Original Article

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Comparison of the Effect of TECAR Therapy and Static Stretching on Hamstring Flexibility in Male Athletes

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ABSTRACT

BACKGROUND AND OBJECTIVE: The hamstring muscle is one of the muscles with a high risk of injury due to loss of flexibility. Using deep heat modalities is one way to improve muscle flexibility. Given that TECAR therapy is a new way to produce heat in deep tissues, the present study was conducted to compare the short-term effects of TECAR therapy and static stretching on hamstring flexibility in athletes.

METHODS: This single-blinded randomized clinical trial was performed on 20 male athletes. Samples were randomly divided into two groups of TECAR therapy with static stretching (n=10) and static stretching (n=10) and were treated for three sessions. Active knee extension (AKE) test, passive knee extension (PKE) test, and sit and reach test were performed before treatment, after the first session and after the third session.

FINDINGS: The mean values of active knee extension and passive knee extension (degree) and mean values of sit and reach test (cm) after the third session in the TECAR therapy group were 72.10±1.59 and 71±1.49 and 35.20±2.39, respectively, and in the static stretching group were 70.70±1.49, 69.70±1.05 and 34.80±1.61, respectively. The results of this study showed that in both groups, the range of active knee extension ($p<0.0001$), the range of passive knee extension ($p=0.004$), and the range of motion in sit and reach test ($p=0.004$) improved significantly after the first and third sessions. The improvement of all three flexibility indices in the TECAR therapy group was higher than static stretching, but there was no statistically significant difference between the two groups.

CONCLUSION: The present study showed that TECAR therapy with static stretching causes a greater increase in hamstring flexibility than static stretching alone.

KEY WORDS: *TECAR Therapy, Stretching, Static Stretching, Hamstring Muscle, Flexibility*.

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Introduction

The flexibility of the soft tissues around the joint is an important factor in preventing damage or re-injury to the joint and the soft tissue around it (1). Shortness of the hamstring muscles reduces the range of motion of the joint, creates inappropriate movement patterns, causes muscle imbalance and reduces muscle strength, and predisposes the person to destructive lesions in the knee and thigh joints (2, 3). Studies examining the flexibility of the hamstring muscles in soccer, basketball, and sprinting athletes have shown that a significant percentage of athletes have low flexibility in the hamstring muscle (4-7).

Stretching is a method that is widely used to improve muscle flexibility (8). Among the types of stretching in studies, static stretching is widely used to improve flexibility in shortened muscle (9). Therapists also use heat modalities to increase the effectiveness of stretching techniques (10). It is theoretically stated that heat can directly affect type I collagens, which provide major resistance to passive muscle structures (11). Heat increases the flexibility of the muscle-tendon unit and improves the effectiveness of stretching by reducing muscle tone (12).

In human studies, despite the widespread use of heat before stretching, there is still disagreement about the use of heat as a modality to increase stretching efficiency in some studies (13). Nowadays, a new heat modality called TECAR is used in many therapeutic areas in physiotherapy (14, 15). Another term for TECAR is CRET, which stands for capacitive and resistive electric transfer (16-18). TECAR is one of the methods of deep heat therapy whose main idea for producing heat inside the tissue is that an alternating current with a frequency of 448 kHz in the range of radio waves is applied on the skin surface by two electrodes based on the capacitive or resistive properties of the device (19, 20).

TECAR is said to provide more blood flow and muscle flexibility than hot packs (surface heat modality) and it treats more area of skin than ultrasound (deep heat modality). In addition, the lower frequency of TECAR compared to diathermy (deep heat modality) prevents excessive heat production between the skin and the electrode, resulting in safer and less dangerous modality (21-24). The results of a study by Yokota et al. showed that hamstring flexibility immediately, 15 minutes and 30 minutes after the intervention showed significant difference compared with other groups (15). In another study, Yokota et al. showed that TECAR therapy is effective in post-workout muscle recovery and maintaining muscle flexibility (23). Despite the use of static stretching to increase muscle flexibility at bedside and despite conflicting results of studies on the enhanced effect of heat therapy on the effectiveness of static stretching, no studies have so far compared the combined effect of static stretching and TECAR therapy on improving shortened hamstring muscles. In other words, previous studies have only examined the flexibility of the hamstring muscle and not the improvement of shortened hamstring muscles, while this is a common issue in athletes and can increase the risk of sports injuries in them (5). Therefore, the present study was conducted to compare the two treatments of static stretching alone and static stretching combined with TECAR therapy on hamstring muscle flexibility in a single-blinded randomized clinical trial.

