Influence of Spinal Manipulation on Autonomic Modulation and Heart Rate in Patients With Rotator Cuff Tendinopathy

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ABSTRACT

Objective: The purpose of this study was to analyze the influence of thoracic spinal manipulation (SM) on autonomic modulation and heart rate in patients with rotator cuff tendinopathy.

Methods: The design of the study was quasi-experimental. Participants were divided into 3 study groups: the asymptomatic group (n = 30), which received SM; the tendinitis group (TG, n = 30), which received SM; and the placebo group (PG, n = 30), which received placebo manipulation. Heart rate variability was analyzed with an electrocardiogram before and after intervention. For intragroup analysis, the paired Wilcoxon test was used to compare the means (pre vs post) of sex and age divided into 5 age groups. The Kruskal-Wallis test was employed for analysis between the groups, and a significance level of 5% was adopted.

Results: The TG demonstrated an increase in respiratory rate (mean of the selected intervals corresponding to parasympathetic activity) post intervention for both sexes ($P = .04$). Heart rate exhibited reduction post intervention in women in the TG ($P = .05$). The PG demonstrated an increase in respiratory rate post intervention for both sexes (female $P = .01$; male $P = .02$). In the age groups, only the PG presented any difference in the 40- to 50-year and 50- to 60-year age groups ($P = .03$) for the same variable. Heart rate exhibited a reduction post intervention in women in the PG ($P = .01$) and a reduction in the 50- to 60-year age group ($P = .04$). No difference in the studied variables was observed in the asymptomatic group, and there were no differences among the groups.

Conclusions: Upper thoracic SM does not directly influence autonomic modulation or heart rate. (J Chiropr Med 2018;17:82-89)

Key Indexing Terms: Manipulation, Spinal; Tendinopathy; Rotator Cuff; Autonomic Nervous System; Heart Rate

INTRODUCTION

Shoulder pain is the third most common musculoskeletal complaint, being more frequent in adults and gradually increasing with advancing age.¹ In relation to shoulder complaints, it is possible to highlight tendinopathies and rotator cuff injuries,² which have an overall incidence rate

of 0.3% to 5.5% and an overall prevalence rate of 0.5% to 7.4%.^{3,4}

To treat rotator cuff tendinopathy (RCT), conservative treatment is initially recommended, such as neuromuscular re-education exercises and manual therapy. Manual therapy uses techniques with therapeutic purposes that are manually applied on muscle, bone, and connective and nervous tissues, with the aim of promoting physiological reactions that normalize these areas.⁵

Among the manual therapy techniques, spinal manipulation is used to describe a maneuver performed on the spine that employs a dynamic impulse of small amplitude and high speed, known as *thrust*. This procedure can provide changes in reflex excitability and sensory processing.^{6,7}

Studies have been carried out that proposed thoracic spinal manipulation as a conservative treatment for shoulder pain and presented clinically positive results for shoulder pain and functionality.⁸⁻¹⁰ Based on these findings, individuals with RCT could benefit from such an approach. In addition, the relationship between the

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thoracic spine and shoulder movements leads to the term *regional interdependence*, which refers to the concept that apparently unrelated deficiencies in an anatomic region may be associated with primary symptoms and contribute to patient complaints.¹¹

Thus, the rational basis for the clinical use of thoracic manipulation to treat the shoulder is based on this theory. In addition, studies have revealed that reduced mobility of the upper thoracic segments could be related to shoulder pain.^{12,13} In this way, manipulation of the upper thoracic region can restore the mobility of the vertebra and consequently have a positive effect on the patient's shoulder.

Despite the therapeutic benefits that have been reported for spinal manipulation for shoulder dysfunction, its mechanisms of action are still not well defined in the scientific literature. Some authors have reported that there is a close relationship between pain and the autonomic nervous system (ANS),^{14,15} such that manipulation may result in immediate sympathoexcitatory effects.¹⁶ From this, some studies have revealed that spinal manipulation may be able to stimulate the ANS,¹⁷ which can be analyzed through heart rate variability (HRV).^{18,19}

Heart rate variability measured by an electrocardiogram (ECG) is a simple and noninvasive measure for verifying spontaneous cardiac impulses.²⁰ This measure describes oscillations between consecutive heart beats (ECG R wave intervals) and oscillations between consecutive instantaneous heart rates (HRs).²¹ Heart rate variability can also measure the balance between the sympathetic and parasympathetic systems, which may be altered in people who exhibit some dysfunction or pain—for example, in participants with neck or lumbar pain.^{18,19} However, it is not known whether this also occurs in individuals with shoulder pain, and although some studies have reported that there may be differences in HRV according to sex and age,²² there is no consensus on this.

