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ELECTRICAL MUSCLE STIMULATION (EMS) IMPLEMENTATION IN EXPLOSIVE STRENGTH DEVELOPMENT

1. INTRODUCTION

Research on the use of electromyostimulation (EMS) as a method of training of skeletal muscle has increased over the past years (Hainaut&Duchateau, 1992; Maffiualetti et al., 2000; Malatesta et al., 2003; Selkowitz, 1985). Several studies have indicated that this training modality enables the development of maximal force, with a great diversity in reported strength gains, ranging between 0-44% (Kots et al., 1971; Laughman et al., 1983; Selkowitz, 1985). Differing stimulation modes (frequency, pulse duration), testing procedures, training protocols (number and duration of the sessions), pre training status, and interindividual differences may account, at least partly, for the observed discrepancies (Enoka, 1988; Hainaut&Uchateau, 1992). Recently, some studies have attempted to investigate the effect of EMS training on the specific performance of athletes from various team sports. For instance, Maffiuletti (2000) and Malatesta (2003) demonstrated the positive effects of short-term EMS training on the vertical jump performance of basketball and volleyball players. Electrical muscle stimulation (EMS), also known as neuromuscular electrical stimulation (NMES) or electromyostimulation is the elicitation of muscle contraction using electric impulses. The impulses are generated by a device and delivered through electrodes on the skin in direct proximity to the muscles to be stimulated. The impulses mimic the action potential coming from the central nervous system, causing the muscles to contract. The electrodes are generally pads that adhere to the skin. EMS is both a form of electrotherapy and of muscle training. It is cited by important authors (Zatsiorsky&Kraemer, 2006) as complementary technique for sport training, and there are a lot of published research about positive effect of EMS training (Babaoult et al., 2007; Malatesta et al., 2003; Seyri, Maffiuletti, 2011; Willoughby et al., 1996).

2. METHODS

The survey was conducted as a case study with three subjects. Purpose of the study was to try is it objective to study EMS influence to explosive strength development as isolated methods (for further research).

Subjects

The study was conducted on subject of 3 male patients of different ages, 19, 30 and 40 years old. Subjects were recreational athletes. All the subjects agreed to participate in the study on a voluntary basis and signed an informed consent form.

EMS Training procedures

The study lasted four weeks, and the respondents have not used any type of training or activity, which would affect the development of explosive strength of the lower extremities.

Program of Electrical muscle stimulation was performed in the evening, every other day, with COMPEX mi sport apparatus (Medical SA - All rights reserved - 07/06 - Art. 885,616 - V.2 model). In 4 week period, a total of 13 treatments were performed on selected muscle groups - quadriceps femoris and gastrocnemius. Program of plyometric training (Plyometric) (28 min per treatment), for each muscle group were applied.

Testing

The initial and final testing was conducted in the laboratory of the Faculty of Sport and Tourism in Novi Sad, on the contact plate AXON JUMP (Bioingeniería Deportiva, VACUMED, 4538 Westinghouse Street Ventura, CA 93 003) under identical conditions. Three tests were carried out for each type of jump, and the best result was retained.

3. RESULTS

Results of initial and final results are shown in table 1.

Table 1. *Results of initial and final measurement after EMS training procedures*

	19yo			**30yo**			**40yo**		
	IM (cm)	FM	diff.	IM	FM	diff.	IM	FM	diff.
SJ	32,40	34,20	1,80	31,10	32,7	1,60	28,20	30,10	1,90
CMJ	42,30	44,30	2,00	34,20	36,1	1,90	30,10	32,10	2,00
VJ	56,00	56,60	0,60	45,30	46,5	1,20	35,20	36,30	1,10
LL	21,30	23,00	1,70	20,40	22	1,60	15,20	16,70	1,50
RL	21,70	23,20	1,50	18,80	21,1	2,30	13,90	15,90	2,00

SJ - squat jump **CMJ** - countermovement jump **VJ** - vertical jump
LL - left leg jump **RL** - right leg jump

IM – initial measurement **FM** – final measurement

In complete jump protocol, subjects achieved better results in final measurement. SJ increase average 1.77±0.12 cm, CMJ – 1.97±0.05 cm, VJ – 0.97±0.26 cm, LL – 1.60±0.08 cm and RL – 1.93±0.33 cm.

4. DISCUSSION

We can conclude that all subjects made improvement instead of initial measurement. Improvement varied from 4.7-14.3%. We can conclude that EMS treatment made improvement.

Positive results are notified in few researches with similar methodology, where strength and vertical jump were significantly increased in experimental groups (Seyri, Maffiuletti, 2011). Considering muscle contraction type, in 5 weeks of EMS training, eccentric, isometric, and concentric torques and ball speed had significantly improved. It appeared appropriate to conduct EMS training during at least 3 (Billot et al., 2010). Some research notified positive results even in shorter time period (10 days) in jumps (Malatesta et al., 2003). EMS program, also is notified of significantly enhanced isokinetic strength of the knee extensors (eccentric and for two concentric velocities) (Brocherie et al., 2005).

EMS training, didn't show results on body weight, BMI, or skinfold thickness, but, resulted in significant improvements in the muscular strength and endurance (Porcari et al., 2005). So, the commercial use of EMS like the weight lose product doesn't have scientific support.

Some results, on the other hand, concluded that EMS training have no influence in improvement, like in drop jump performance (after 4 week). EMS doesn't facilitate larger training effects of the conventional training (Reiser, Waitz, 2005). NMES training may not be an effective alternative to voluntary training in healthy subjects (Holcomb, 2006).

To summarize, the present study demonstrated that an increase in explosive strength of the knee extensors can be achieved in a relatively short period (4 week) by using EMS training. As a practical recommendation, it is suggested that EMS training could be used over the season to enhance strength. Nevertheless, further experiments are needed to determine long-term benefits of the EMS training. As a study limitation, in future research, there should be involved control group of subjects, also and two groups – a group with isolated EMS treatment, and a group with combined training EMS + plyometric training, to analyze exactly and with more confidence effect of EMS training.

5. REFERENCES

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ELECTRICAL MUSCLE STIMULATION (EMS) IMPLEMENTATION IN EXPLOSIVE STRENGTH DEVELOPMENT

Electrical muscle stimulation (EMS), is also known as neuromuscular electrical stimulation (NMES) may be used for therapeutic purposes and training. EMS is causing muscle contractions via electrical impulses. The survey was conducted as a case study. The study was conducted on subject of 3 male of different ages. The study lasted 4 weeks, and the respondents have not used any type of training or activity, which would affect the development of explosive strength of the lower extremities. Electrical stimulation was performed in the evening, every other day, with COMPEX mi sport apparatus (Medical SA - All rights reserved - 07/06 - Art. 885,616 - V.2 model). In 4 week period, a total of 13 treatments were performed on selected muscle groups - quadriceps femoris and gastrocnemius. Program of plyometric training (Plyometric) (28 min per treatment), for each muscle group were applied. The main objective of this study was to quantify and compare explosive leg strength, using different vertical jump protocols, before and after the EMS program. The initial and final testing was conducted in the laboratory of the Faculty of Sport and Tourism in Novi Sad, on the contact plate AXON JUMP (Bioingeniería Deportiva, VACUMED, 4538 Westinghouse Street Ventura, CA 93 003) under identical conditions. In all three of the respondents indicated an increase in vertical jump in all applied protocols.

Key words: *Electrical stimulation, training, explosive strength.*