EFFECTS THE PULSED ELECTROMAGNETIC FIELD ON THE SUPERFICIAL DIGITAL FLEXOR TENDONITIS IN DONKEY: SONOGRAPHY STUDY

Ashraff waleed abdulrazaq, Fereidoon Saberi Afshar*

Majid Masoudifard*

College of Veterinary Medicine, University of Basra, Basrah, Iraq

*College of veterinary medicine, University of Tehran, Tehran, Islamic Republic of Iran

Keywords: superficial digital flexor tendonitis, collagenase enzyme, donkey.

Corresponding Author: ashraff2013g@gmail.com

ABSTRACT

The aim of this study was to determine the effects of pulsed electromagnetic therapy on the collagenase enzyme induced tendonitis in donkeys. Under sonogram guidance, 1000 IU of collagenase enzyme were injected in the core of superficial digital flexor tendon of right and left forelimbs of each donkey (5 donkeys, 10 forelimbs). Clinical evaluations of the injected tendons were performed to assess heat, response to palpation, swelling presence, and lameness grade according to American Association of Equine Practitioners (AAEP) for two week. The sonograms of the superficial digital flexor tendons were recorded prior to injections and at days 3, 7 and 14 after the injection. When the inflammation was stabilized in two weeks, all forelimbs were divided into equal treatment and control groups. Pulsed electromagnetic therapy (600 Gauss, 50 Hz) used for treatment group for two weeks (14 days) and control group remained without any treatment. In both groups the lesion percentage, the echogenicity score, and fiber alignment score at the maximum injury zone were measured by sonogram images. Clinically 1000 IU of collagenase enzyme can induce acute tendonitis that established in two weeks. After used pulsed electromagnetic therapy for two week, sonographically, in treatment group, the results showed better scores have been obtained with time in regard to "the lesion percentages", "echogenicity" and "fiber alignment" in compare to control group. On the basis of these results can be concluded that pulsed electromagnetic therapy is a simple, inexpensive and noninvasive method with positive and encouraging effects for treatment of the superficial digital tendonitis in donkeys.
INTRODUCTION

Tendons connect muscle to bone and allow transmission of force by muscle to bone, resulting in joint movement (1). The flexor tendons of lower limbs are important weight bearing structures at rest and during locomotion. Between the two flexor tendons, the SDFT is more commonly injured than the deep digital flexor tendon (DDFT). Tendon damage may occur as a result of either overstrains of tendon or a traumatic penetrating injury (2). Tendon injuries may have a clinical or subclinical phases, the clinical phase can be divided into acute (inflammatory), sub-acute (reparative), and chronic (remodeling) stages. The acute inflammatory phase starts at the onset of injury and last 1-2 weeks (3). Clinicians, when evaluating a tendon injury, need to evaluate heat, response to digital pain, and swelling. Heat and pain could be evaluated according to four point scale from normal to sever (normal: 0; mild: 1; moderate: 2; sever: 3). Accuracy assessment of the mid-metacarpal swelling was accomplished through measuring of the mid-metacarpal circumferences, medio-lateral width, and the dorso-palmar thickness (4, 5) and, lameness grade was evaluated by (6). Ultrasonographic evaluations have been used for the diagnosis of soft tissue injuries in horses, basically, ultrasonography has been introduced as an appropriate method for the assessment of morphological changes in the tendon and ligament structure (7, 8), and it is known as one of the most accurate and non-invasive tools to evaluate the tendon structure after an injury (9). The echogenicity and fiber alignment of the core lesions, were considered the major ultrasonographic diagnostic criteria of the severity of the injured tendon (10). The ability to accurately induce uniform tendons injuries are very important in studies designed to evaluate and compare new treatments for injured tendons. Various methods were studied for finding an experimental model to standardize tendon injuries. The use of a bacteria-derived collagenase was explored for induce tendon damage enzymatically, resulting in lesions similar particulars to those occurring naturally (9, 11, 12, 13). Tendon repair involves an inflammatory phase, angiogenesis, cell proliferation, collagen production, remodeling stages, intrinsically via proliferation of epitenon and endotenon tenocytes, or extrinsically via invasion of cells from the surrounding sheath and synovium (14). In the new researches are using to repair the superficial digital flexor tendonitis in equine biological therapy (intralesional injection) such as platelet rich plasma, growth factor and hyaluronic acid. Other researches are using physical therapy such as laser, electrical shock wave and magnetic field therapy (15, 16, 17). In general physical medicine and in particular magnetobiology can provide noninvasive, safe and easy to stratify methods to direct repair the site of damage or
source of pain, inflammation and dysfunction (18). Electromagnetic stimuli interact with cells either via transmembrane receptors or ion channels (19, 20). Pulsed electromagnetic therapy used to repair pain and edema in soft tissue. It has been shown act at the cellular level stimulating different cell functions, overall cell proliferation and differentiation (21, 22, 23). The aim of this study was to determine the effects of pulsed electromagnetic therapy on the injured superficial digital flexor tendon.

