Open Journal of Therapy and Rehabilitation, 2015, 3, 63-69
Published Online August 2015 in SciRes. http://www.scirp.org/journal/ojtr
http://dx.doi.org/10.4236/ojtr.2015.33009

The Effectiveness of the Functional Magnetic Stimulation Therapy in Treating Sciatica Syndrome

Tamara Radaković[1*], Nikola Radaković[2]

[1]Faculty of Medicine, Novi Sad, Serbia
[2]Center of Integrative Medicine "CIM", Novi Sad, Serbia
Email: *tamara.radakovicc@gmail.com, ratatam1@gmail.com

Received 2 June 2015; accepted 7 July 2015; published 10 July 2015

Abstract

Introduction: Degenerative or traumatic causes are most common in generating sciatica syndrome, which is normally treated with well-known physical therapy methods. A relatively new way of treating sciatica problems is so-called functional magnetic stimulation (FMS), whose principle is based on electromagnetic field inducing electrical field inside the body. Electrical field triggers action potential of nerve cells and that way stimulates peripheral motor nerve system. Aim: Aim of this study is to measure and estimate the effectiveness of implementing therapy with functional magnetic stimulation in regular physical treatment of sciatica syndrome. Materials and Methods: 28 male patients aged between 30 and 55 with back problem were recruited on an outpatient basis. FMS therapy was performed with TESLA Stym® device (Iskra Medical d.o.o., Slovenia) treating lumbosacral region equally on both sides of the spine. Physical examination was performed to evaluate tree parameters: the mobility of the lumbar spine in flexion and extension, together with the straight leg raise test (Lasegue sign). We estimated patients' progress, comparing angle values of mobility from the first examination day with other examination days. Results: In FMS treated group of patients, lumbosacral flexion, extension and Lasegue test angle were significantly higher compared to day 0 on the first physical examination day (day 3) ($p < 0.05$). In control group such increase of a measured angle was not noticed until a second physical examination day (day 5) or a third physical examination day (day 8) ($p < 0.05$). Discussion: Results in this study showed that applying FMS therapy along with other standard physical therapy methods rapidly increased effectiveness of the treatment of sciatica syndrome (*lat. ischialgia*). It suggests that functional magnetic therapy could be suggested as a regular physical therapy method in treating this kind of pain syndromes.

*Corresponding author.

How to cite this paper: Radaković, T. and Radaković, N. (2015) The Effectiveness of the Functional Magnetic Stimulation Therapy in Treating Sciatica Syndrome. *Open Journal of Therapy and Rehabilitation*, **3**, 63-69.
http://dx.doi.org/10.4236/ojtr.2015.33009

Keywords

Sciatica Syndrome, Lasegue Sign, Functional Magnetic Stimulation, FMS

1. Introduction

Functional magnetic stimulation (FMS) of peripheral nerves and muscles is based on the principle of electromagnetic induction. Functional magnetic field is generated by a pulse of current created through a wire inside a coil in the applicator of TESLA Stym® device [1]. Dynamic magnetic field up to 1.5 T inside the body induces electric current that is responsible for triggering action potential on motor nerve system [2]. This direct stimulation of motor neurons [3] results in contraction of the muscle or a group of muscles, depending on the number of axons affected. Key advantage of direct nerve stimulation is in inducing its metabolism, perineural circulation and nutrition. Therefore, FMS is a suitable option for treating neuropathic diseases, radiculopathies and plexopathies [4]. FMS induced muscle stimulation can be used for preventing muscle atrophy while it simultaneously increases blood circulation [5].

