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Immediate response gain in handgrip strength with acupuncture: an experimental study

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Abstract:	BACKGROUND: Muscle strength is an important component for performing different daily tasks and has significant effect on health. Grip strength can be considered as one of the parameters of the overall strength state of the individuals. The objective of this study was to evaluate the immediate response of the capacity of gaining handgrip strength after the application of acupuncture. MATERIALS AND METHODS: The study was experimental, quantitative, and partially blind clinical trial with a control group. The sample consisted of 73 healthy volunteers of both sexes, not athletes, with average age 35 ± 10.01 years, which were divided by deterministic allocation with sequential alternation in three groups: acupuncture (GACP n=24), sham acupuncture (Gsham n=25) and control (GCRT n=24). Calibrated mechanical manual dynamometer and needles 0.25 x 40mm were used. The handgrip test was performed in all groups, in both hands. The average measures were used for statistical analysis, this procedure was done before and after the intervention. The GACP received needles in TE5 (Waiguan), ST36 (Zusanli) and GB34 (Yanglingquan). The Gsham received superficial needles placed out of the acupoints. RESULTS: GACP showed a significant strength gain of 4.78 Kgf (p = 0.005), the Gsham showed a non-significant gain of 1.13 Kgf (p = 0.370) and GCRT that not received acupuncture intervention, showed a non-significant reduction of handgrip strength average of about 1.97 Kgf (p = 0.210). CONCLUSION: The acupuncture in a single intervention was able to promote as immediate significant average gain strength response in handgrip of 4.78 Kgf.
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Immediate response gain in handgrip strength with acupuncture: an experimental study

ABSTRACT

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CONCLUSION: The acupuncture in a single intervention was able to promote as immediate significant average gain strength response in handgrip of 4.78 Kgf.

KEYWORDS: Acupuncture, strength gain, handgrip.

1 INTRODUCTION

The hand is a complex organ with specialized mechanisms that allow man to achieve details and unique activities. The muscular action at hand movements enables a wide range of amplitude and mio-articular arrangements. This makes the hand not only a structure capable of performing great grip strength but, also, to present fine motor skills such as when playing an instrument (Taekema et al., 2009).

The term muscle strength is generally used to define the ability of a particular muscle to produce or to resist to a load, and it is classified like isometric, isotonic and isokinetic (Borges et al., 2009). Muscle strength is essential to the performance of motor skills, whether related to athletic performance or activities of daily living (Sasaki et al., 2007).

There is a close relationship between muscle strength and functional capacity. Therefore, the evaluation of muscle strength is of great importance and essential to detect possible changes and risks in specific populations, such as in athletes (Soares et al., 2012).

The precise measurement of the exerted forces by the fingers and hand is of great value in biomechanical studies. It is also useful for evaluating the recovery of

people undergoing surgery of the hands or the loss of upper limb mobility due to illnesses, accidents or disabilities (Martins et al, 2015). In their studies, Smith et al. (2006) and Habibi et al. (2013) concluded that, by evaluating the handgrip strength, it is possible to predict the quality of the strength of the whole body, thus becoming an important predictive method.

In the sports area, the grip strength is strongly required in specific modalities and can be a key factor in athletic performance, such as athletics throwing, gymnastics, rowing, tennis and others. The occurrence of muscular fatigue in gripping in some decisive moments can result in an error, leading to the athlete to defeat (Leyk et al., 2007).

The acupuncture is currently being used in the routine clinical practice to improve muscle weakness conditions, lassitude and asthenia, by his energetic or invigorating effects, arousing the interest by its study. Based on this fact, some acupoints have awoken research interest for their ergogenic effects (Yin et al., 2007; Ahmedov, 2010). Acupuncture in the clinical setting requires syndromic diagnosis and needs subsequent sessions to achieve results (Maciocia, 2015). A Few studies addressed the immediate response of the ergogenic effects of acute intervention by acupuncture.

The objective of this study was to evaluate the immediate response capability of grip strength gain after a single application of acupuncture.

2 MATERIALS AND METHODS

2.1 Subjects and sample

This study was previously approved by the Ethics Committee of the IBRATE Faculty of Technology under number 129.429/2012. The sample consisted of 73 volunteers of both sexes, sedentary, with average age of 35 ± 10.01 years. Volunteers were divided by deterministic allocation in sequential alternation into three groups: acupuncture (GACP n = 24), sham acupuncture (G*sham* n = 25) and control (GCRT n = 24).

