22 - COMPARISON OF MUSCULAR STRENGTH INCREASE BY ISOMETRICS, WITH OR WITHOUT RUSSIAN STIMULATION

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INTRODUCTION

Muscles account for approximately 40 to 50% of total body weight and are endowed with the ability to contract and relax (Powers and Howley, 2003) They vary in function and in shape, size and method of insertion into bone or cartilage. A muscle can have more than one function - stabilization, power production and maintenance of posture - as well as take one or more controlled movements specifically for what would be for a person a simple sequence of movements (KITCHEN, 2003).

According to Fronteira, Dawson e Slovick (2001), Muscle fibers can be classified according to their morphology, histology and biology, but the most widely used classification is according to histology, through its contractile property and the color: red fibers (type I) and white (type II).

Type I fibers: They are activated primarily in a movement responsible for the postural activity in slow, moderate movement, requiring a relatively low voltage, rich in capillaries, they have a higher carrying of oxygen, they are also recruited in anaerobic activities are appropriate in sustained or repetitive contractions, static and they have a greater resistance to fatigue.

Type II fibers: they have great ability to contract, poor hair, strong and dynamic, recruited in an explosion of activity, high-speed or movement skills, require extra effort when they have lower resistance to fatigue.

As time goes by, the reductions in force reflect in the functional capacity of individuals, because of this, programs for muscle strengthening procedures are important and widely used in physical therapy practice, arising from the need to restore the normal functions of a muscle that has its strength decreased.

Tribastone (2001), says that working a muscle usually in isometric or static contraction over time increases in volume as a result, there is a significant increase of muscular power, which for Bienfait (1993), is the fastest method for obtaining muscle hypertrophy.

The static activity (such as obtained with NMES) has advantages such as making it easy for the patient to perform the proposed activity, however, it has several disadvantages as a negative influence on muscle elasticity, does not promote a muscle capillarization, among others (Weineck , 2000).

The neuromuscular electrical stimulation (NMES) is a non-invasive therapeutic procedure, which involves the application of electric current in order to produce muscle contraction (GUIRRO & GUIRRO, 2004). It has been used as a therapeutic resource for gaining strength due to its ability to produce muscle contraction (SIVINI & LUCENA, 2004), and is one of the tools that assist the therapist in resolving problems that impede the function of an individual.

The term Russian current applies to promoters in which there is a continuous output current wave of about 2.500Hz the 5.000Hz. The basis for its use, is the capacity in which the maximum electrical stimulation can cause almost all motor units in a muscle to contract synchronously, something that cannot be achieved in voluntary contraction. This would allow the occurrence of strong muscle contractions with electrical stimulation, and therefore gain more strength (LOW and REED, 2001).

The Russian current can be applied in the usual way by means of surface electrodes fixed on the skin, acting as an interface between the stimulator and the patient's tissues (BRAZILIAN, Castro and PARIZOTTO, 2002).

For Low and Reed (2001), in the electrical stimulation, the greater the frequency therapy, the shorter the pulse in the current, thus the resistance of the passage through the skin is also smaller, making it more comfortable to receive. Thus, it is possible to increase the current intensity and increased the number of lines stimulated muscle, aiming to further increase muscle strength.

In regimes of strength training there is a direct relationship between the intensity of the contraction produced electricity, and increase muscle strength. You must be able to support contractions produced electrically at high intensities. The greater the intensity tolerated, the greater the number of motor units recruited and the greater the depth of penetration of current from surface electrodes (BRAZILIAN, Castro and PARIZOTTO, 2002). Therefore, the greater the force of contraction in an electrical training, greater strength gains will be generated (Prentice, 2002).

According to the author above, electrical stimulation usually cause sensory responses before the motor. If the amplitude or duration of stimulation is sufficiently increased, motor responses are produced and superimposed on the sensory stimulation causing a painful response.

The comfort during electrical stimulation is a fundamental factor for success, and may even limit their application (GUIRRO & GUIRRO 2004).