Sciatica syndrome (SS) (low back pain, *lat. ischialgia*) represents a collective term for various symptoms like: low back pain, severe muscle spasm, reduced mobility of lumbosacral region, radicular pain, positive Lasegue sign, paresthesia in specific dermatome, reduced sense for touch, and sometimes even paresis and hypotrophy of a muscle [6]. Degenerative or traumatic causes are most common in generating sciatica syndrome. Causes can be: disk protrusion or extrusion, osteochondrosis and osteophytosis, anterolisthesis and retrolisthesis, spondylosis, osteoporosis and malformation of lumbosacral vertebrae, fractures, neoplastic infiltrations, compressive tumors and infections [7]. Mechanical or musculoskeletal problems are defined as the cause in almost 90% of the cases [8] [9], while 75% of them do not have a specific cause identified, but are thought to be due to muscle strain or injury to ligaments [8] [9]. Other causes such as fibromyalgia and somatoform disorders are not diagnosed so often as the ones previously mentioned [9].

Low back pain is a very common symptom around the world. When we look at the global picture, about 40% of people experience low back pain at some point in their lives [10], with estimates as high as 80% of people in the developed countries [11]. It is estimated that 9% to 12% of people (around 632 million) have low back pain at any given point in time, while 23.2% of them report having it at some point over any one-month period [10] [12]. This common symptom usually manifests between 20 and 40 years of age [13]. Sciatica syndrome is most commonly diagnosed at age between 40 and 80, with the overall number of individuals affected expected to increase as the population ages [10]. This is why developing modern and more efficient therapeutic approaches for sciatica syndrome is very important.

Standardized medical approach to this problem consists of complete and qualitative diagnostics, physical treatment, and then, if needed, surgical procedure.

Standard physical treatment of the SS is a set of therapies of few combined well-known physiotherapy procedures: diadynamic current (DDC), interference current (IFC), ultrasound (US), laser, electromagnet, massage, traction, IR lamp, application of fixed and mobile ventouses and kinesiotherapy. High field magnetic therapy has already been shown as an effective alternative method in back pain treatment [14] [15].

Aim of this study is to measure and estimate the effectiveness of implementing therapy with functional magnetic stimulation in regular physical treatment of sciatica syndrome.

2. Material and Methods

Twenty-eight male patients aged between 30 and 55 with back problem were recruited on an outpatient basis. Patients were treated in Center of physical medicine and rehabilitation "CIM" in Novi Sad, Serbia during the time period from November 2013 until March 2014. All the patients included in the analysis were diagnosed with *sy. lumbale ac.ishialgia l. dex*. More detailed characteristics are shown in **Table 1**.

Patients were randomly divided into two groups. Each patient received personally adapted physical therapy consisting of 12 consecutive daily sessions. The therapy comprises a combination of three therapy procedures (DDC, IFS, US, lasers, massage, traction, IR lamps, fixed suction cups, kinesiotherapy). Control group of 14 patients received regular physical therapy on daily basis. FMS treated group of 14 patients received 20 minutes of

FMS therapy every other day in addition to the daily regularly physical therapy. The therapeutic scheme for both groups of patients is represented in **Table 2**. FMS therapy was performed with TESLA Stym® device (Iskra Medicald. o.o., Slovenia) using the large movable applicator, treating lumbosacral region equally on both sides of the spine. Specific combination of amplitudes and frequencies, named as "Program no. 2" on this device was used in treatments. This combination was used since the most patients subjectively found it as the most relaxing.

Physical examination was performed to evaluate tree parameters: the mobility of the lumbar spine in flexion and extension, together with the straight leg raise test (Lasegue sign). These three parameters (flexion, extension, Lasegue test) were assessed in *angles*, measured with goniometer [16] [17]. Follow-up examinations were performed on the 3rd, 5th, 8th and 12th day of therapy and included the same tests [**Table 2**]. Patients were instructed not to consume painkillers, non-steroidal anti-inflammatory drugs, opioids or other anti-rheumatic drugs during the 12 days of therapy. We estimated patients' progress, comparing angle values of mobility measured on the first examination day (examination before the beginning of the therapy) with values measured on the examination performed on the 3rd, 5th, 8th and 12th day of therapy. We compared it using statistical t-test and one-way ANOVA on each examination day. Statistical analyses were performed using Statistica version 10 software (StatSoft, USA) [18].

The study was study was conducted in accordance with the Helsinki Declaration. Informed consent was obtained from all patients before the first treatment.