**MATERIALS AND METHODS**

**Animals:**
Five apparently clinically healthy adult donkeys, with a mean age of 3 years (range 2-4 years) and the mean weight 125 kg (range 100-150 kg) were included in this study. All donkeys were evaluated clinically and bilateral ultrasonography examination of the SDF T performed to rule out pre-existing tendon affection. The present study was approved by the Committee of Animal Welfare and Ethics, Faculty of veterinary medicine, Tehran University.

Donkeys were divided into two equal groups, and each group consisted of 5 limbs (five forelimbs right and five forelimbs left):

In order to create the tendinitis, collagenase enzyme (type I collagenase: C-0130, sigma. USA) were injected at the mid SDFT of both forelimbs (The dosage of collagenase enzyme and its volume were 1000 IU and 0.1 milimeter respectively) these area evaluated by clinical signs and sonography at day 3, 7 and 14 after the injection.

After the inducing of tendinitis in all limbs (left and right), these limbs divided randomly into two treatment and control groups (five limbs in each group). The daily treatments with pulsed electromagnetic field began at day 14 and finished at day 28. The time for the exposure of affected limbs with pulsed electromagnetic field in treatment group was 15 minute twice daily. At the end of the treatment the sonographic examination was repeated at day 28. The control group left without any treatment. The duration of monitoring in all animals was 42 days.

**Collagenase enzyme injections in SDFT (24)**

All forelimbs were clipped and prepared with routine aseptically method. The reference marks were made at 2 cm intervals starting 2 cm below descending accessory carpal bone (DACB) and extended distally 16 cm with permanent markers.(Fig 2) The all animals sedated
with xylazine hydrochloride (0.5 mg/kg, IV) (Manufactured by interchemie werken "De Adelaar" B.V. Metaalweg 8 Venray, Holland) and a 27-gauge needle was inserted into each tendon via its lateral border by ultrasonographic guidance to confirm that the tip of the needle was completely in the middle of the tendon. (Fig 3) The dosage of 1000 IU was injected in all forelimbs (the volume of collagenase enzyme was 0.1 ml in each groups).

Clinical examination

The clinical points of interest were evaluated at 3, 7, and 14 days after induction and record in clinical score index, Swelling digital palpation (Score 0-3) or (normal, mild, moderate or severe), heat (digital palpation & thermal band) (Score 0-3) or (Normal=36°, Mild=37°, moderate=38°, sever=39°), Pain reaction: digital pressure (Score 0-3) or (normal, mild, moderate or severe) Lameness: inspection (Grade 1-5) (4, 25).

Ultrasonographic evaluation

The tendons were assessed by using Sonosite Micromax Ultrasonographic Machine (company) with a 10-13 MHz transducer prior to injection, and at 3, 7, 14, 28 and 42 after the injection of collagenase enzyme in the treatment and control groups. Both sagittal and transverse planes were obtained in weight bearing animals every two cm from 2-16cm below DACB. Different ultrasonographic points were evaluated and recorded in ultrasonographic
index scores. The method for examination and score, Percentage lesion (lesion CSA/tendon CSA × 100) at the maximum injury zone (MIZ) and the echogenicity score determined based on a scale of (0-3) (0= Normal to near normal echogenicity; 1= Mostly echogenic 25-50% loss of echogenicity; 2= 50 % anechoic and 50 % echogenic; 3= Mostly to completely anechoic) and the fiber alignment: based on the linear arrangement of the echoes in the longitudinal images, scored between 0-3 (0=Parallel fiber pattern in 76-100 % of fibers; 1=Parallel fiber pattern in 51-75 % of fibers; 2= Parallel fiber pattern in 26-50 % of fibers; 3=Parallel fiber pattern in 0-25 % of fibers), (26, 27).