The goal of this research was to verify if an active exercise had more efficiency when associated to neuromuscular electrical stimulation (Russian current).

METHODOLOGY

This research is characterized by being quantitative and explanatory, and has a longitudinal cut (cause - effect), held at the Institution of Higher Education - FAG - Faculdade Assis Gurgacz.

As criteria for inclusion: healthy volunteers were not engaged in physical activities and / or sports regularly, aged between 18 and 28 years old, female, Caucasian, who were on the waiting list for the orthopedic sector of the Clinic for Physiotherapy - FAG. Exclusion criteria: Individuals who have any contraindication for the use of electric current; Individuals who have been injured or undergone surgical procedures in the member being treated for less than 18 (eighteen) months, individuals who have not agreed or signed an Informed Consent; individuals practicing some kind of physical activity and / or sports on a regular basis during the course of events; not in any environment issue considering the criteria for inclusion in the research.

The subjects were verbally invited and informed about the experimental procedures that would be made. After reading and signing the consent form, the doubts were clarified and then there was an initial individual assessment.

For the assessment of muscle strength in the grip of both groups it was used a manual dynamometer brand CROWN, giving as kg / strength (Kg / f) with an accuracy of 1% of the total capacity of the individual.

The patient, at the time of measurement, was placed sitting in a comfortable position in which the arm to be evaluated and treated was supported with the elbow to 90 degrees. The force was measured on the non-dominant, and was prompted with verbal stimuli that were made 3 (three) repetitions of grip on the device, and then performed an average of three measures to establish the first result.

The subjects were divided into two groups randomly, called G1 and G2. In the first group (G1), composed of seven (7) individuals, only isometrics was used as a treatment, asking the patient to squeeze a rubber ball (palm pressing) for 9 seconds and relax for 9 seconds for 20 minutes.

In the second group (G2), also composed of seven (7) individuals, it was used isometric for muscle strength, the same as of G1 and the patient asked to squeeze the ball as he feels that the current passing through the arm (9 seconds) and rest (9 seconds), until there is a new stimulus, and application of an electric current of medium frequency known Russian current (ENDOPHASYS - R 4-CHANNEL - brand KLD). In the first ten minutes parameters were used to activate fiber type I: frequency of the machine: 2500 Hz, pulse frequency: 30Hz, Gust: 50% Rise: 9 seconds Decay: 9 seconds. In the last ten minutes, the parameters used were the same, only with change in pulse rate of 30 Hz to 50 Hz. The dosage was applied in accordance with maximum intensity supported for each patient, without causing pain.

In this group, it was applied with circular electrodes of 1.5 cm in diameter and the cleaning of the site was used cotton and 70% alcohol.

The application of the electrodes was through Bipolar mode placed at motor points of muscles flexor carpi radialis and flexor digitorum profundus in order to activate muscle fibers type I and type II, being a muscle of mixed fiber.

There were 12 (twelve) calls three times a week every other day, where the beginning of the end of the seventh and twelfth treatment, new measures were made to verify that the groups had an increased muscle strength significantly to this research . To review, we used the same apparatus (dynamometer) and the same method of first assessment.

The data will be analyzed and compared by student t test at 5%, and prepared charts using Microsoft Office Excel 2003.

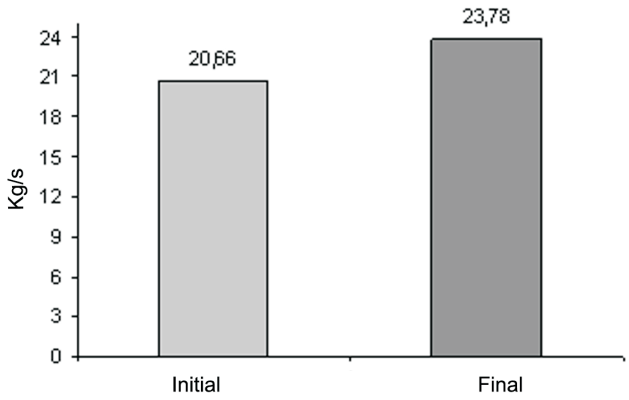
RESULTS

Since this is a sample of less than 30 elements, a comparison was made (pre and post) by the student t test for paired samples at the 5% significance level.