3. Results

3.1. Flexion in Lumbosacral Region

Figure 1 indicates lumbosacral flexion measurement on a daily basis. Firstly, there was no difference between the control and FMS treated group on day 0, before the first treatment. In FMS treated group of patients, lumbosacral flexion angle was significantly higher compared to day 0 on the first physical examination day (day 3). In control group such increase of a measured angle was not noticed until a second physical examination day (day 5).

3.2. Extension in Lumbosacral Region

Figure 2 represent measured angles in lumbosacral extension after the therapy. Again, there was no difference between the control and FMS treated group on day 0, before the first treatment. In FMS treated group of patients, lumbosacral flexion angle was significantly higher compared to day 0 on the second physical examination day (day 3). In control group such increase of a measured angle was not noticed until a third physical examination day (day 8).

3.3. Lasegue Sign. Strait Leg Test (Flexion)

Measured angles by performing Lasegue test showed noticeable increase in motion in the FMS treated group.

Table 1. Summarized characteristics of patients enrolled in this study.

	Diagnose	Number of patients	Age	Sex
Control group	sy. lumbale ac. ischalgial.dex.	14	42.4 ± 6.99	Male
FMS group	sy. lumbale ac. ischalgial.dex.	14	43 ± 6.27	Male

Table 2. Therapy schedule scheme. *Orange colour* represents days with regular physical therapy for control and FMS treated group; *Red colour* represents 20 minutes of FMS therapy (FMS treated group only); *Blue colour* represents physical examination (control and FMS treated group).

Days	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
Standard physical therapy												
FMS therapy												
Physical examination												

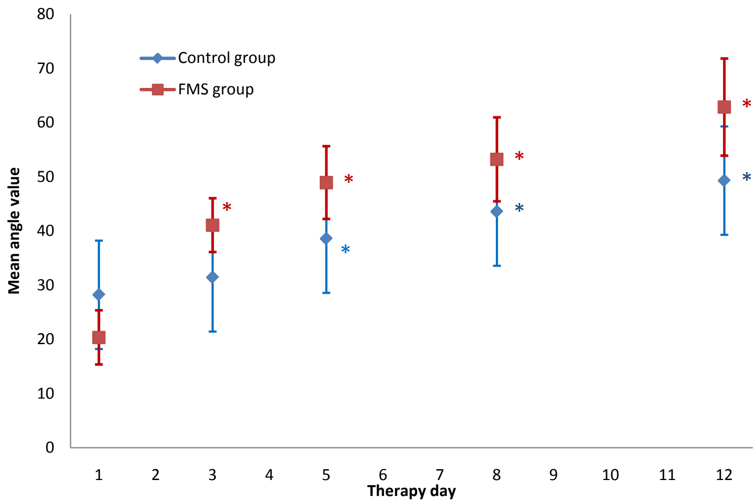

Figure 1. Lubmosacral flexion angle for control and FMS treated group for every day of therapy. Statistical significance is marked with *(p < 0.01).

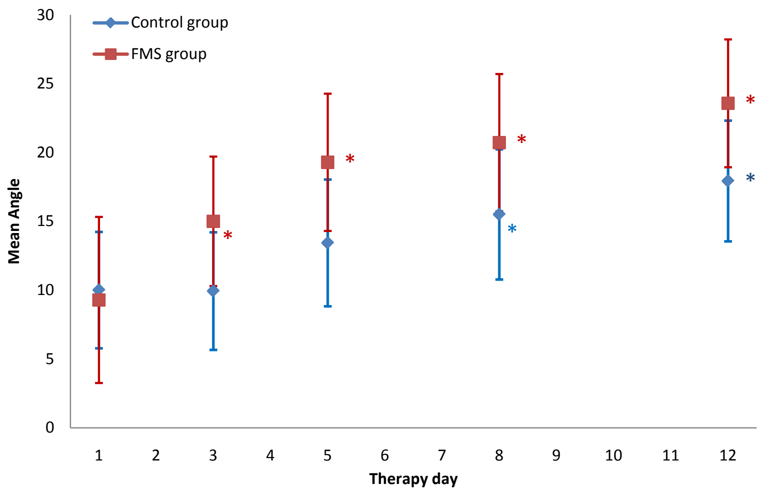

Figure 2. Extension in Lubmosacral region for control and FMS treated group for every day of therapy. Statistical significance is marked with *(p < 0.05).