Methods

This single-blinded randomized clinical trial was approved by the Ethics Committee of Tehran University of Medical Sciences with the code IR.TUMS.FNM.REC.1398.063 and the clinical trial registration number was IRCT20190920044826N1. after obtaining written consent from participants, the study was performed for 6 months (in 2019) in the biomechanics laboratory of the Faculty of Rehabilitation Sciences, Tehran University of Medical Sciences. Convenience sampling was used in this study. Subjects participated in the study by invitations and the two groups were matched in terms of age, height, weight, body mass index, type of sport and dominant foot.

Twenty non-professional male athletes in the age range of 20 to 30 years, who exercised for three 2-hour sessions every week in one of the sports of basketball, football and handball, participated in this study. Inclusion criteria for both groups were shortened hamstring muscle (angle less than or equal to 70 degrees in passive knee extension test), no pain and musculoskeletal injuries of the lower limb in the last six months, no history of surgery and instability, no obvious deformities in the lower back and lower limbs and willingness to participate in the study. Each person was excluded from the study if they did not wish to continue their cooperation.

First, assessments were done to evaluate shortened hamstring muscle of the dominant leg. The 90/90 test was used for this purpose (25). The angle less than or

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equal to 70 degrees was considered shortened hamstring muscle. After determining shortened hamstring muscle, participants were randomly divided into one of the groups of TECAR therapy (n=10) or static stretching (n=10) through convenience sampling (by rolling dice) (26). Demographic characteristics of individuals were recorded. A tape measure mounted on the wall and a digital scale were used to measure height and weight. Assessments were performed by active knee extension (AKE) test, passive knee extension (PKE) test, and sit and reach test (25, 27, 28).

A set square (Lafayette, USA) was used to measure the range of motion of the knee and the Flex - Tester Box was used to measure the flexibility of the hamstring muscle. In both groups, evaluations were performed before the beginning of treatment, immediately after the first session and also after the third session. The tests were repeated three times for each person and the average of three repetitions was recorded as the level of hamstring muscle flexibility. To have a single-blinded study, the intervention was performed by a physiotherapist and the evaluation was performed by another physiotherapist who was unaware of the type of intervention.

Treatment was performed for both groups in three sessions every other day. In the TECAR therapy group, the capacitive property of the TECAR device (TecaTen model, Class B, IRAN) was used. The hamstring muscle was treated with TECAR device (frequency of 448 KHz) for 15 minutes and then, four 30-second static stretches were applied. The time interval between stretches was 10 seconds. In the static stretching group, only four 30-second static stretches were performed for the hamstring muscle.

In the present study, SPSS software version 20 was used for statistical analysis. Kolmogorov-Simonov test was used to examine the data distribution. The results of this test showed that all study variables follow the normal distribution. To compare demographic variables as well as range of motion in active knee extension test, passive knee extension test, and sit and reach test before treatment, after the first treatment session and after the third treatment session between the two groups, One-Way ANOVA ("analysis of variance") was used. Chi-square test was used to compare the type of sport between groups. Repeated measures ANOVA model was used to compare the range of motion in active and passive knee extension test and sit and reach test to achieve differentiation between the two groups by performing measurements for three times (pre-treatment measurement, measurement after the first session of treatment, and measurement after the third session of treatment) and one independent factor (static stretching group and static stretching plus TECAR therapy group). Each variable was analyzed separately. In addition, to determine the rate of change in hamstring flexibility indices for each group, the effect size between the evaluation before the beginning of treatment and the evaluation after the third session was calculated, and $p<0.05$ was considered significant.

Results

In this research, 20 male athletes with shortened hamstring muscles were studied in two groups of TECAR therapy (n=10) and static stretching (n=10). There was no statistically significant difference between the two groups in terms of age, height, weight and body mass index (Table 1).

