

Effect of myofascial techniques applied to the cranial region on autonomic Nervous System analyzed by Heart Rate Variability.

Efeito das técnicas miofasciais aplicado à região craniana no Sistema Nervoso Autônomo analisados por Variabilidade da Frequência Cardíaca.

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Abstract

Introduction: To study the effect of myofascial techniques applied to the cranial region on the behavior of autonomic nervous system (ANS), using the analyses of heart rate variability. **Method:** This is a clinical trial study accomplished with 66 healthy subjects (33 male and 33 female). Myofascial techniques applied to the cranial area using craniosacral therapy were executed on the individuals. The Nerve-Express system, a fully automated system, was used before and after the application of the techniques to quantitatively assess the autonomic function based on heart rate variability analysis. To verify the existence of differences among the dependent variables the Wilcoxon Signed Ranks Test was used and Mann-Whitney Test was applied in order to compare the independent variable. **Results:** It was observed a statistically significant increase, in the values of parasympathetic nervous system (PSNS), after the application of the technique. The quantitative values of sympathetic nervous system (SNS) decreased or did not modify in female group. This profile in female group was statistically significant although in the male group the myofascial mobilization did not modify the values of SNS. The quantitative values of SNS and PSNS behaved equal relatively in both studied groups, not being significant statistically the difference between the male and female groups. **Conclusion:** These results suggest that the myofascial technical applied to the cranial area by craniosacral therapy is able to promote alterations in the behavior of ANS, generally, increasing PSNS and decreasing SNS.

Keywords: Skull; Musculoskeletal Manipulations; Autonomic Nervous System; Heart Rate.

Resumo

Introdução: Estudar o efeito das técnicas miofasciais aplicadas no crânio e seu comportamento no sistema nervoso autônomo, usando a análise da variabilidade da frequência cardíaca. **Metódo:** Este é um estudo ensaio clínico realizado com 66 indivíduos saudáveis (33 do sexo masculino e 33 do sexo feminino). Técnicas miofasciais aplicadas à área cranial usando terapia craniossacral foram executados sobre os indivíduos. O sistema Nerve-Express, um sistema totalmente automatizado, foi usada antes e após a aplicação das técnicas de avaliar quantitativamente a função autônômica com base na análise da variabilidade da frequência cardíaca. Para verificar a existência de diferenças entre as variáveis dependentes foi utilizado o teste Wilcoxon Signed Ranks enquanto que o teste de Mann-Whitney foi aplicado para comparar a variável independente. **Resultados:** Foi observado um aumento estatisticamente significativo, nos valores do sistema nervoso parassimpático (SNPS), após a aplicação da técnica. Os valores quantitativos do sistema nervoso simpático (SNS) diminuiu ou não apresentou mudanças no grupo feminino. Este perfil no grupo feminino foi estatisticamente significativo, embora no grupo masculino a mobilização miofascial não alterou os valores de SNS. Os valores quantitativos do SNS e SNPS comportou relativamente igual em ambos os grupos estudados, não sendo estatisticamente significativa a diferença entre os grupos masculino e feminino. **Conclusão:** Estes resultados sugerem que a técnica miofascial aplicada à área craniana por terapia craniossacral é capaz de promover a alterações no comportamento do SNA, geralmente, aumentando o SNPS e diminuindo o SNS.

Palavras chaves: Crânio, manipulações musculoesqueléticas, sistema nervoso autônomo, frequência cardíaca.