Statistical t-test showed significant difference in second group of patients already on the first examination after first physical examination day (day 3) while significant increase in motion was measured on second physical examination day (day 5) in the control group (**Figure 3**).

4. Discussion

Since the first achievements in training and counteracting atrophy [19]-[21], neuromuscular electrical stimulation has opened up several additional fields for applications. Today, it plays an indispensable role in rehabilitation, physiotherapy [22] and treatment of chronic low back pain [23]. Ratajczak B *et al.* (2011) showed that diadynamic currents (DDC) and transcutaneous electrical nerve stimulation (TENS) have analgesic effect in treating sciatic syndrome (*lat. ischialgia*) [24]. However, electrical stimulation shows several crucial drawbacks. A number of issues reflect badly on this very promising and potent method: not only the stimulation-related pain [25], but also the limited force response, electrochemical degradation effects near the electrodes [26] [27] and limited penetration of the current into the muscle because of the parallel paths through the surface tissue layers. In contrast, functional magnetic neuromuscular stimulation (FMS) is less painful and allows profound activation

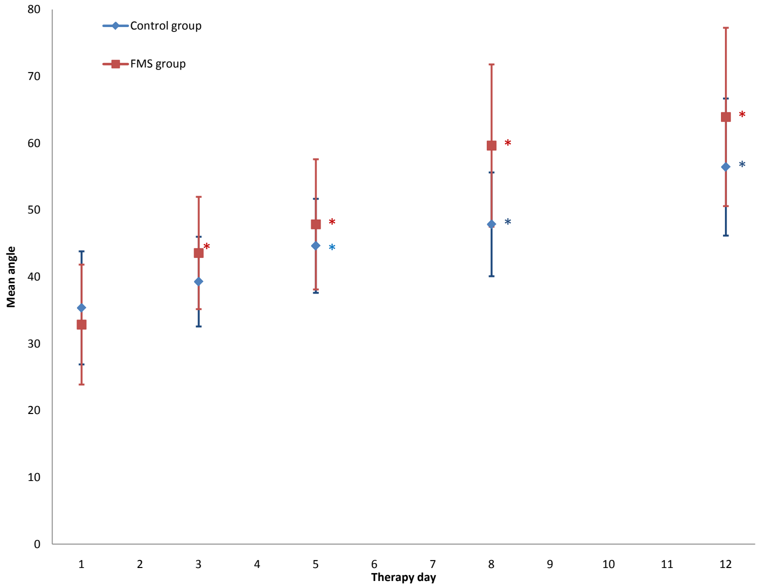

Figure 3. Lasague test angle for control and FMS treated group for every day of therapy. Statistical significance is marked with *($p < 0.05$).

of muscles at the level approaching maximal voluntary contraction [28]. The aforementioned regularly used physical procedures have a limited effect on all local structures and surface tissues due to the basic underlying principles of electricity, ultrasound and light in human tissue. Their effects depend on skin resistance, moisture and resistance of other tissues, tissue water content and many other factors. Due to all these, these physical procedures only achieve effects at limited depths.

On the other hand, FMS works by the principle of magnetic field, whose intensity does not depend on the characteristics of the local tissue. FMS propagation depth is up to 7 - 10 cm deep inside the tissue. FMS therapy can also be used similar like electrotherapy with various positive noticeable effects like muscle training, increased circulation, oxygenation and rehabilitation process of nerve and muscles, reduced muscle spasms and inflammatory processes.

Analyzing values measured in this study, we have compared values within the group, but not between the groups, since every group of patients has their own characteristics and individual progress. Statistics followed each group of patient's own mobility improvement during the therapy time. Significant statistical results show that improvements of patient's mobility are more rapidly achieved by adding functional magnetic stimulation to the regular physical therapy treatment.