In addition, the type of sport and dominant leg did not show a statistically significant difference between the two groups. Prior to treatment, there was no difference between the two groups in the range of motion of the passive knee extension, the range of motion of the active knee extension, and the sit and reach test. Evaluation of group effect in repeated measures ANOVA did not show a statistical difference between the two groups, but the effect of evaluation time on hamstring flexibility indices was significant and the mean of all three indices after the third treatment session was higher than the first treatment session and the pre-test session (active knee extension range ($p<0.0001$), passive knee extension range ($p=0.004$), sit and reach test ($p=0.004$)). Interaction between group effect and evaluation time was significant for all three variables and this means that the type of treatment in each group has affected the rate of changes in range of motion and movement (Table 2).

The range of motion in active and passive knee extension did not show a statistically significant difference between the two treatment groups. Furthermore, there was no statistically significant difference in range of motion in sit and reach test between the two treatment groups after the first treatment session and after the third treatment session (Table 3).

To determine the rate of changes in hamstring flexibility indices for each group, the effect size was calculated between pre-test session and after the intervention in the third session. The Cohen's d

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index was used to determine the effect size (29). Hamstring flexibility indices in the TECAR therapy group had a large effect size. In the static stretching group, the rate of changes in active and passive knee extension had a large effect size and the range of motion in sit and reach test had a medium effect size (Table 4).

Table 1. Demographic data of athletes in the two groups of TECAR therapy and static stretching and the results of independent t-test for group homogeneity

Variable (unit)	TECAR therapy group (n=10) Mean±SD	Static stretching group (n=10) Mean±SD	P-value
Age (years)	22.90±2.51	24.40±2.54	0.36
Weight (kg)	68.60±4.08	71.20±3.01	0.16
Height (cm)	178.40±4.64	181.70±2.94	0.14
Body mass index (kg/m^2)	22.55±1.06	21.56±0.86	0.70

Table 2. Main group effect and group-by-time interaction effect for hamstring flexibility indices

	Group effect		Effect of evaluation time		Group x Time interaction	
	P-value	F index	P-value	F index	P-value	F index
range of motion in passive knee extension	0.09	2.61	0.0001	71	0.006	6.10
range of motion in active knee extension	0.011	5.30	0.0001	87	0.002	7.58
range of motion in sit and reach test	0.83	0.18	0.0001	47.58	0.011	3.80

Table 3. Hamstring flexibility indices (range of motion in active and passive knee extension and the range of motion in sit and reach test) based on assessment sessions between the two treatment groups

	Mean difference	95% confidence interval		P-value
		High limit	Low limit	
Passive knee extension range after the first session	0.6	2.18	-0.98	0.43
Passive knee extension range after the third session	1.40	2.85	-0.05	0.058
Active knee extension range after the first session	1.10	3.14	-0.94	0.27
Active knee extension range after the third session	1.30	2.51	0.08	0.24
Range of motion in sit and reach test after the first session*	0.2	1.39	-1.79	0.79
Range of motion in sit and reach test after the third session*	0.4	1.32	-1.52	0.66

***Range of motion in sit and reach test**

Table 4. Effect Size changes in muscle flexibility indices

	TECAR therapy group	Static stretching group
Passive knee extension range	3.26	2.06
Active knee extension range	3.45	3.14
Range of motion in sit and reach test *	1.69	0.70

***Range of motion in sit and reach test**

Discussion

The present study showed that TECAR therapy with static stretching caused a greater increase in hamstring flexibility than static stretching alone, but no significant difference was observed between the results in the two groups. In TECAR therapy with static stretching group and static stretching alone, the effect size for the range of motion in active and passive knee extension based on the interpretation of Cohen's d index was large (17). The results of the present study are in line with the findings of Tashiro et al. and Hawamdeh et al. However, in these

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studies, hamstring flexibility was measured in a single session and straight leg raise (SLR) test was used (18, 22). In this test, the flexibility of the hamstring muscle is affected by the condition of the pelvic and lumbar joints, and for this reason, in the present study, the sit and reach test and the active and passive knee extension tests were used to accurately evaluate the length of the hamstring muscle in both distal and proximal attachments. Among the treatments used to improve flexibility, studies on TECAR therapy as a novel heat therapy modality are scarce. The studies were either non-controlled clinical trials or one-session studies, and mainly considered other indices such as blood circulation, oxygen saturation in this area and deep tissue heat. Moreover, the target groups of these studies were not athletes (23, 26).