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INTRODUCTION

Since the first evidence of the mobility between cranial sutures, described by Sutherland⁽¹⁾ in the early 1930s, different studies have been performed on this area. The idea that restrictions in cranial mobility could promote modifications in the organism led to the creation of diverse therapeutic modalities, such as, cranial osteopathy e craniosacral therapy.^(2,3) Despite the fact that these therapies present differences in the methodology, they use the same concept of involuntary mobility of the cranial bones: the palpation of the cranial rhythm/impulse and the treatment of the diverse dysfunctions.^(2,3)

Craniosacral Therapy (CST) has been used to treat different conditions, ranging from headaches pain to developmental disabilities. The CV-4 technique, also used in CST, was referred to support the compression of the fourth ventricle, as studied by Hanten and colleagues.⁽⁴⁾ They found that CST was able to reduce the superior pain when compared with the resting positioning or no intervention for tension-type headaches. The potential to use CST in the conventional care in adults with asthma has also been demonstrated.⁽⁵⁾ However, the British Columbia Office of Health Technology Assessment, in a systematic review of scientific evidence, found insufficient evidence to support CST.⁽⁶⁾ In spite of the disagreement in the literature, the palpation of patients using CST motion and the use of the information to guide further evaluation and treatment is being used by craniosacral practitioners.⁽⁷⁾

The focus of CST is the dura mater membrane system, as the primary cause of dysfunction. The bones of the skull can be as "handles" for the practitioner to use to access and affect the membrane system that attaches to those bones.⁽⁸⁾ The myofascial system is an integral part of the initial CST evaluation. In normal conditions, the fascia remains somewhat mobile, thus mobility restrictions are then interpreted to be sites of either current problems or residue from previous lesions or alterations.⁽⁸⁾ The cranial nerves also carry dural sleeves with them for some distance; therefore, any abnormal meningeal tension may be transmitted to a nerve and affect its function. Tension anywhere along the contiguous meninges can, therefore, be transmitted to the cranial nerves, since both peripheral and central nervous systems are continuous in tissue tract.⁽⁹⁾

Cutler et al.⁽¹⁰⁾ studying the autonomic nervous system (ANS) and the cranial manipulation, for the first time, showed that the cranial manipulation, specifically using CV-4 technique, can alter sleep latency, determining directly the muscle sympathetic nerve activity in healthy humans. According to Upledger and Vedevoogd⁽⁹⁾, the ANS is closely related to the craniosacral system. The ANS presents an important role in the maintenance of homeostasis and influences

the activity of most tissues and organ systems in the body.⁽¹¹⁾ Thus, disorders in the ANS could produce different systemic alterations, like endocrine dysfunctions and the increase in both heart rate and blood pressure.

The study performed by Task Force of the European Society of Cardiology and North American Society of Pacing and Electrophysiology⁽¹²⁾ demonstrated that heart rate variability (HRV) represent a potential method to evaluate the ANS, both in healthy individuals and patients with diverse cardiovascular and non-cardiovascular disorders. It has been shown that HRV signals contain well defined rhythms, providing important physiological information.⁽¹³⁻¹⁵⁾

In the CST, myofascial mobilization techniques are used directly on the cranial region, as a treatment procedure.⁽⁹⁾ Fascia liberation decreases the tension on both dura mater and cranial structures.⁽⁸⁾ Thus, this technique could promote the relaxation and a better mobility in the cranial bones, leading to regular functions in the body.^(8,9) Since normalization in the cranial motility could produce modifications in the ANS, in this work we studied the effect of myofascial techniques applied in the cranial region on the behavior of ANS, using the analyses of heart rate variability.

METHODS

Subjects

This is a clinical trial study, which sixty-six health volunteers (33 female and 33 male) were recruited in a simple convenience. Description of participants is presented in the table 1. For both groups the exclusion criteria included: modifications in either cranial or central nervous system or the use of medications known to affect the autonomic and/or cardiovascular systems. The procedure was explained to the subjects before it was begun, and they were free to withdraw from the study at any stage. All volunteers received written information prior the experiment and signed a consent form. All experiments were approved by the Vale do Paraíba University Human Research Ethics Committee (protocol number: H271/CEP/2007).

Table 1. Description of the studied population.