There are reports on multiple acute and chronical locomotors system problems being relieved or solved using FMS. These include tissue regeneration after muscular or tendon injuries, relieving pain effect, preventing and reducing muscular and nerve atrophy, muscle spasms, reducing intra-articular calcifications and foremost treating conditions due to pelvic floor muscle problems. In the literature, there are reports showing significant improvement due to conditions of female stress and urge incontinence [29]-[31]. The success in treating symptoms of female urge incontinence additionally shows [31] [32] that functional magnetic field is also affecting smooth muscles structures during few weeks of therapy. Further studies are expected to show more profound knowledge of FMS effect on vegetative nervous system. FMS effect of directly depolarizing nerve cell in transcranial magnetic stimulation (TMS), using similar magnetic fields, is used for decades in diagnostic as well as therapeutic application in treating neurological and psychiatric disorders [33]. Use of the magnetic muscle stimulation in locomotory system stimulation was long hindered by overheating of the devices within minutes of their continuous use [34]. Applications in physical therapy and rehabilitation require magnetic stimulators with capability of continuous use for hour(s) while imitating output signal parameters used in electrical neuromuscular stimulation. Such magnetic stimulators have only recently been available; therefore further studies are needed to rigorously determine true potentials of FMS.

Results in this study showed that applying FMS therapy along with other standard physical therapy methods rapidly increased effectiveness of the treatment of sciatica syndrome (*lat. ischialgia*). Most of the patients also have reported significant low back pain relief already after first therapy with FMS (TESLA Stym®). This leads us to the conclusion that functional magnetic therapy could be suggested as a regular therapy method in treating sciatica syndrome and similar medical conditions.

References

[1] Taylor, L.J. (2007) Magnetic Muscle Stimulation Procedures Fatigue without Effort. *Journal of Applied Physiology*, **103**, 733-734. http://dx.doi.org/10.1152/japplphysiol.00660.2007

[2] Barker, A.T. (2002) Principles of Magnetic Stimulator Design. In: Pascual-Leone, A., Davey, N.J., Rothwell, J.C., Wassermann, E.C. and Puri, B.K., Eds., *Handbook of Transcranial Magnetic Stumulation*, Arnold, London, 3-17.

[3] Machetanz, J., Bischoff, C., Pichlmeier, R., *et al.* (1994) Magnetic Induced Muscle Contraction Is Caused by Motor Nerve Stimulation and Not by Direct Muscle Activation. *Muscle & Nerve*, **17**, 1170-1175. http://dx.doi.org/10.1002/mus.880171007

[4] Man, W.D., Moxham, J. and Polkey, M.I. (2004) Magnetic Stimulation for the Measurement of Respiratory and Skeletal Muscle Function. *European Respiratory Journal*, **24**, 846-860. http://dx.doi.org/10.1183/09031936.04.00029004

[5] Bustamante, V., Gorostiza, A., Lopez de Santamaria, E. and Galdiz, J.B. (2007) Magnetic Stimulation of the Quadriceps: Analysis of 3 Stimulators Used for Diagnostic and Therapeutic Applications. *Archivos de Bronconeumología*, **43**, 411-417. http://dx.doi.org/10.1016/S1579-2129(07)60093-7

[6] Vogt, M.T., Cawthon, P.M., Kang, J.D., Donaldson, W.F., Cauley, J.A. and Nevitt, M.C. (2006) Prevalence of Symptoms of Cervical and Lumbar Stenosis among Participants in the Osteoporotic Fractures in Men Study. *Spine* (*Phila Pa* 1976), **31**, 1445-1451. http://dx.doi.org/10.1097/01.brs.0000219875.19688.a6

[7] Engstrom, J.W. and Deyo, R.A. (2011) Back and Neck Pain. *Harrison's Cardinal Manifestations and Presentation of Diseases Part* 2, **2**, 129-142.

