year-old Polish Warmblood mare was brought in for a clinical examination due to the sudden onset of second-degree lameness in the left forelimb. The degree of lameness was assessed according to the Horse Lameness Grading Scale (AAEP scale), where grade 2 indicates lameness that is difficult to observe at a walk or when trotting in a straight line, but becomes apparent under specific conditions, such as circling, inclines, or hard surfaces (source: Mid Rivers Equine Centre, access 21.11.2025). The examination revealed an increased local temperature and swelling on the lateral side of the proximal third of the metacarpus, which was painful during palpation. The horse's medical history showed no previous injuries in that region. The heart rate and body temperature were within normal limits.

Clinical findings. Due to the location and swelling, there was a suspicion of an injury to the accessory ligament of the deep digital flexor tendon (ALDDFT). To confirm the diagnosis, an ultrasonography examination of the palmar metacarpal region was performed. An ultrasound Esaote MyLab 5 machine with a linear 7.5-12 MHz probe was used. The injury of the ALDDFT was confirmed. Approximately 3 months after the presentation, after the first rehabilitation course, the ultrasound examination was repeated.

Diagnosis. The initial ultrasound examination revealed a severe injury to the accessory ligament of the deep digital flexor tendon. A disruption of tendon fibers and decreased echogenicity were observed, accompanied by the formation of dark spaces indicative of hematoma. The swelling in the proximal third remained consistently visible throughout the entire rehabilitation program, gradually decreasing in tandem with the progression of treatment, as corroborated by subsequent ultrasound imaging.

Treatment. Physiotherapeutic techniques, such as laser therapy and shock wave therapy, were applied according to the available literature on treating this condition. Meanwhile, magnetotherapy was used based on literature recommendations concerning magnetotherapy effects, and because of the limited research in this field, this component was innovative. The parameters and duration of physiotherapy were chosen in accordance with guidelines available in professional literature and equipment manufacturers' recommendations to ensure animal safety while optimizing therapeutic outcomes. The physiotherapy interventions were selected for their complementary effects in supporting tissue regeneration.

The rehabilitation process was supervised by a veterinarian and a licensed equine physiotherapist certified in physiotherapeutic treatment of musculoskeletal disorders in horses. For the first five days, the mare received nonsteroidal anti-inflammatory drugs to reduce the swelling and inflammation. The initial phase of rehabilitation involved hand-walking and light lunging exercises. One week after the injury, the horse began with 5 minutes of hand-walking, which was gradually increased to 30 minutes over a one-month period. Box rest, coupled with hand-walking, continued for three months. Rehabilitation commenced two months after the injury diagnosis.

The rehabilitation protocol included daily magnetotherapy sessions for a week, followed by intervals of 3 and 4 days, spanning a total of 6 weeks (Tab. 1). Boot applicators were placed on both forelimbs during each 30-minute session. Laser therapy with a Ga As 904 head was administered twice a week concurrently with magnetotherapy.

In the second phase of rehabilitation, lunging work was introduced, primarily at a walk with 1-2 minutes of trot, gradually increasing trot duration. Shock wave therapy was introduced after 6 months, comprising six treatment sessions at weekly intervals (Tab. 2).

Tab. 1. Parameters of magnetotherapy treatments

Treatment number	Generator frequency (Hz)	Emitter frequency (Hz)	Intensity (mt)	Pause (sec.)	Time (min.)
1-7	4	3000	2	1:2	30
8-14	12	3000	5	1:2	30
15-17	25	3000	10	1:2	30

Tab. 2. Parameters of extracorporeal shock wave therapy treatments

Treatment number	Frequency (Hz)	Pressure (Ba)	Number of strokes
1	5	2.0	2000
2	10	2.5	2000
3	12	3.0	2000
4	16	3.5	2000
5	20	4.0	2000
6	22	5.0	2000

During the rehabilitation period, physiotherapy, magnetotherapy (G-Pulse 210 µP/300 Emitter; generator parameters intensity: 0.5-10 mT, frequency: 1-25 Hz), laser therapy (laser As Gs 904, penetration depth: 3-4 cm, frequency: 700 Hz, peak power: 25 Hz), and shock wave therapy (BTL-5000 SWT POWER; pressure: 1-5 Ba, frequency: 1-22 Hz) were used. The thermographic images were performed using an FLIR T250 thermal imaging camera (resolution: 320 × 240, spectral range: 7.5-13 µm, temperature: –20°C to + 350°C). Thermographic examinations were consistent with established measurement standards in veterinary medicine (27).