Volunteers were recruited by self-selection (posters) meeting the following eligibility criteria: not being pregnant, no surgeries in upper limbs, no chronic musculoskeletal disorders, that could interfere with the correct execution of the dynamometer test. Also, volunteers should not have ingested analgesics, antispasmodic, anti-inflammatory, muscle relaxant or anesthetic medications, received acupuncture or physiotherapy within three days before the data collection. Volunteers should not have done physical exercise to strengthen upper limbs during the week before the data collection.

2.2 Methods

The study was blinded by the evaluator and partially blinded by the volunteer, quantitative and with a control group. The data collection, acupuncture and handgrip test were conducted on the premises of the clinical school of IBRATE Faculty of Technology (Curitiba, Brazil).

After signing a consent term, according to the Helsinki Declaration, volunteers were designated by deterministic allocation in sequential alternation to one of three

groups: acupuncture (GACP n = 24), *sham* group (G*sham* n = 25) and control group (GCRT n = 24), with no exclusion in the sample until the end of the study.

In the first stage of the study, the volunteers performed the grip strength test, using a mechanical manual dynamometer (Grip dynamometer, model 5001, Takei Scientific Instruments, Japan), previously calibrated. The equipment measures the strength depending on the amount of tension produced, ranging from 0 to 100 Kgf, with individual adjustment size of the handle strap (Figure 1).

For a correct application of the handgrip strength test, we followed the protocol recommended by Fernandes and Marins (2011), such as the communication of guidelines to the volunteer about the correct position for performing the test, number of measurements, rest period between attempts, duration time of contraction, and strap position.

Volunteers were informed that they should wait for the evaluator's command to start performing each maximum gripping movement. They performed three repetitions of maximum strength contractions using the right hand and another three using the left hand. For the statistical evaluation, the average of the three measurements of each hand, before and after the intervention, were considered.

Figure 1 - Illustration of the handgrip test.

The maximum contraction time was three seconds, after when the evaluator voiced the "stop" command. With the dynamometer pointer locked at the maximum value, the strength value was read from the device.

The dynamometry test was applied by the invitation of a professional Physical Education, who was not aware to which group each volunteer belonged. After running the test, volunteers belonging to the GACP were needled bilaterally in the following acupoints; ST36 (*Zusanli*), TE5 (*Waiguan*) and GB34 (*Yanglingquan*), according to Lian et al. (2012), and they remained at rest for 20 minutes. Disposable stainless steel threadlike needles, measuring 0.25 x 40 mm (Arhon Din®, Brazil) were used.

Among the above-mentioned acupoints, ST36 is considered the most effective to gain strength by acupuncture (Ahmedov, 2010). Also, Maciocia (2015) recommended acupoint TE5 to increase "Yang energy" and vitality, and GB34 to strengthen the tendons.

Disposable needles were introduced at a depth of 1.5 inches (38.10mm) and initially stimulated until the patient reported a "deqi" feeling, which corresponds to a tingling, light "shock" and/or heavy feeling in the arms. The G*sham* group received only

superficial needling and outside the acupoints. A distant location was chosen medially 20 mm far from those points used in the GACP. The GCRT was submitted to the handgrip strength test, and remained at rest for 20 minutes.

All the acupuncture applications were performed by a professional trained acupuncture. Volunteers did not know to which group they belonged. After the resting period, all the volunteers of all groups were reevaluated with the grip strength test.

2.3 Statistical analysis

The data collected were subject to an exploratory analysis, using the graphical methods of Box-and-Whiskers and Steam and Leaf for the identification and deletion of outliers that potentially influenced the central tendency parameters (Elliott and Marsh, 2008). The symmetry and flattening of the distribution curves were evaluated by means of the skewness and kurtosis values, respectively. Normality of distributions was confirmed by the Kolmogorov-Smirnov non-parametric test, with the Lilliefors correction.

Next, using the descriptive statistics, the average and standard deviation of the variables under study were calculated, for the total sample and for each study group. The comparison between the mean values obtained for each group at each moment of the evaluation was made by One-Way ANOVA test with Post Hoc LSD to compare the variables in pairs. The intra-group analysis compared the average of the force between the pre-treatment times and immediate post-treatment using the Student t-test for paired samples, and the significance level was set to 0.05. For all the statistical analysis, we used the SPSS program, version 20.