[8] Manusov, E.G. (2012) Evaluation and Diagnosis of Low Back Pain. *Primary Care*, **39**, 471-479. http://dx.doi.org/10.1016/j.pop.2012.06.003

[9] Cohen, S.P., Argoff, C.E. and Carragee, E.J. (2008) Management of Low Back Pain. *BMJ*, **337**, a2718. http://dx.doi.org/10.1136/bmj.a2718

[10] Hoy, D., Bain, C., Williams, G., *et al.* (2012) A Systematic Review of the Global Prevalence of Low Back Pain. *Arthritis & Rheumatism*, **64**, 2028-2037. http://dx.doi.org/10.1002/art.34347

[11] Menezes Costa, L.C., Maher, C.G., Hancock, M.J., McAuley, J.H., Herbert, R.D. and Costa, L.O.P. (2012) The Prognosis of Acute and Persistent Low-Back Pain: A Meta-Analysis. *CMAJ*: *Canadian Medical Association Journal*, **184**, E613-E624. http://dx.doi.org/10.1503/cmaj.111271

[12] Chou, R. and Shekelle, P. (2010) Will This Patient Develop Persistent Disabling Low Back Pain? *JAMA*: *The Journal of the American Medical Association*, **303**, 1295-1302. http://dx.doi.org/10.1001/jama.2010.344

[13] Casazza, B.A. (2012) Diagnosis and Treatment of Acute Low Back Pain. *American Family Physician*, **85**, 343-350.

[14] Lo, Y.L., Fook-Chong, S., Huerto, A.P. and George, J.M. (2011) A Randomized, Placebo-Controlled Trial of Repetitive Spinal Magnetic Stimulation in Lumbosacral Spondylotic Pain. *Pain Medicine*, **12**, 1041-1045. http://dx.doi.org/10.1111/j.1526-4637.2011.01143.x

[15] Lee, P.B., Kim, Y.C., Lim, Y.J., Lee, C.J., Choi, S.S., Park, S.H., *et al.* (2006) Efficacy of Pulsed Electromagnetic Therapy for Chronic Lower Back Pain: A Randomized, Double-Blind, Placebo-Controlled Study. *The Journal of International Medical Research*, 34, 160-167. http://dx.doi.org/10.1177/147323000603400205

[16] Goldsmith, G., Morrismy, R., Hall, C.E., Keh, I.D. and Cowie, H. (1987) Accuracy of the Cobb Technique in Scoliosis Measurements. *Orthopaedic Transactions*, **11**, 32.

[17] Goldberg, M.S., Poitras, B., Mayo, N.E., Lobelle, H., Bourassa, R. and Cloutier, R. (1988) Observer Variation in Assessing Spinal Curvatures and Skeletal Development in Adolescent Idiopathic Scoliosis. *Spine*, **13**, 1371-1377. http://dx.doi.org/10.1097/00007632-198812000-00008

[18] StatSoft, Inc. (2011) STATISTICA (Data Analysis Software System), Version 10. http://www.statsoft.com

[19] Selkowitz, D.M. (1985) Improvement in Isometric Strength of the Quadriceps Femoris Muscle after Training with Electrical Stimulation. *Physical Therapy*, **65**, 186-196.

[20] Snyder-Mackler, L., Ladin, Z., Schepsis, A.A. and Young, J.C. (1991) Electrical Stimulation of the Thing Muscles after Reconstruction of the Anterior Cruciate Ligament. Effects of Electrically Elicited Contraction of the Quadriceps Femoris and Hamstring Muscles on Gait and on Strength of the Thigh Muscles. *Journal of Bone and Joint Surgery*, **73**, 1025-1036.

[21] Sinkjær, T. and Popović, D.B. (2005) Trends in the Rehabilitation of Hemiplegic Subjects. *Automatic Control*, **15**, 1-10.