Another advantage of the present study compared to previous studies is the use of more sessions and repeated evaluations because TECAR is usually used for more than one session in the clinic, and previous studies only examined the flexibility of the hamstring muscle and not the improvement of muscle shortening. More than one session of treatment is needed to be effective in relieving muscle shortening by TECAR therapy and stretching. In previous studies, active and passive pads were used on the hamstring muscle, which could prevent the uniform distribution of energy in the patient's body, because in this method, the entire surface of the pad should be in contact with the body throughout the treatment. In the present study, a removable applicator was used, which was moved along the entire length of the muscle by the physiotherapist (18, 22, 27). Due to the fact that this study was a single-blinded trial, the results are less biased and more accurate than previous studies. In the present study, TECAR therapy and static stretching were performed non-simultaneously, and due to the duration of stretching, some of the deep heat generated in the muscle might have been reduced due to exchanges between blood vessels. Therefore, in future studies, it is better to study the simultaneous effect of TECAR therapy and static stretching compared to static stretching alone. This study was performed on asymptomatic athletes and if treatment is used on patients with symptoms of pain, it may show different effects due to the analgesic properties of TECAR therapy.

Overall, this study showed that TECAR therapy with static stretching can increase hamstring flexibility and its effect in three sessions is higher than one treatment session, but there was no significant difference between the two group in healthy athletes. It is suggested that future studies be performed with follow-up so that in addition to effectiveness, the durability of different treatments can be compared with each other.

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References

1.Kisner C, Colby LA. Therapeutic exercise: foundations and techniques, 5th ed. Philadelphia: F.A. Davis Company; 2007.p. 69-75.

2.Naimi SS, Khoshamooz Y, Haghighivand S, Moradi Boosari A, Sarmadi AR. Comparison of Effectiveness and Permanency of two Stretching Methods (Hold-Relax & US+ Stretching) in Treatment of Hamstring Muscle Tightness. Razi J Med Sci. 2005;12(47):187-96. [In Persian]

3.Knight CA, Rutledge CR, Cox ME, Acosta M, Hall SJ. Effect of superficial heat, deep heat, and active exercise warm-up on the extensibility of the plantar flexors. Phys Ther. 2001;81(6):1206-14.

4.Worrell TW, Smith TL, Winegardner J. Effect of hamstring stretching on hamstring muscle performance. J Orthop Sports Phys Ther. 1994;20(3):154-9.

5.Kumar GP. Comparison of cyclic loading and hold relax technique in increasing resting length of hamstring muscles. Hong Kong Physiother J. 2011;29(1):31-3.

6.Bandy WD, Irion JM, Briggler M. The effect of static stretch and dynamic range of motion training on the flexibility of the hamstring muscles. J Orthop Sports Phys Ther. 1998;27(4):295-300.

7.Davis DS, Ashby PE ,McCale KL, McQuain JA, Wine JM. The effectiveness of 3 stretching techniques on hamstring flexibility using consistent stretching parameters. J Strength Cond Res. 2005;19(1):27-32

8.Rubini EC, Costa AL, Gomes PS. The effects of stretching on strength performance. Sports Med. 2007;37(3):213-24.

9.Bandy WD, Irion JM. The effect of time on static stretch on the flexibility of the hamstring muscles. Phys Ther. 1994;74(9):845-50.

10.Taylor BF, Waring CA, Brashear TA. The effects of therapeutic application of heat or cold followed by static stretch on hamstring muscle length. J Orthop Sports Phys Ther. 1995;21(5):283-6

11.Henricson AS, Fredriksson K, Persson I, Pereira R, Rostedt Y, Westlin NE. The effect of heat and stretching on the range of hip motion. J Orthop Sports Phys Ther. 1984;6(2):110-5.