Analyzing the results of initial and final grip strength of the groups, it was found that there was an increase of mean force in both, but in group 1 (G1) the difference was too small to be significant at the level of 5% strength gain muscle. In group 2 (G2) the difference shown can be significant for this research.

In Figure 1 we can see that the average increase in muscle strength of this group was equal to 3,12 kg / s, comparing the average of the initial group of 20,66 kg / s and final of 23,78 kg / s

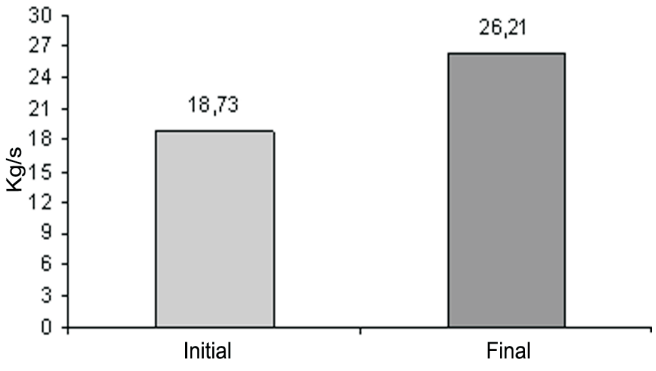
GRAPH 1: Average increase of strength on group 1 (G1)



SOURCE from the author, 2009.

The initial and final strength average of group 2 is represented on graph 2, it shows the initial average (18,73 kg / s), and the final (26,21 kg / s), and it is possible to calculate the difference between them, an increase of 7,48 kg / s in strength.

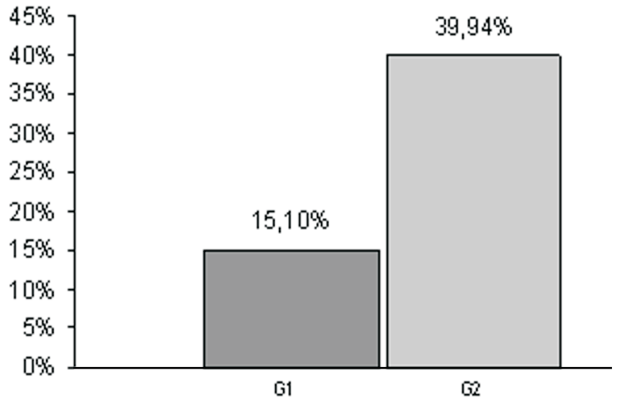
GRAPH 2: Increase on the average strength of group 2 (G2)



SOURCE from the author, 2009.

The third graph represents in percentage the average difference of the final increase on group 1 (G1) that was of 15,10% and on group 2 (G2), of 39,94%. Therefore, the difference between them is of 24,84%.

GRAPH 3: Percentage of the increase on both groups.



SOURCE from the author, 2009.

DISCUSSION

There are many benefits on the muscular strength increase program used by physiotherapy, which emerge from the necessity of establishing the functions of a muscle when it shows its strength decreased or for a better performance.

As said by the American Physical Therapy Association, the NMES is the action of therapeutic electrical stimulation on the integral muscular tissue, resource which is frequently used on physiotherapy practices, currently applied in several clinical conditions (BRASILEIRO, CASTRO e PARIZOTTO, 2002).

The NMES may be used to increase the spread of movement (ADM), strengthening and making treatment programs easier. Soares, Pagliosa e Oliveira (2002), compared the gain in palm pressing strength, making use of the NMES. They obtained as a result an increase of 22,75% of muscular strength on the group stimulated with the medium frequency current, and an increase of 8,7% on the low frequency group. They have concluded that currents in a medium frequency are more efficient when the goal is gain in strength. In this research, it was used a medium frequency current associated to isometrics for the results comparisons.