Magnetic apparatus

This apparatus consist of parts: 1-power supply*, this convert alternative current (AC) of electricity to direct current (220 V, 50 Hz). 2- Magnetic coil**-modified magnetic silk has these characteristic by (type grad P1/2L, Hz, diameter 21 mm). A coil has 1000 turns isolated by special plastic materials. 3-compass: use to indicate the magnetic direction. 4-Gauss-meter or magnetometer***: we can measurement the magnetic field. After collagenase injection and inflammation induced, the animal in treated groups were treated with pulsative magnetic field (600 Gauss, 50 Hz), therapy was applied by direct contact of source of magnetic field (center of magnetic coil) opposite the dorsal surface at the site of tendon for 15 minutes twice daily for 14 days (from 14-28 days for experimental design).

Statistical analysis

Data was statistically analyzed by One-Way ANOVA with multiple comparison tests using statistical software program (SPSS for windows version 20, USA) Differences were considered significant at (P ≤ 0.05).

RESULT

Clinical signs:

The heat, pain, swelling and lameness recorded after had injected the collagenase enzyme in the SDFT. In summary the mean heat and pain showed significant changes (P<0.05) at day 3 and disappeared at day 7, in day 14 did not show any meaningful changes in regards to these criteria (P>0.05). The swelling showed significant changes (P>0.05) at all times (2.5±0.129), and the lameness showed meaningful changes at days 3 and 7, these changes gradually decreased at day 14 after had injected the collagenase enzyme.
Table (1): The clinical indices after injected collagenase enzyme (Mean ±SE)

<table>
<thead>
<tr>
<th>Clinical signs</th>
<th>Time</th>
<th>Group (1000 IU) Mean±SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>After 3day</td>
<td>2.92 ± 0.083</td>
</tr>
<tr>
<td></td>
<td>After 7day</td>
<td>0.17 ± 0.167</td>
</tr>
<tr>
<td></td>
<td>After 14day</td>
<td>0</td>
</tr>
<tr>
<td>Heat</td>
<td>After 3day</td>
<td>3 ± 0.00</td>
</tr>
<tr>
<td></td>
<td>After 7day</td>
<td>0.5 ± 0.224</td>
</tr>
<tr>
<td></td>
<td>After 14day</td>
<td>0</td>
</tr>
<tr>
<td>Pain</td>
<td>After 3day</td>
<td>2.5 ± 0.129</td>
</tr>
<tr>
<td></td>
<td>After 7day</td>
<td>2.5 ± 0.129</td>
</tr>
<tr>
<td></td>
<td>After 14day</td>
<td>2.5 ± 0.129</td>
</tr>
<tr>
<td>swelling</td>
<td>After 3day</td>
<td>2.75 ± 0.112</td>
</tr>
<tr>
<td></td>
<td>After 7day</td>
<td>2.33 ± 0.105</td>
</tr>
<tr>
<td></td>
<td>After 14day</td>
<td>0.5 ± 0.224</td>
</tr>
<tr>
<td>lameness</td>
<td>After 3day</td>
<td>2.75 ± 0.112</td>
</tr>
<tr>
<td></td>
<td>After 7day</td>
<td>2.33 ± 0.105</td>
</tr>
<tr>
<td></td>
<td>After 14day</td>
<td>0.5 ± 0.224</td>
</tr>
</tbody>
</table>

Sonographic assessments after collagenase enzyme injections

The lesion percentages, echogenicity and fiber alignment in SDFT are recorded before and after the collagenase injections. Briefly the mean lesion percentages are showed statistically significant changes after the injections at day 3, 7 and 14 after the injections of collagenase enzyme in comparison with before the injections (P<0.05). Also these changes are significant between day 3 and 7 but no significant changes were seen between day 7 and 14 all animals.

Sonographic assessments after the treatment with electromagnetic field

After the establishments of collagenase induce tendinitis, the daily treatment with pulsed electromagnetic field began at day 14 and continued up to 2 weeks. The lesion percentages, echogenicity and fiber alignment in SDFT were improved continuously with time. Although the duration of treatment was 2 weeks (until day 28) but the daily monitoring for more than that showed continuous improvement of the tendon structure until day 42 (P<0.5).(tables 3,4, 5, 6, 7) (figures 4, 5, 6,7,8) . and (Figure sonography in control and treatment group 9-22)
Table 3: lesion study for treated and control group

