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TARGETED RADIOFREQUENCY THERAPY FOR TRAINING INDUCED MUSCLE FATIGUE – EFFECTIVE OR NOT?

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ABSTRACT

Background: Training induced muscle fatigue (hereinafter also referred as TIMF) is leading to unwanted consequences among sportsmen and actively sporting people such as decreased muscle strength and additional painful discomfort and mobility issues. The knowledge about the mechanisms of influencing the fatigue induced processes in muscle tissue is not comprehensive. The conventional manual techniques, cold patches and conventional physiotherapy have some effect in improving these conditions, however, finding effective methods to influence these consequences appears beneficial in sports medicine. Such method could be Radiofrequency therapy up to 0.5 MHz, known as Targeted Radiofrequency Therapy (hereinafter also referred as TR-Therapy). Aim of this self-controlled study is to evaluate the effect of the TR-Therapy for over-exertion management including the effect on decreased muscle strength, limited range of motion and possible painful discomfort.

Materials: 7 healthy and actively sporting participants underwent through 2 stages (Active stage – including overexertion of the forearm flexors and subsequent TR-Therapy session; and Control stage - including overexertion of the forearm flexors and subsequent resting period). Data for muscle strength in kg, active Range of Motion (ROM) in (°) and Pain and discomfort perception by 10 point Visual Analog Scale (VAS) were obtained and evaluated.

Results: 31% increase in the muscle strength during the active stage was observed and respectively 12% during the control stage, with level of significance $p<0.05$. ROM and pain and discomfort perception data did not show statistically significant results ($p>0.05$).

Conclusions: The results of this study suggest TR-Therapy as effective solution for muscle strength restoration after TIMF.

Keywords: muscle training, muscle fatigue, decreased muscle strength, radiofrequency therapy.

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INTRODUCTION

Professional sportsmen and actively sporting people often suffer from consequences of training induced muscle fatigue (hereinafter also referred as TIMF): decreased muscle strength and subsequently appearing painful discomfort and affected range of motion. The decrease in the muscle strength is led by decreased energy on cellular level due to imbalanced nutrition substances and metabolic wastes. In the common case the result might be delayed onset muscle soreness if damaged muscle fibers are present [1-3]. The knowledge about the mechanisms of influencing the fatigue induced processes in muscle tissue is not comprehensive. Manual techniques, cold patches and conventional physiotherapy have some effect in improving these conditions [4-8], however deeper researches and analysis of possible higher effective methods should take place.

Radiofrequency method with working frequency up to 0.5MHz – also known as Targeted Radiofrequency Therapy (hereinafter also referred as TR-Therapy), is recently recognized as effective solutions in physiotherapy field. The mechanism of action of this therapy relies on interaction of the radiofrequency currents with the biological structures further resulting in endogenous temperature increase which is stimulating the blood flow [9-14] and the processes of oxygen delivery which is supporting the mechanisms of adenosine triphosphate (ATP) creation [15]. ATP is considered a primary source of energy on cellular level and hence supports muscles ability to contract as well as increases their activity [16,17]. Additionally, the process of metabolic wastes removal is stimulated as well [15]. Therefore, aim of this research was to study the effect of TR-Therapy on treatment of TIMF consequences such as decreased muscle strength, limited range of motion and possible painful discomfort.

MATERIAL AND METHODS

Study design: Self-controlled study conducted in order to evaluate the effect of TR-Therapy on overexertion treatment.

Aim: Aim of this study was to evaluate the effect of TR-Therapy on TIMF induced consequences such as decreased muscle strength, limited range of motion and possible painful discomfort.

Participants: 7 participants (n=4 Male, n=3 Female) aged between 24 and 33 (28.14 ± 3.44) in normal health condition and actively sporting took part in this study. All participants underwent 2 stages:

- *Active stage* consisted of: 1. *exercising* including isotonic contraction of forearm flexors (motion that causes muscles to shorten, thereby generating force): flexor carpi radialis, flexor carpi ulnaris, flexor digitorum profundus , flexor digitorum superficialis (dumbbell with weight 4 to 10 kg depending on the subjects' specifics) until total exhaustion and overexertion and immediately afterwards 2. 1 (one*) treatment with TR-Therapy* with 30 min duration (as described below).
- *Control stage* consisted of: 1. *exercising* including isotonic contraction of forearm flexors (dumbbell with weight 4 to 10 kg depending on the subjects' specifics) until total exhaustion and overexertion and immediately afterwards 2. *recovery period including active rest* with duration 30 min.

Both active and control stages were 7 – 10 days apart in order participants to be able to return to initial condition and any deviations of the outcome results to be eliminated.

The TR-Therapy was applied in capacitive mode with 30 min total duration, 500 kHz frequency and 100% duty factor. During therapy the participants were asked to evaluate the heat perception of the delivered TR-Therapy energy according to a scale, consisting of the next grades: 1-*no* heat perception, *very low* intensity; 2-*moderate* heat perception, *low intensity*; 3-*evident* heat perception, *medium* intensity; 4-*strong*, but not unpleasant, heat perception, *high intensity*. The *recommended grade* for this study was 2. The therapist was in a constant communication regarding the level of heat perception with the participants.

Outcome measurements:

Primary outcome measure was muscle strength, kg of forearm flexors measured by hand dynamometer (by Zhongshan Camry Electronic Co. Ltd)

Secondary outcome measures were active Range of Motion (ROM) of the wrist and 10 point Visual Analog Scale (VAS) for pain and discomfort after exercise varying from 0 – 'no pain' to 10 – 'worse possible pain'.

The measures were taken before exercise (except for the VAS for pain and discomfort), after exercise and after TR-Therapy or rest for respectively Active and Control stage.