Around the decade of 1950 German scientists performed new researches on isometrics training, the results indicated that the training with static strength caused enormous gains on muscular strength, such training is superior to other dynamic action methods (WILMORE e COSTILL, 2001).

In this research, both groups presented gain in strength, but, for this specific research, the group without electrical stimulation did not show a significant increase in the average, and the group that used Russian Current presented very significant increase.

Several studies showed that the electrical stimulation leads to a gain in strength similar or in some few cases even greater than those obtained when the volunteered exercise is made isolated.

Gathering lots of these studies, the average gain in strength using electrical stimulation would be of 20 to 25% in approximately one month, varying between no increase to 50% increase in strength (LOW e REED, 2001). In this research, the increase in strength on the group that has used the electrical stimulation on Russian Current was of 39,94%, such percentage justifies the therapy using electrical stimulation on Russian Current associated to isometrics for trainings which aim the gain in strength.

In the work done by Sivini and Lucena (1999), it was verified the development of muscular strength using Russian Current on healthy people. They used four groups, those performed protocols composed only on exercises to strengthen the quadriceps, on NMES or the combination of both. Therefore, like this research, the results indicated that NMES is efficient on programs of muscular strengthening when associated to volunteer exercises of the same type, in this specific case, it was used isometrics for the treatment.

Characteristics of the electrical stimulation program such as the: number of sessions, intensity of the current and frequency are totally variable. As for the number of sessions, some researches like Soo, Currier and Threlkeld (1988), observed a significant gain in 10 sessions. Others, like Delitto, et al. (1988) and Mohr, et al. (1985), observed significant increase between 12 and 25 sessions. For this reason, we have chosen to perform a treatment of 12 sessions, three times a week, for 20 minutes.

Related to the positions of the electrodes on the motor spots, as used in this presented research, are justified by the fact that Salgado (1999), related that in the electrical stimulation, the electrodes must be put on the motor spots of the body, where the impedance is smaller, in other words, where the resistance on the passage of the current is smaller, hitting the muscle with bigger efficiency, this way increasing the muscular strength.

Low and Reed (2001) have affirmed that the use of NMES on normal muscles with the objective of increasing the muscular strength is, still, a question that is not entirely answered. The essence of the problem seems to be the fact that the electrical stimulation increases the muscular strength, but not in the same amount as it would be possible with the equivalent volunteering exercise. And, Noronha et al (1998), also said that there are no increases on muscular strength through neuromuscular electrical stimulation on healthy people. Such statements contradict with this research, as it is clearly possible to observe that the group in treatment with isometrics associated to electrical stimulation obtained an average increase of 39,84% in strength, as for the other group which was treated only with isometrics, the average was only 15,10%.

Delitto, Rose and Mckowen, (1988) compared the effectiveness of 2 protocols of muscular strengthening. As the experience finished its results showed that the subjects submitted to the protocol of stimulation presented higher percentages, relating to the muscular strength, than to those subjects from the exercise group only, all that can be clearly observed in the analysis of the results in this research.

Guirro, Nunes and Davini (2000) reported that the increasing of the strength in electrical stimulation is due to a bigger intensity supported, as a consequence for the higher recruiting of motor units. Brasileiro & Villar (1997) report that, the higher the intensity supported by the subject, within the limits of pain, the bigger is the gain of muscular strength. Canavan, (1995) says that the fact of associating an isometrics contraction to NMES makes the current more comfortable, improving the tolerance of the patient to the current, increasing the gain of muscular strength.

However, findings of researches referring to effects of therapeutic electricity on muscular strength are confusing and

controversial, in part due to the differences between methodologies of research, as well as in the selection of subjects. (CANAVAN, 1995)

Due, as well, to an enormous variety of used protocols, comparisons between the researches already published are difficult. Then, the proposal of this research was to verify if the stimulation in the gain of muscular strength associated to isometrics is more efficient than a training constituted only of exercises of isometrics muscular contraction. That which can be clearly proved is that the second group obtained a higher average (39,94%), with a difference of 24,84% from group 1 (15,10%).