Results and discussion

The damage to the ALDDFT was verified (Fig. 1). Repeated ultrasound examinations revealed a gradual

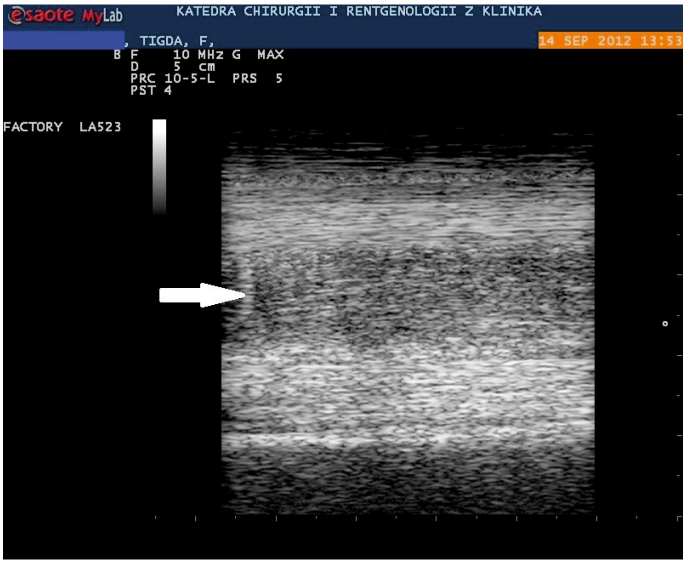

Fig. 1. Ultrasound image formed in zone B, frequency of probe – 10 MHz. Arrow marks ALDDFT. Evident thickened ligament with decreased echogenicity and chaotic arrangement of collagen fibers

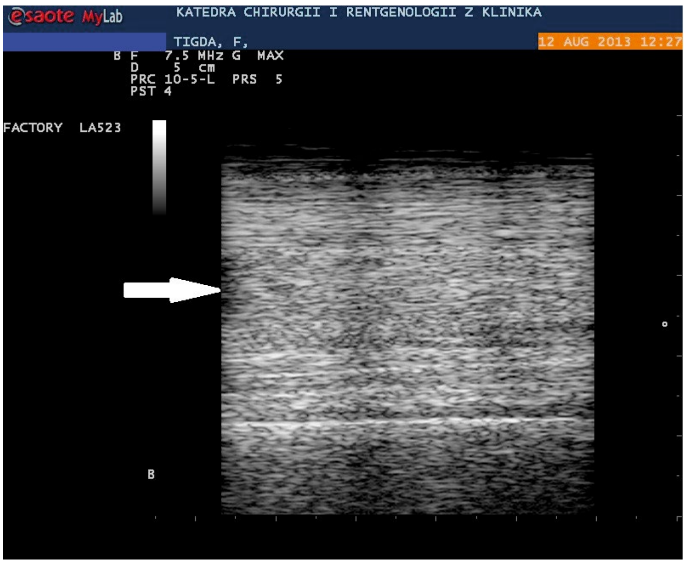

Fig. 2. Ultrasound view of ALDDFT (arrow) at the end of the rehabilitation process

improvement in tendon echogenicity, indicating an ongoing rebuilding process with initially chaotic but progressively more organized fiber alignment. By the end of the rehabilitation, a substantial improvement in echogenicity and parallel fiber arrangement was observed (Fig. 2).

Thermographic monitoring was performed at one-month intervals (Fig. 3), showing a gradual decrease in surface temperature within the affected area, consistent with a reduction of inflammation and tissue regeneration. However, the diagnostic value of thermography was partially limited by coat trimming in the distal part of the limb, required for ultrasonographic evaluation. Final thermographic examination, performed at the end of the rehabilitation period, revealed a decrease in surface temperature within the affected region, accompanied by normalization of thermal distribution (Fig. 4).

Swelling was present around the injured ligament throughout the rehabilitation period. After the initiation of extracorporeal shock wave therapy (ESWT), a significant reduction in swelling was observed and maintained even without physical exercise. The physiotherapeutic program effectively promoted regeneration of the ALDDFT injury and reduced swelling, which confirmed its therapeutic efficacy. The combination of laser therapy and magnetotherapy produced superior regenerative effects compared to their individual use.

Aging in horses leads to physiological and structural changes, including slower collagen fiber regeneration and reduced elasticity of soft tissues, which may prolong the healing process (35). In this case, the advanced age of the horse likely contributed to delayed tissue recovery despite appropriate therapy.

Our findings align with previous studies indicating that ultrasonography remains the most reliable diagnostic method for monitoring tendon healing and structural changes in the DDFT (1, 12, 32, 33). Similarly, thermography has been shown to complement ultrasonographic assessments in detecting early inflammatory processes and in monitoring rehabilitation outcomes (7, 8, 11, 34). The decrease in surface temperature observed in our study corresponds with reports by other authors (8, 14) who noted comparable thermal responses to ESWT and laser therapy.

Although research on magnetotherapy in horses is limited, existing studies suggest beneficial physiological effects without adverse hematological or biochemical changes (17). Our results support these findings, indicating that magnetotherapy can safely stimulate tissue regeneration when used as part of a combined rehabilitation program.