<table>
<thead>
<tr>
<th>Lesion</th>
<th>0day</th>
<th>3day</th>
<th>7day</th>
<th>14day</th>
<th>28day</th>
<th>42day</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>0 Aa</td>
<td>10.6±0.72 Bb</td>
<td>12.79±0.87 Cc</td>
<td>12.10±0.75 Bb</td>
<td>11.00±0.76 Bb</td>
<td>10.08±0.76 Bb</td>
</tr>
<tr>
<td>Treatment</td>
<td>0 Aa</td>
<td>10.56±1.13 Bb</td>
<td>12.86±1.21 Cb</td>
<td>12.24±1.21 Bb</td>
<td>7.39±0.72 Dd</td>
<td>4.17±0.55 Ee</td>
</tr>
</tbody>
</table>

*Capital letter different between groups  *Small letter difference within groups

Figure 4: lesion study for treated and control group

Table 4: tendon study for treated and control groups

<table>
<thead>
<tr>
<th>Tendon</th>
<th>0day</th>
<th>3day</th>
<th>7day</th>
<th>14day</th>
<th>28day</th>
<th>42day</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>42.86±1.64 Aa</td>
<td>50.14±1.44 Bb</td>
<td>56.16±1.33 Cc</td>
<td>54.97±1.40 Cc</td>
<td>52.99±1.61 Cc</td>
<td>51.09±1.70 Cc</td>
</tr>
<tr>
<td>Treatment</td>
<td>41.55±2.49 Aa</td>
<td>48.51±2.29 Bb</td>
<td>55.54±2.01 Cc</td>
<td>54.69±1.89 Cb</td>
<td>47.86±1.73 Bb</td>
<td>43.62±2.27 Aa</td>
</tr>
</tbody>
</table>

*Capital letter different between groups  *Small letter difference within groups

Figure 5: Tendon study for treated and control groups
Table 5: Lesion percentage study for treated and control groups

<table>
<thead>
<tr>
<th>Lesion %</th>
<th>0 day</th>
<th>3 day</th>
<th>7 day</th>
<th>14 day</th>
<th>28 day</th>
<th>42 day</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>0 Aa</td>
<td>20.49±1.03 Bb</td>
<td>22.82±0.96 Bc</td>
<td>22.11±0.82 Bc</td>
<td>20.67±0.79 Bc</td>
<td>19.62±0.83 Bc</td>
</tr>
<tr>
<td>Treatment</td>
<td>0 Aa</td>
<td>21.21±1.35 Bb</td>
<td>22.40±1.50 Bb</td>
<td>21.76±1.33 Bb</td>
<td>15.36±1.04 Cc</td>
<td>9.46±0.84 Dd</td>
</tr>
</tbody>
</table>

*Capital letter difference between groups *Small letter difference within groups

Figure 6: Lesion percentage study for treated and control groups

Table 6: Echogenicity study for treated and control groups

<table>
<thead>
<tr>
<th>Echogenicity</th>
<th>0 day</th>
<th>3 day</th>
<th>7 day</th>
<th>14 day</th>
<th>28 day</th>
<th>42 day</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>0 Aa</td>
<td>1.70±0.13 Bb</td>
<td>2.42±0.07 Cc</td>
<td>2.38±0.04 Cc</td>
<td>2.22±0.04 Cc</td>
<td>2.00±0.08 Ee</td>
</tr>
<tr>
<td>Treatment</td>
<td>0 Aa</td>
<td>1.67±0.07 Bb</td>
<td>2.44±0.01 Cc</td>
<td>2.39±0.08 Cc</td>
<td>1.88±0.04 Dd</td>
<td>1.24±0.09 Ff</td>
</tr>
</tbody>
</table>

*Capital letter difference between groups *Small letter difference within groups

Figure 7: Echogenicity study for treated and control groups
Table 7: Fiber alignment of treated and control groups

<table>
<thead>
<tr>
<th>Fiber alignment</th>
<th>0day</th>
<th>3day</th>
<th>7day</th>
<th>14day</th>
<th>28day</th>
<th>42day</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>0 Aa</td>
<td>1.72±0.12 Bb</td>
<td>2.34±0.05 Cc</td>
<td>2.30±0.03 Cc</td>
<td>2.22±0.05 Cc</td>
<td>1.98±0.07 Dd</td>
</tr>
<tr>
<td>Treatment</td>
<td>0 Aa</td>
<td>1.72±0.10 Bb</td>
<td>2.42±0.07 Cc</td>
<td>2.37±0.07 Cc</td>
<td>1.90±0.05 Dd</td>
<td>1.22±0.09 Ee</td>
</tr>
</tbody>
</table>