CONCLUSION

Throughout the results obtained in this research, the gain of muscular strength was progressive in both groups, but the group which was treated with isometrics associated to Russian stimulation obtained a higher average when compared to the group that only used isometrics.

We may conclude as satisfying the electrical stimulation on Russian Current associated to isometrics, making the use of this current important to better results in the sense of: increase in muscular strength.

It is suggested that there should be performed more researches using the association of electric currents (NMES) to active exercise, looking for more proper parameters and that those promote more gains in muscular strength and bigger therapeutic benefits to the patients.

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COMPARISON OF MUSCULAR STRENGTH INCREASE BY ISOMETRICS, with or without RUSSIAN STIMULATION

ABSTRACT

The neuromuscular electrical stimulation (NMES) is a non-invasive therapeutic procedure, with the purpose of producing muscular contraction. It is very used in the clinical practice favoring the strengthening and muscular hypertrophy in the healing process of diseases, it also improves physical conditions and esthetic aspects. The applying technique is critical to the effectiveness of the results. This research's goal is to verify if an active exercise is more efficient when associated to a neuromuscular electrical stimulation. In the process, 14 volunteering subjects participated, those were adequate to the criteria of inclusion/exclusion, divided into two groups: G1 – verify the effectiveness of the treatment with isometrics isolated; G2 – verify the effectiveness of the treatment with isometrics associated to NMES on Russian current. The treatment lasted 20 minutes for both groups, with 9 seconds of isometrics contraction and 9 seconds of relaxation, however, in the second group it was associated to the device in a frequency of 2500Hz modulated to 30Hz to activate fibers type I and 50Hz to activate fibers type II, with the maximum supported dose. All subjects were evaluated and revaluated with a dynamometer, in the beginning, the middle and the end of the treatment, in a total of 12 sessions. The average of the increasing for the G1 was of 3,12 Kg / s, for G2, 7,82 Kg / s. Through the obtained results, we may conclude that both groups obtained an increase in progressive muscular strength, but only the second group it was significant to this research, with a difference between them of 24,84%, making the application of Russian stimulation important for the muscular strengthening.

KEYWORDS: electrical stimulation, Russian current, muscular strength.

COMPARAISON DE L'AUGMENTATION DE FORCE MUSCULAIRE PAR ISOMÉTRIQUE, ASSOCIÉE OU NON À LA STIMULATION RUSSE.

RÉSUMÉ

La stimulation électrique neuromusculaire (SENM) est une procedure thérapeutique non envahissante, avec intention de produire de contraction musculaire. Elle est largement utilisée dans la pratique clinique en favorisant la fortification et l'hypertrophie musculaire dans la guérison des maladies, l'amélioration de la condition physique et l'aspect esthétique. La technique d'application est très importante pour l'efficacité des résultats. Cette étude a eu l'objectif de vérifier si un exercice actif a plus grande efficacité quand il est associé à l'électrothérapie. L'étude a inclus 14 volontaires, qui étaient conformes aux critères d'inclusion / exclusion, divisés dans deux groupes: G1 - vérifier l'efficacité du traitement par isométrie isolement ; G2 - vérifier l'efficacité du traitement par isométrie associée à la SENM par courant russe. La durée du traitement pour les deux a été de 20 minutes, 9 secondes de contraction isométrique et 9 secondes de détente, mais le second groupe a été associé à l'appareil à une fréquence de 2500Hz modulée par 30 Hz pour activer les fibres de type I et 50 Hz pour activer les fibres type II, avec dose maxima supportée.Tous ont été évalués et réévalués avec un dynamomètre, au début, milieu et à la fin des assistances, un total de 12. L'augmentation moyenne du G1 de 3,12 Kg/f, et G2: 7,48 Kg/f. À travers les résultats obtenus, il se peut observer que les deux groupes ont obtenu augmentation de force musculaire progressive, cependant seul le second groupe a été significatif pour cette recherche, avec différence entre eux de 24,84%.