Laser therapy has been documented to accelerate tissue repair and reduce inflammation in both experimental and clinical equine cases (16, 25, 29, 41). In our study, laser application combined with magnetotherapy enhanced tissue regeneration and reduced swelling, confirming the synergistic effect of these modalities.

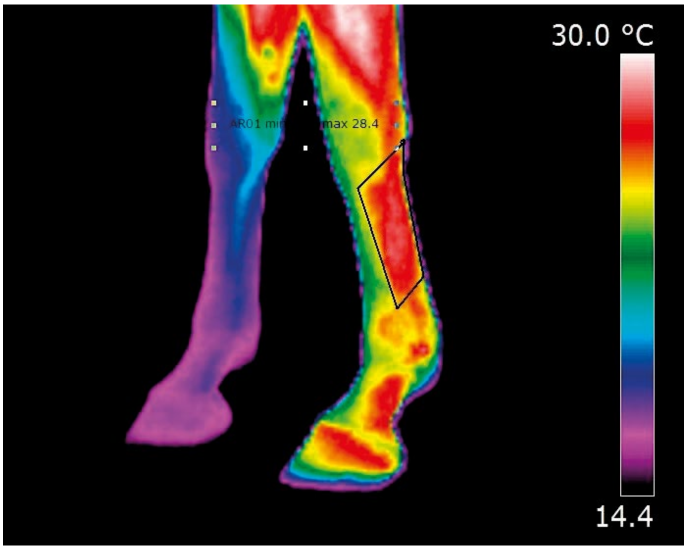

Fig. 3. Thermal image around the damaged ALDDFT. Evident significant increase in heat emission in this region

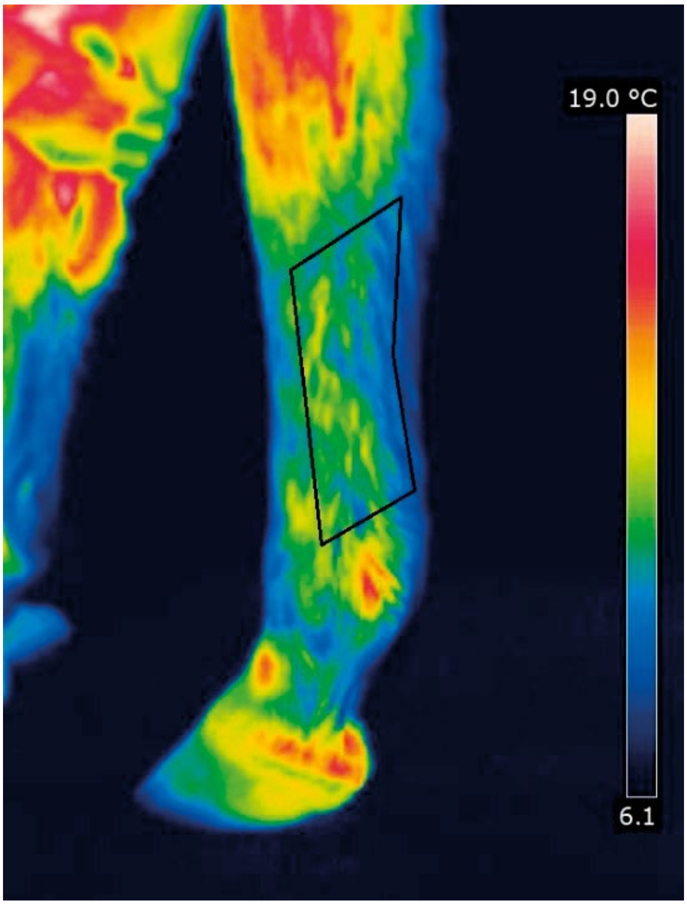

Fig. 4. Thermographic image of the distal limb after completion of rehabilitation, showing normalization of surface temperature in the previously injured area

ESWT is recognized as a safe and non-invasive method in equine orthopedics, capable of reducing pain, improving tissue perfusion, and stimulating collagen synthesis (3-5, 15, 18, 39). The improvement in echogenicity and swelling reduction observed in our case are consistent with literature reports describing similar outcomes following ESWT in horses with desmitis or tendonitis (6, 18, 40).

In the presented case of an 18-year-old Polish Warmblood mare with an injury to the accessory ligament of the deep digital flexor tendon (ALDDFT), the combined application of magnetotherapy, laser therapy, and extracorporeal shock wave therapy (ESWT) proved effective in promoting tissue regeneration and reducing swelling. Ultrasonographic and thermographic monitoring confirmed a gradual improvement in tendon echogenicity and normalization of surface temperature, indicating progressive healing. Despite the patient's advanced age and delayed initiation of treatment, the integrated physiotherapeutic program resulted in a satisfactory clinical outcome and functional recovery. The case demonstrates that multimodal physiotherapy, when tailored to the horse's condition, can significantly enhance the healing of chronic tendon and ligament injuries. Further studies involving larger clinical samples are recommended to establish standardized rehabilitation protocols for similar conditions in horses.

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