12.Nakano J, Yamabayashi C, Scott A, Reid WD. The effect of heat applied with stretch to increase range of motion: a systematic review. Phys Ther Sport. 2012;13(3):180-8.

13.Hernandez-bule ML, Paino CL, Trillo MA, Ubeda A. Electric stimulation at 448 kHz promotes proliferation of human mesenchymal stem cells. Cell Physiol Biochem. 2014;34(5):1741-55.

14.Kumaran B, Watson T. Thermal build-up, decay and retention responses to local therapeutic application of 448 kHz capacitive resistive monopolar radiofrequency: A prospective randomised crossover study in healthy adults. Int J Hyperthermia. 2015;31(8):883-95.

15.Yokota Y, Tashiro Y, Suzuki Y, Tasaka S, Matsushita T, Matsubara K, et al. Effect of Capacitive and Resistive Electric Transfer on Tissue Temperature, Muscle Flexibility, and Blood Circulation. J Nov Physiother. 2017;7(1):1000325.

16.Kato S, Saitoh Y, Miwa N. Repressive effects of a capacitive-resistive electric transfer (CRet) hyperthermic apparatus combined with provitamin C on intracellular lipid-droplets formation in adipocytes. Int J Hyperthermia. 2013;29(1):30-7.

17.Cole AJ, Eagleston RA, Herring SA. The Benefits of Deep Heat. Phys Sportsmed. 1994;22(2):76-88.

18.Hawamdeh MM. The effectiveness of capacitive resistive diathermy (Tecartherapy®) in acute and chronic musculoskeletal lesions and pathologies. Eur J Sci Res. 2014;118(3): 336-40.

19.Takahashi K, Suyama T, Onodera M, Hirabayashi S, Tsuzuki N, Zhong-Shi L. Clinical Effects of Capacitive Electric Transfer Hyperthermia Therapy for Lumbago. J phys ther sci. 1999;11(1):45-51.

20.Sadick NS, Makino Y. Selective Electro-Thermolysis in Aesthetic Medicine: A Review. Lasers Surg Med. 2004;34(2):91-7.

21.Osti R, Pari C, Salvatori G, Massari L. Tri-length laser therapy associated to tecar therapy in the treatment of low-back pain in adults: a preliminary report of a prospective case series. Lasers Med Sci. 2015;30(1):407-12.

22.Tashiro Y, Hasegawa S, Yokota Y, Nishiguchi S, Fukutani N, Shirooka H, et al. Effect of Capacitive and Resistive electric transfer on haemoglobin saturation and tissue temperature. Int J Hyperthermia. 2017;33(6):696-702.

[DOI: 10.22088/jbums.23.1.53]

23.Yokota Y, Sonoda T, Tashiro Y, Suzuki Y, Kajiwara Y, Zeidan H, et al. Effect of Capacitive and Resistive electric transfer on changes in muscle flexibility and lumbopelvic alignment after fatiguing exercise. J Phys Ther Sci. 2018;30(5):719-25.

24.Wood RA, Lewis BK, Harber DR, Kovack PJ, Bates ER, Stomel RJ. Early ambulation following 6 French diagnostic left heart catheterization: a prospective randomized trial. Cathet Cardiovasc Diagn .1997;42(1):8-10.

25.Reurink G, Goudswaard GJ, Oomen HG, Moen MH, Tol JL, Verhaar JA, et al. Reliability of the active and passive knee extension test in acute hamstring injuries. Am J Sports Med. 2013;41(8):1757-61.

26.Bito T, Tashiro Y, Suzuki Y, Kajiwara Y, Zeidan H, Kawagoe M, et al. Acute effects of capacitive and resistive electric transfer (CRet) on the Achilles tendon. Electromagn Biol Med. 2019;38(1):48-54.

27.Kendall FP, McCreary EK, Provance PG, Rodgers MM, Romani WA. Muscles: Testing and Function, with Posture and Pain (Kendall, Muscles), 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2005.p. 59-73.

28.Minkler S, Patterson P. The validity of the modified sit-and-reach test in college-age students. Res Q Exerc Sport. 1994;65(2):189-92.

29.Cohen J. Statistical Power Analysis for the Behavioral Sciences, 2nd ed. London, United Kingdom: Routledge; 1988.

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