Results evaluation and statistics:

All outcome data were tested for statistical significance by means of students t-test (SPSS 23.0, IBM Corporation). Values of $p < 0.05$ were deemed statistically significant. Levels of change in the parameters – Δ,% - between after exercise and after recovery (respectively for Active and Control stage) were calculated and tested for statistical significance by the means of students t-test as referred above.

RESULTS

All 7 participants underwent through both Active and Control stage. A slight post – treatment erythema after TR-Therapy was observed, which resolved within half to one hour after therapy.

The outcome data from both Active and control stages taken after exercise and after recovery are presented in Table 1.

	Parameter		Muscle strength, kg	ROM, º Flexion	ROM, º Extension	VAS
Active stage, n=7 participants	T0, Before exercise	Mean ± SD	65.43±30.53	72.29±18.39	69.57±15.89	N/A
	T1, After exercise		48.57±26.32	69.29±18.79	67.00±11.90	3.29±1.38
	T2, After TR-Therapy		61.57±30.36	72.14±15.77	69.14±13.98	2.43±1.13
	$p_{\text{outcome data T0 vs T1}}$		<0.05	NS	NS	N/A
	$p_{\text{outcome data T1 vs T2}}$		<0.05	NS	NS	NS
	Δ(T2-T1), %		31	6	3	25
	$p_{\Delta(T2-T1)}$		<0.05	NS	NS	NS
Control stage, n=7 participants	T0, Before exercise	Mean ± SD	65.71±30.76	72.29±18.84	70.43±15.48	N/A
	T1, After exercise		48.43±26.43	68.29±17.67	67.86±13.80	3.57±1.13
	T2, After TR-Therapy		52.43±27.20	70.00±16.07	72.14±12.54	2.86±0.69
	$p_{\text{outcome data T0 vs T1}}$		<0.05	NS	NS	N/A
	$p_{\text{outcome data T1 vs T2}}$		NS	NS	NS	NS
	Δ(T2-T1), %		12	3	7	17
	$p_{\Delta(T2-T1)}$		NS	NS	NS	NS

Table 1: Outcome data

	Parameter		After exercise: Active Stage Data (Mean ± SD)	After exercise: Control Stage Data (Mean ± SD)	p	After recovery: Active Stage Data (Δ %)	After recovery: Control Stage Data (Δ %)	p
1	Muscle strength, kg		48.57±26.32	48.43±26.43	NS	31	12	<0.05
2	ROM, º	Flexion	69.29±18.79	68.29±17.67	NS	6	3	NS
		Extension	67.00±11.90	67.86±13.80	NS	3	7	NS
3	VAS		3.29±1.38	3.57±1.13	NS	25	17	NS

Table 2: Comparison table

The obtained data and calculated results are compared in the next Table 2. The levels of change in both groups are visualized in Figure 1.

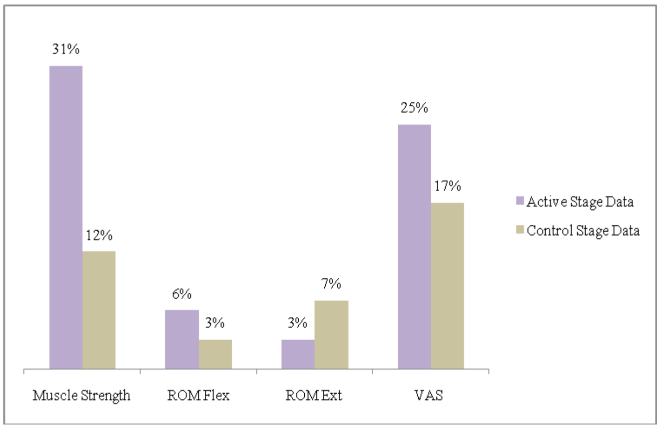

Figure 1: Levels of improvement, %

The level of change in the muscle strength (after exercise versus after recovery) was 31% during active stage and 12% during control stage with level of significance <0.05.

The levels of improvement in active ROM were minor and statistically insignificant. An uncommon observation was that the flexion has higher score during active stage and lower score during control stage, whereas the reversely is valid for extension – lower score during active stage and higher score during control stage.

The post- exercise level of pain and discomfort was from *moderate to light level* on the VAS Scale (see Appendix 1) and was decreased to *light level* with respectively 25% during active stage and 17 % during the control stage. However the data analysis did not confirm statistical significance.

DISCUSSION

The method has previously been studied mainly for pain relief by *Molina et al. 2003* and mobility restoration by *Benizet et al. 2003*, and evidence for effectiveness were present. The common suggestion for the mechanism of action of the therapy relays on the hyperthermia effect and the subsequently increased blood circulation and activated metabolic waste removal within the treated area. Even though the TIMF management by the means of the studied method is not a conventional approach, its mechanism of action is inherited. The results from the current study supports the evidences from previous studies and, in addition, suggest that the increased muscle strength is led by increased number of the muscle fibers to contract - again resulting from increased blood circulation and the associated with it oxygen and nutrition substances delivery in the muscle as well as the stimulated process of metabolic waste (including lactate) removal.

CONCLUSION

The results of this study suggest that TR-Therapy is effective TIMF solution for muscle strength restoration and is able to influence painful discomfort and the limited range of motion. The therapy could appear beneficial in TIMF treatment and sport medicine.

CONFLICT OF INTEREST

The author Ondrej Prouza has the following potential conflict of interest to report – business relationship with BTL Industries Ltd., as follows – provision of clinical consulting services. The author Ondrej Prouza declares that the above reported did not affect the outcomes of the current study.

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