Sex	Variables	Mean	Std. Deviation
Female (n=33)	Age (years)	24.21	2.91
	Height (m)	1.63	0.06
	Weight (Kg)	56.03	8.32
Male (n=33)	Age (years)	24.67	3.05
	Height (m)	1.77	0.07
	Weight (kg)	74.33	11.78

m = meter; Kg = kilogram

Instrumentation

In this study was used the Nerve-Express system (NE)(Heart Rhythm Instruments, Inc. USA), a non-invasive system, fully automated computer-based which permits a quantitative assessment of the ANS based on HRV analysis. The evaluation was based on the Orthostatic test (Orthotest) as a test modality offered by NE. The NE recognizes 74 ANS states that represent different relationships between sympathetic nervous system (SNS) and parasympathetic nervous system (PSNS) activities. These states are illustrated in the Cartesian system of coordinates, been the PSNS represented on the X-axis and the SNS on the Y-axis. The intersection point among the axes is the point of autonomic balance; to the right and above this point, NE reproduces an area of increased SNS and PSNS activities in four graduations. The decrease of SNS and PSNS activities are demonstrated below and left of the point of autonomic balance.⁽¹⁶⁾

Technical intervention

Myofascial techniques applied in the cranial area by CST were selected for this study. They are them: 1) suboccipital stimulation, 2) Frontal Lift, 3) Parietal Lift, 4) Sphenobasilar Compression-Decompression, 5) temporal wobble and 6) ear pull. The techniques were executed in agreement with the beginnings of the craniocervical therapy,⁽⁹⁾ by a physiotherapist specializing in Manual Therapy with knowledge and practice of the myofascial cranial therapy.

Research method

The subjects were oriented to maintain silence, normal respiration and to be relaxed during the test execution. Before beginning the tests all subjects remained resting for during 10 minutes, in order to maintain the normal heart rate. Initially, the orthotest was done. After orthostatic test application, the myofascial techniques were executed in the cranial area in a comfortable supine position, during approximately 20 minutes. After the myofascial techniques, the orthotest was immediately repeated. This procedure was executed in the same manner to all subjects in a quiet environment.

Statistical Analysis

The quantitative values presented by NE were transported to a database in the program Microsoft Excel 2007 and analyzed using the SPSS version 13.0 (Statistical Package for the Social Science - SPSS Inc, Chicago). In order to verify the specific and general characteristics of the studied sample it was performed a descriptive analyzes. In order to verify the normality in the distribution of the data, both the Shapiro-wilk and Kolmogorov-Smirnov normality test were used. Once the normality in the distribution of the data was not observed, non-parametric tests were used. To verify the exist-

ence of differences among the dependent variables (heart rate, PSNS e SNS, both before and after mobilization techniques of skull) the Wilcoxon Signed Ranks Test was used. The Mann-Whitney Test was used to compare the independent variable, in other words, the difference between male and female group. The results were considered statistically significant when $P < 0.05$.

RESULTS

Initially, we studied the behavior of heart rate after application of the myofascial technique on the individuals. A decrease in the heart rate was observed after using the technique, both in the male and the female groups, in the supine position (Fig 1). In the female group, this decrease was statistically significant, in both supine and upright positions (Figs 1 and 2). However, in the male group, the decrease was statistically significant only in the supine position, not presenting a statistically significant difference in the standing position (Figs 1 and 2). Despite the fact that the decrease in the heart rate was higher in the female group when compared to male group in the supine position, the statistical analysis showed that this difference was not significant. These data demonstrated that the use of myofascial technique was able to promote a decrease in the heart rate in the individuals treated.

The quantitative values of PSNS produced by Nerve-express system, both before and after using myofascial technique are shown in the figure 3. An increase in the values of PSNS was observed after the application of the technique, both in female and male groups. This in-

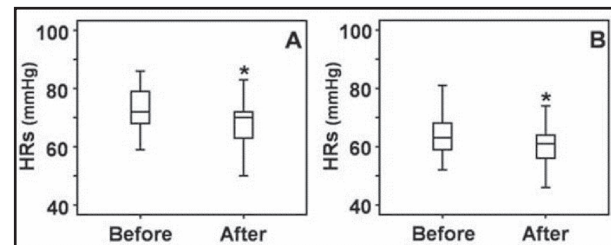


Figure 1. Boxplot of the heart rate values in the supine position (HRs) determined both before and after the myofascial techniques were applied on the skull. Female group (A), male group (B). Statistical analysis indicated $p < 0.05$ (*).