3 RESULTS

Table 1 shows the average values (± SD) by age and handgrip strength for each group at each time of evaluation.

Table 1 - Average values (± SD) by age and handgrip strength (Kgf) in the GACP, G*sham* and GCRT at every moment of the evaluation.

Group	n	Average age	Handgrip strength	
			Pre-treatment	Immediate post
GACP	24	36.42 ± 10.74	32.21 ± 9.71	33.64 ± 9.93
Gsham	25	33.48 ± 7.57	34.65 ± 8.71	34.99 ± 8.76
GCRT	24	30.92 ± 9.83	32.95 ±10.40	32.44 ± 10.75

No significant differences in age between the groups were found. The percentage variation between groups revealed significant differences in handgrip strength of the pre-treatment time to the immediate post-treatment time ($F = 6.183$ $p = 0.003$), see Figure 2.

When comparing groups in pairs, regarding the percentage variations, the GACP showed significant increase in strength when compared to GCRT ($p = 0.001$) and, also, a statistically significant trend when compared to G*sham* ($p = 0.059$). There was no significant difference between G*sham* and GCRT.

When comparing the strength average between pre-treatment and immediately post-treatment moments in each group, only the GACP presented significant increase in the handgrip strength (p = 0.005).

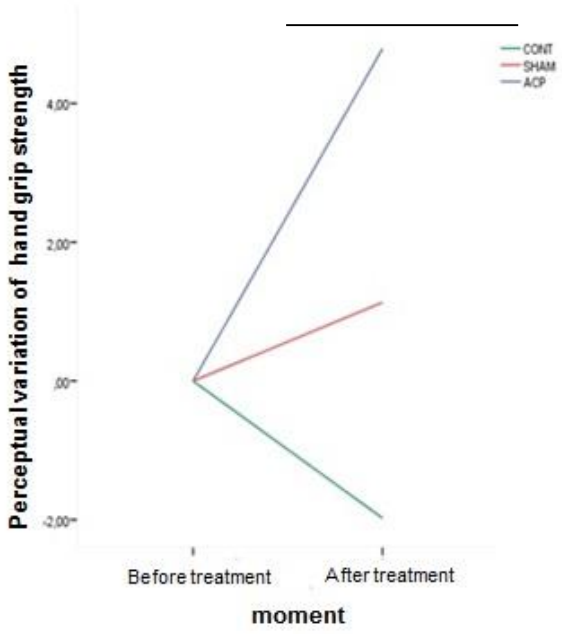

Figure 2 - Percentage variation of the average handgrip strength (Kgf) in the GACP, G*sham* and GCRT, between the two moments of evaluation (* p <0.05).

4 DISCUSSION

This study raised an important result regarding to the immediate effect of acupuncture in a single intervention. Results indicate that acupuncture was able to significantly and immediately increase the gain of handgrip strength measured by the dynamometer. This result is consistent with the studies of Yim et al (2007) and Huang et al. (2007) who concluded that there are ergogenic effects of some acupoints. It is possible that the lost of strength found in GCRT may be due to muscle relaxation, considering that the volunteers of this group received no intervention. However, they rested supine on a stretcher at the same time and under the same conditions and between other subjects.

The muscular strength is among the key components for the evaluation of fitness. According Lucareli et al (2010) handgrip test can be considered as a parameter of the overall power status of individuals having high acceptability in physical fitness tests, particularly when evaluating muscle strength of the upper members. Therefore, to assess handgrip strength it's important and very frequent in occupational health, driver's licenses of expedition expertise, according to the National Traffic Council (2012), and admission tests in various types of work, among others.

In the present study we observed the appropriate use of the dynamometer as an assessment instrument between pre and post-treatment moments. However, it is important to notice that a methodical and meticulous execution is required by the evaluator, with verbal commands and demonstration. It is not unusual for volunteers to try to go beyond their own limits as to compete with themselves.

Handgrip strength is influenced by factors such as age, gender, weight, palm surface and fingers size, and body mass index, among others (Habibi et al., 2013). In the present study, groups were homogeneous.

There are 35 muscles related to forearm and hand movement, and many of them are involved in the grip action. According to Kisner and Colby (2009) the muscles of the flexor mechanism of the hand and forearm create grip strength, while the forearm extensors stabilize the wrist. Steven-Moore (2002), studying pathogenesis models of repetitive stress injuries in extremities of upper limbs confirms that the main critical factor for the development of this type of injury is the compression force transmitted to the retinaculum extensor muscle. Therefore, handgrip strength gains are important, supporting the curative, preventive or performance aspects.