*Capital letter different between groups *Small letter difference within groups

Figure 8: Fiber alignment of treated and control groups
Figure: (9, 10): sonography figures (sagittal and transverse) at day 3 after injection collagenase enzyme in control group. Figure (11, 12): sonography figures (sagittal and transverse) at day 7 after injection collagenase enzyme in control group. Figure (13, 14): sonography figures (sagittal and transverse) at 28 day. Figure (15, 16): sonography figures (sagittal and transverse) at day 42.
Figure (17, 18): sonography figures (sagittal and transverse) at day 3 after injection collagenase enzyme in treated group. Figure (19, 20): sonography figures at day 7 after injection collagenase enzyme in treatment group. Figure (21, 22): sonography figures at day 28 treated for two week (14-28 day) with electromagnetic field. Figure (23, 24): sonography figures at day 42.
DISCUSSION

The first step for the diagnosis of tendonitis is the clinical evaluations. For this reason clinicians need to assess the tendonitis by palpation of the injured area and detect local heat, pain response, local swelling and appearance of the tendon. The degree of lameness is the important criteria to evaluate the severity of the tendonitis too. According to the present study, increased local heat, pain reaction, swelling of the metacarpal region, and lameness were seen. These findings are deredconoc by the other researchers too. (2, 9). Damage to a tendon causes hemorrhage, inflammation, heat and swelling and then followed by fibroblastic proliferation, collagen production and remodeling. (27). Minor tendon traumas may cause low grade inflammation of injured part which will become warmer than the same parts on the other limb. Slight strain may not always induce lameness. In case of the major damage, the limb probably become very painful and the animal may be severely lame. Physical remedies such as ice application, hydrotherapy, and bandaging and stalls rest have been the fundamental policy of treatment in the acute cases of tendonitis where a decrease of inflammation is indicated to neutralize of devastating proteolytic enzymes on the remaining intact tendon matrix. (28). Dehghan et al., 2007 showed the enzyme takes some time to induce and stabilize local tendonitis in SDFT.