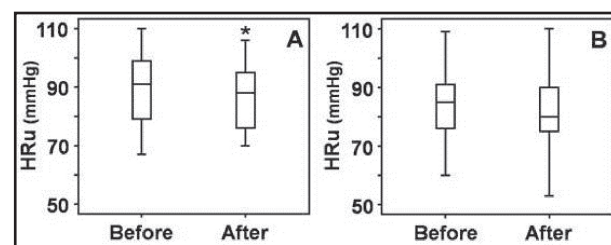


Figure 2. Boxplot of the heart rate values in the upright position (HRu) determined both before and after the myofascial techniques were applied on the skull. Female group (A), male group (B). Statistical analysis indicated $p < 0.05$ (*).

crease was statistically significant when compared the before and after groups, both in the female and the male groups. Although the increase in quantitative values of PSNS was higher in the female group than in the male group, it was not statistically significant.

The behavior of the SNS determined both before and after using the myofascial mobilization technique is presented in the figure 4. It was observed that after the myofascial mobilization, the quantitative values of SNS produced by NE, decreased or did not modify in female group. This profile in female group was statistically significant, although in the male group the miofascial mobilization did not modify the quantitative values of SNS produced by Nerve-express system.

The statistical analyze demonstrated that the quantitative values of SNS and PSNS behaved relatively equal in both studied groups, the difference between the male and female groups not being statistically significant.

DISCUSSION

It has been suggested that in Craniosacral Therapy (CST) soft forces applied on the skull could be transmitted to the dura mater membrane promoting a therapeutic effect on the cranial system.⁽⁶⁾ Using different techniques, such as frontal lift, parietal lift, sphenobasilar compression and sphenobasilar decompression to the skull, Kostopoulos et al.⁽¹⁷⁾ demonstrated a relative elongation of the falx cerebri in embalmed cadaver. However, in spite of the different studies showing direct evidence of the effect of craniosacral dysfunction on the health,⁽¹⁸⁻²⁰⁾ the presence of the mobility between the cranial bones and its interaction with the body is still a matter of discussion.^(6,21)

Experimental evidence has demonstrated the relationship between the somatic structures and the ANS, mainly via neurological reflex mechanisms.⁽²²⁾ The ANS is known to control and regulate all involuntary physiologic activities by controlling the activities of the internal organs, glands and circulation.⁽¹¹⁾ Using the digital strain gauge plethysmography, Purdy et al.⁽²³⁾ demonstrated reduction in sympathetic tone after suboccipital dermatomiotonic stimulation. Using the NE, our results demonstrated that the application of the myofascial technique produced an alteration of autonomous activity.

In spite of the cardiac automaticity to be intrinsic to various pacemaker tissues, the heart rate and rhythm are largely under the control of the ANS.⁽²⁴⁾ Spectral analysis of the R-R-intervals or heart rate has been widely used in heart rate variability (HRV) studies, and it has been shown to reflect the dynamics of the two nervous systems.^(12,25) The influence of the ANS on the behavior of the HRV is promoted by chemical mediators.⁽¹²⁾ In this work, the application of the cranial mobiliza-

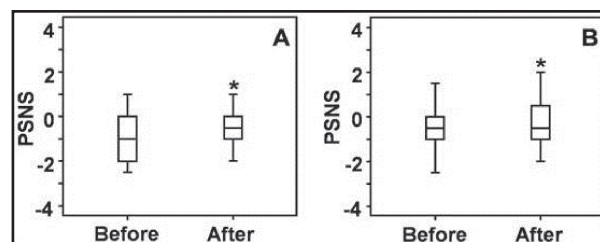


Figure 3. Boxplot of the quantitative values of PSNS (PSNS) determined both before and after the myofascial techniques were applied on the skull. Female group (A), male group (B). Statistical analysis indicated $p < 0.05$ (*).