MOTS-CLÉS: Courant russe ,Force musculaire,Stimulation électrique.

COMPARACIÓN DEL AUMENTO DE LA FUERZA MUSCULAR POR ISOMETRÍA, ASOCIADA O NO A LA ESTIMULACIÓN RUSA

RESUMEN

La estimulación eléctrica neuromuscular (EENM) es un procedimiento terapéutico no invasivo, con el propósito de producir contracción muscular. Es muy utilizada en la práctica clínica favoreciendo el fortalecimiento e hipertrofia muscular en la cura de enfermedades, mejora del acondicionamiento físico y aspecto estético. La técnica de aplicación es muy importante para la efectividad de los resultados. Este estudio objetiva verificar si un ejercicio activo tiene mayor eficacia cuando asociado a una electroestimulación neuromuscular. Participaron de este estudio 14 individuos voluntarios, que se adecuaron a los criterios de inclusión/exclusión, divididos en dos grupos: G1 – verificar la eficacia del tratamiento con isometría aisladamente; G2 – verificar la eficacia del tratamiento con isometría asociada a la EENM por corriente rusa. El tiempo de tratamiento en ambos fue de 20 minutos, con 9 segundos de contracción isométrica y 9 segundos de relajamiento, pero en el segundo grupo fue asociado al aparato en una frecuencia de 2500Hz modulada por 30Hz para activar fibras tipo I y 50Hz para activar fibras tipo II, con dosis máxima soportada. Todos fueron evaluados y reevaluados con un dinamómetro, al inicio, medio y fin de los atendimientos, en un total de 12. La media de aumento para G1 fue de 3,12Kg/f, y para G2 7,48Kg/f. Por medio de los resultados obtenidos, podemos concluir que ambos los grupos obtuvieron aumento de fuerza muscular progresiva, pero solamente el segundo grupo fue significativo para este estudio, con diferencia entre ellos de 24,84%, tornando la aplicación de la estimulación rusa importante para el fortalecimiento muscular.

PALABRAS CLAVE: Estimulación eléctrica, corriente rusa, fuerza muscular

COMPARAÇÃO DO AUMENTO DE FORÇA MUSCULAR POR ISOMETRIA, ASSOCIADA OU NÃO À ESTIMULAÇÃO RUSSA

RESUMO

A estimulação elétrica neuromuscular (EENM) é um procedimento terapêutico não invasivo, com intuito de produzir contração muscular. É muito utilizada na prática clínica favorecendo o fortalecimento e hipertrofia muscular na cura de enfermidades, melhora do condicionamento físico e aspecto estético. A técnica de aplicação é muito importante para a efetividade dos resultados. Esta pesquisa objetiva verificar se um exercício ativo tem maior eficácia quando associado à uma eletroestimulação neuromuscular. Participaram deste estudo 14 indivíduos voluntários, que se adequaram aos critérios de inclusão/exclusão, divididos em dois grupos: G1 - verificar a eficácia do tratamento com isometria isoladamente; G2 - verificar a eficácia do tratamento com isometria associada à EENM por corrente russa. O tempo de tratamento em ambos foi de 20 minutos, com 9 segundos de contração isométrica e 9 segundos de relaxamento, porém no segundo grupo foi associado ao aparelho numa freqüência de 2500Hz modulada por 30 Hz para ativar fibras tipo I e 50 Hz para ativar fibras tipo II, com dose máxima suportada. Todos foram avaliados e reavaliados com um dinamômetro, no início, meio e fim dos atendimentos, em um total de 12. A média de aumento para G1 foi de 3,12Kg/f, e para G2: 7,48Kg/f. Através dos resultados obtidos, podemos concluir que ambos os grupos obtiveram aumento de força muscular progressivo, porém somente o segundo grupo foi significativo para esta pesquisa, com diferença entre eles de 24,84%, tornando a aplicação da estimulação russa importante para fortalecimento muscular.

PALAVRAS-CHAVE: estimulação elétrica, corrente russa, força muscular.

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