Sonographically the lesion of acute stage was characterized by decreased or losses of a normal tendon echogenicity with complete absence of normal characteristic pattern in transverse and sagittal plane. (7). Ultrasonographic evaluations have been used for the diagnosis of soft tissue injuries in horses, basically, ultrasonography has been introduced as an appropriate method for the assessment of morphological changes in the tendon and ligament structure (7, 8), and it is known as one of the most accurate and non-invasive tools to evaluate the tendon structure after an injury. (9). In this study all lesions proliferated from 1-7 days following collagenase injection, and then stabilized between 7 -14 days. The same results were reported by (3). He showed the acute inflammation phase begins on the onset of injury and last 1-2 weeks. At this moment ultrasonographic assessments in order to detect degree of echogenicity changes and fiber irregularities found ranged between 1.5 and 2.2. The anechoic or hypoechoic lesion observed at this time correspond to areas of hemorrhage, edema, and fiber disruption (3). The echogenicity and fiber alignment of the core lesions, were considered the major ultrasonographic diagnostic criteria of the severity of the injured tendon (10). In the present study the injection of 1000 IU collagenase in animals induced
moderate to severe tendonitis that began at day 3 and gradually increased with time. The acute tendonitis were seen in all animals and lasted more than 1 week. The ability to accurately induce uniform tendons injuries are very important in studies designed to evaluate and compare new treatments for injured tendons. Various methods were studied for finding an experimental model to standardize tendon injuries. The use of a bacteria-derived collagenase was explored for induce tendon damage enzymatically, resulting in lesions similar particulars to those occurring naturally. In this study the injection of 1000 IU collagenase enzyme can produce acute tendonitis and at least due to the sonographic and clinical parameters this kind of tendonitis is close to what happens in normal field situations and can use as a standard method to induce acute superficial digital flexor tendonitis in donkeys. Echogenicity and fiber alignment of the tendons are the basis for evaluation of tendon injury. The tendon echogenicity assessment is dependent in both equipment setting and the scanning technique of the operator. Measurement cross sectional area is the most valid and accurate measurement technique for detection of the tendon damage. The lesion site gradually fills with hypoechoic amorphous echoes that should represent granulation tissue and immature tissue. Echogenicity of the damage area gradually increment and the demarcation between the injured and uninjured tendon become less distinct. A central core lesion appears sonographic calls as a discrete anechoic or hypoechoic area within the center of the tendon. The Fiber damage to the tendon injury appears as an anechoic or hypoechoic region lacking a parallel fiber pattern. Ultrasonography technique is considered one of the most accurate diagnosis tools in the early stage, and advanced healing lesions; this technique is widely used to assess the tendon lesions severity and progression. The application of ultrasonographic technique for the diagnosis of flexor tendon damages in equine has provided a safe and non-invasive objective for examinations of tendon shape, echogenicity, and fiber alignment as indicators for the phase of tendon repairing. Ultrasonographic assessments of the tendon for accurate are performed two sonographic views: longitudinal, to observe the normal alignment of the tendon fibers and the other is transverse, vertical to the mid-point of each area, to acquire structural dimensions. Pulsed electromagnetic fields are commonly used because they decrease edema and improve microcirculation by facilitating water engulfment. Pulsed electromagnetic field therapy inhibits inflammatory edema, accelerates hematoma resolution, increase microcirculation, and reduces the number of neutrophils. The ultrasonographic finding during 14 days with pulsed electromagnetic therapy in treatment group revealed more improvement in regard to the lesion percentages, echogenicity and fiber...
alignment in SDFT in comparison to control group. A few studies on the clinical effect of Pulsed electromagnetic field therapy on tendon or ligament repair have been reported (34). Pulsed electromagnetic therapy could affect membrane-mediated signal transduction processes, modulating cell proliferation, gene expression, and activity of cytokines and growth factors involved in the inflammatory response and in tissue repair, such as FGF-2 (fibroblast growth factor-2), VEGF (vascular endothelial growth factor), NFkB (nuclear factor kappa B), and IL-1B (interlockine-1B) (35, 36, 37, 38). In this study the ultrasonography in treatment group during 28 days showed gradually increase in echogenicity and better organization in fiber alignments. There are a lot of researches that refer to the positive effects of pulsed magnetic field on injured tendons. Pulsed electromagnetic field therapy used in the treatment persistent rotator cuff tendinitis and possibly other chronic tendon lesions had been reported previously by Binder (39). Strauch et al., 2006 studied the effect of pulsed electromagnetic therapy on tendon, showed better collagen alignment, reduction of inflammation, and a better return to histologic normality (40). A logical explanation for the repair of injured tendon have been stated by some investigators. They have mentioned Pulsed electromagnetic fields may play a role for repair of tendinopathy and for tendon regeneration, by increasing TGF-β (transforming growth factor-beta) production in vitro (41).

On the basis of ultrasonography, pulsed electromagnetic therapy at day 28 resulted in increased echogenicity and the fibers appeared more parallel and more organized. These findings have also been reported by (42). They showed that pulsed magnetic field can specifically increase collagen production, the major differentiated function of fibroblasts, possibly by altering cyclic-AMP (adenosine monophosphate) metabolism. Pulsed electromagnetic field therapy successfully increases membrane flexibility by increasing the synthesis of collagen, a crucial protein that supports membrane elasticity, within the fibroblast (42). The progressive enhance of core lesions echogenicity, gradual fiber alignment and progressive decrease of lesion CSA observed in this study. These findings showed better tendon healing in treatment group. The electromagnetic group revealed significant (p≤0.05) improvement of core lesion CSA at day 14 and 28 after treatment. In the treatment group, pulsed electromagnetic revealed significant improvement of echogenicity and fiber alignment score at day 14 and 28 (p≤0.05). The same findings have been recorded in racing Thoroughbred by Zuffove and co-workers (43).
CONCLUSION

Optimistically, pulsed electromagnetic therapy has the potential to revolutionize the treatment of superficial digital flexor tendonitis in sport horses, which is currently dominated by pharmaceutical and surgical interventions. This method is a new therapeutic tool and may be developed for future clinicians to provide noninvasive treatments with low risk of side effects and no problem with drug interactions, however to verifying or reject these results especially in horses further research is recommended.

REFERENCES


3-Karlin W.M. (2010). Equine superficial digital flexor tendon evaluation using low field magnetic resonance imaging and ultrasonography Thesis Submitted in partial fulfillment of the requirements for the degree of Master of Science in VMS-Veterinary Clinical Medicine University of Illinois at Urbana-Champaign.