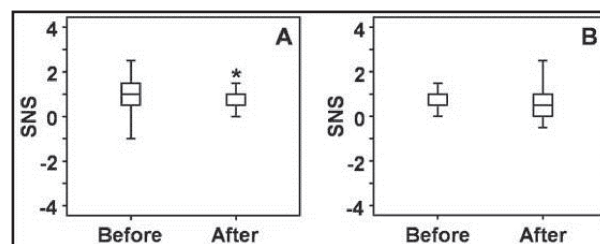


Figure 4. Boxplot of the quantitative values of SNS (SNS) determined both before and after the myofascial techniques were applied on in the skull. Female group (A), male group (B). Statistical analysis indicated $p < 0.05$ (*).

tion technique was able to promote a decrease in heart rate. This effect, according to the available literature, is showing the relation between the PSNS and the decrease in the cardiac beats.⁽¹²⁾ In this study, it was demonstrated that the alteration in ANS was not statistically significant after the techniques execution both in male and female groups. A recent study described by Zhang⁽²⁶⁾ showed that the sex did not seem to significantly affect the HRV.

Spectral analysis of HRV has increased the understanding of the modulatory effects of neural mechanisms on the heart. Efferent vagal activity is considered a major contributor to the High Frequency (HF) component.^(13,27,28) The Low Frequency (LF) component is considered by some authors as a marker of sympathetic modulation⁽²⁸⁻³⁰⁾ and by others as a parameter that includes both sympathetic and vagal influences.^(13,31) Task Force of the European Society of Cardiology and North American Society of Pacing and Electrophysiology⁽¹²⁾ related that this discrepancy is due to the fact that in some conditions associated with sympathetic excitation, a decrease in the absolute power of the LF component is observed. It is important to recall that during sympathetic activation the resulting tachycardia is usually accompanied by a marked reduction in total power, whereas, the reverse occurs during vagal activation.

Heart rate variability is increasingly used to assess autonomic dysfunction in different pathological conditions, either of cardiac^(32,33) or noncardiac origin.^(34,35) In this study the Nerve-Express System was used to measure the behavior of ANS after myofascial technique

applications. The proprietary algorithms of NE by spectral analysis of wave, represented by rhythmogram, permit to identify two main spectral components: low and high frequency.⁽¹⁶⁾ Terechtchenko et al.⁽³⁶⁾ demonstrated that the Nerve-Express algorithm allowed the noninvasive quantitative assessment of autonomic activity and mechanism after the development of heart disturbance, which may help in the choice of treatment.

Nerve-Express reliability, demonstrated in the literature, seems to be essential in obtaining the results presented in this study. Thus, NE could be used to demonstrate the relation between the soft myofascial techniques, applied in the head area, in generating alteration in ANS, an important factor in medical practices. The results obtained in this study benefitted future works in the attempt of unmasking questions, still existent, on the techniques of cranial mobilization.

CONCLUSIONS

The effects of the skull mobilization techniques on autonomic function have been demonstrated by craniocervical therapy, however, when associated with other techniques, involving both the cranium and sacrum bones. Our results suggest that the myofascial techniques applied in the cranial area by craniocervical therapy, when applied individually, provoke alterations in the behavior of ANS. They have a significant effect in reducing heart rate. In general, they increase the PSNS and they decreased the SNS. It was demonstrated that the effect of the techniques seems not to be influenced by gender, because the SNS and PSNS behaved relatively equal in both groups studied. Further studies in this area may lead to a better understanding of the effects of myofascial techniques applied in the cranial region on the behavior of ANS and observe to what extent the change postural has one influence in relation this technique.

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