Nichols and Harrigan (2006) point out that the use of complementary and alternative medicine (CAM) among western athletes is increasing. Alternative therapies, including acupuncture, are used by 56% of athletes, against 36% in the non-athlete population. Koh et al. (2012) demonstrate concern about their studies because the athletes are among the largest users of CAM, including looking for "on their own" resources and, opposed to the rest of the population, they would be using these therapies not only for rehabilitation, but also aiming potential benefits in sports performance, often without proper monitoring.

Recent years have witnessed a growing interest of the scientific community in the possible effects of acupuncture in the variables involved in the physical performance (Zhou et al., 2012). Studies of physical strength and performance are more evident in athletes. A study by Luna and Fernandes-Filho (2005) evaluated the effects of acupuncture in high-performance speedsters in maximal dynamic strength variables, explosive, anaerobic endurance and speed. The results showed a clinically significant improvement in all the variables studied and statistically significant improvement in maximal dynamic strength and explosive power. In that study they do not considered the *sham* and control groups.

Hubscher et al. (2010) evaluated the effect of acupuncture in the isometric strength of hip in 33 non-professional athletes. They found significant strength gains compared to the *sham* and the placebo group. Another study of Snyder et al. (2011) in healthy subjects demonstrated that the acupuncture at the ST36 point (*Zusanli*) increased significantly the propulsion force of vertical jumps. In another area, Rancan et al. (2009) also found good results in strength gains, concluding that the acupuncture has increased molar bite strength and changes in electromyography activity of masticatory muscles in the volunteers assessed.

Overall, the present study and the literature cited converge to a consensus, strongly indicating the good results, the use of acupuncture to gain strength, despite targeting different muscle groups that proposed methodology, strength type and population. However, it is worth to notice that there are results that contradict those discovery in this study, such as Costa and Araújo (2008), conducted in mice, not in humans. They found that the isometric strength of the tibialis anterior muscle was reduced after acupuncture.

The physiology of the ergogenic effects associated with acupuncture has been the focus of some authors. Lee et al. (2002) through a study with rats showed suppressive effects of acupuncture on 5 HT (5-hydroxytryptamine) and the expression of TPH (tryptophan hydroxylase) in the dorsal raphe nucleus, observing that the increased concentration of 5 HT reduces physical performance in humans and rats.

A study of Toda (2012) concluded that acupuncture was able to increase the carnitine levels and, therefore, decrease the fatigue of skeletal muscle. It is known that a

muscle fatigue tend to lose strength, particularly to sustain the movement. Enoka and Duchateau (2007) also found functional improvement using acupuncture, by increasing the local microcirculation and, consequently, better oxygenation of the muscle tissues, as well as

the removal of metabolites and increase of ATP synthesis (Sandner-Kiesling et al., 2001; Goldman et al., 2010).

The increase in muscle strength or other physical capabilities are important, making it crucial to certain populations, even small gains. Recalling the London Olympics Games in 2012, gold, silver and bronze medals in the men's weightlifting up to 105 kg were separated by a difference performance of only 1 Kg (http://www.olympic.org/weightlifting, Acess: 05/22/2015).

Another area that can be covered with the strength gain benefits is gerontology. Alexander et al. (2008) studied the behavior of grip muscle strength in elderly. Observing that this population loses muscle mass and consequent muscle strength over the years, they concluded that muscle strength is a physical capability of extreme importance in domestic accidents.

About the composition of acupuncture points assessed in this study, we observed that, in addition to the ergogenic effects, there was operational ease of execution, good tolerance and openness of the volunteers, which provide therefore a recommendation for further work and physical training programs.

5 CONCLUSION

The results of this study demonstrated significant and immediate increase of grip strength when comparing the moments before and after the application of acupuncture needles in the points: ST36 (*Zusanli*), TE5 (*Waiguan*), and GB34 (*Yanglingquan*). Results found suggest exciting possibilities, through discreet. It is recommended to extend this study to evaluate the efficacy and operational viabilities of use in athlete monitoring programs, particularly for high-performance athletes, in which small gains may be representative for the final result. The evaluation of the stability of gains over time gain is suggested for future studies.

6 CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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