[22] Hamid, S. and Hayek, R. (2008) Role of Electrical Stimulation for Rehabilitation and Regeneration after Spinal Cord Injury: An Overview. *European Spine Journal*, **17**, 1256-1269. http://dx.doi.org/10.1007/s00586-008-0729-3

[23] Rushton, D.N. (2002) Electrical Stimulation in the Treatment of Pain. *Disability & Rehabilitation*, **24**, 407-415. http://dx.doi.org/10.1080/09638280110108832

[24] Ratajaczak, B., Hawrylak, A., Demidas, A., Kuciel-Lewandowska, J. and Boemer, E. (2011) Effectiveness of Diadynamic Currents and Transcutaneous Electrical Nerve Stimulation in Disc Disease Lumbar Part of Spine. *Journal of Back and Musculoskeletal Rehabilitation*, **24**, 155-159.

[25] Delitto, A., Strube, M.J., Shulman, A.D. and Minor, S.D. (1992) A Study of Discomfort with Electrical Stimulation. *Physical Therapy*, **72**, 410-421.

[26] Merrill, D.R., Bikson, M. and Jefferys, J.G.R. (2005) Electrical Stimulation of Excitable Tissue: Design of Efficacious and Safe Protocols. *Journal of Neuroscience Methods*, **141**, 171-198. http://dx.doi.org/10.1016/j.jneumeth.2004.10.020

[27] McCreery, D.B., Agnew, W.F., Yuen, T.G.H. and Bullara, L.A. (1992) Damage in Peripheral Nerve from Continuous Electrical Stimulation: Comparison of Two Stimulus Waveforms. *Medical & Biological Engineering & Computing*, **30**, 109-114. http://dx.doi.org/10.1007/BF02446202

[28] Polkey, M.I., Kyroussis, D., Hamengard, C.H., Mills, G.H., Green, M. and Moxham, J. (1996) Quadriceps Strength and Fatigue Assessed by Magnetic Stimulation of the Femoral Nerve in Man. *Muscle & Nerve*, **19**, 549-555. http://dx.doi.org/10.1002/(SICI)1097-4598(199605)19:5<549::AID-MUS1>3.0.CO;2-B

[29] Galloway, N.T., El-Galley, R.E., Sand, P.K., Appell, R.A., Russell, H.W. and Carlan, S.J. (1999) Extracorporeal Magnetic Innervation Therapy for Stress Urinary Incontinence. *Urology*, **53**, 1108-1111. http://dx.doi.org/10.1016/S0090-4295(99)00037-0

[30] Yokoyama, T., Fujita, O., Nishiquchi, J., Nozaki, K., Nose, H., Inoue, M., Ozawa, H. and Kumon, H. (2004) Extracorporeal Magnetic Innervation Treatment for Urinary Incontinence. *International Journal of Urology*, **11**, 602-606. http://dx.doi.org/10.1111/j.1442-2042.2004.00857.x

[31] Fujishiro, T., Takahashi, S., Enomoto, H., Uqawa, Y., Ueno, S. and Kitamura, T. (2002) Magnetic Stimulation of the Sacral Roots for the Treatment of Urinary Frequency and Urge Incontinence: An Investigational Study and Placebo Controlled Trial. *The Journal of Urology*, **168**, 1036-1039. http://dx.doi.org/10.1016/S0022-5347(05)64569-7

[32] Yokoyama, T., Fujita, O., Nishiquchi, J., Nozaki, K., Nose, H., Inoue, M., Ozawa, H. and Kumon, H. (2004) Extracorporeal Magnetic Innervation Treatment for Urinary Incontinence. *International Journal of Urology*, **11**, 602-606. http://dx.doi.org/10.1111/j.1442-2042.2004.00857.x

[33] George, M.S. and Belmaker, R.H. (2000) Transcranial Magnetic Stimulation in Neuropsychiatry. American Psychiatric Press, Arlington.

[34] Behrens, M., Mau-Moller, A., Zschorlich, V. and Bruhn, S. (2011) Repetitive Peripheral Magnetic Stimulation (15 Hz RPMS) of the Human Soleus Muscle Did Not Affect Spinal Excitability. *Journal of Sports Science and Medicine*, **10**, 39-44.