Although the literature contains studies with spinal manipulation related to shoulder articulation and spinal manipulation with HRV, to our knowledge there are no studies that link these 2 themes, especially in volunteers with RCT. Therefore, the present study aims to analyze the influence of spinal manipulation on the autonomic modulation and heart rate of volunteers with RCT.

METHODS

The present study is a quasi-experimental study using a quantitative approach, performed in a Clinical Physiotherapy School and in a private clinic. The study was approved by the Ethics and Human Research Committee under Certificate of Presentation for Ethical Consideration number 37088014.0.0000.0118, and all volunteers signed an informed consent form to participate voluntarily in the study.

Participants were intentionally recruited through informal invitation and pamphlets. Inclusion criteria for the tendinitis group (TG) and placebo group (PG) were as follows: RCT; men and women; aged between 20 and 70 years; presenting pain for at least 6 months; accepting kinetic-functional evaluation and presenting a medical report or image examination of rotator cuff injury; not be taking medication that contains beta-blockers and anti-inflammatories for at least 1 month; not undergoing physical therapy; and presenting a pain intensity >3 on the visual analogue scale.²³ The same criteria were used for the asymptomatic group (AG), with the exception of presenting with shoulder injury and pain.

Exclusion criteria for all groups included full rotator cuff injury (>5 cm); any history of shoulder surgery; presenting an absolute contraindication to spinal manipulation; pain in the spine (thoracic region); heart transplant; pacemaker; a history of surgery or trauma to the spinal column; pregnant women; a history of cancer; presenting neurologic disease; and visual or hearing impairment.

A total of 90 participants were divided into 3 groups: AG (n = 30), this group that did not present with shoulder pain and received the true manipulation; TG (n = 30), the group that had a rotator cuff injury and received the true manipulation; and PG (n = 30), the group that presented with a rotator cuff injury and received placebo manipulation.

Regarding the intervention for the symptomatic volunteers (TG and PG), randomization of the manipulation was carried out by a single draw, consisting of an envelope containing 100 pieces of colored paper (50 orange and 50 blue) cut into rectangular shapes. Orange corresponded to the true manipulation, and blue corresponded to the placebo manipulation. In this way, each volunteer removed 1 piece of paper from the envelope and showed it to the physical therapist, who designated the individual to the randomly selected manipulation. Although the volunteers knew of the existence of a PG, they did not know which group they were assigned.

An anamnesis was applied, composed of identification data of the participant and issues pertaining to the research, such as age, sex, and the shoulder with the injury, among others. Subsequently, a kinetic-functional assessment was carried out by a physiotherapist to confirm the injury in question. This evaluation consisted of 5 clinical trials in which volunteers were required to perform at least 3 of the following tests with positive results, indicating signs of rotator cuff injury²⁴: (1) positive Hawkins-Kennedy test, (2) positive Neer test, (3) pain during active elevation below 60 degrees in the scapular plane or sagittal plane, (4) positive Jobe test (empty mug), and (5) pain or weakness with external rotation of the shoulder resisted with the arm next to the body.

For HRV assessment, an ECG was performed for 8 minutes before and after the intervention. Participants were

positioned in the supine position on a stretcher and requested to remain at rest, immobile, without speaking, and with normal breathing. Three disposable ECG electrodes were placed on the chest of the participants in derivation II. In this way, the first electrode was placed on the right subclavian space (negative terminal), the second was placed on the eighth left intercostal space (positive terminal), and the third was placed on the ninth right intercostal (reference terminal). Participants remained resting in the supine position for 1 minute before the 8-minute ECG recording.

After 8 minutes of data recording, the volunteers were positioned in the prone position to receive the intervention. Subsequently, volunteers returned to their initial position. Before the second recording (post), an interval of 1 minute was allowed for posture stabilization, after which the ECG recording was performed again.

True spinal manipulation was performed in the TG and AG groups in the upper thoracic spine (in the fourth and fifth thoracic vertebrae). The technique utilized was called the Crossed Pisiform, or prone thoracic manipulation. The participants positioned themselves in the prone position with the upper limbs alongside the body. The physical therapist stood on the right of the participant at the height of the thoracic spine and made contact with the hypothenar eminence of the left and right hand in the transverse processes, first in the fourth thoracic vertebrae and maintaining the upper limbs in extension. Afterward, pressure was exerted on the vertebra while keeping the upper limbs in extension. The participant was then asked to take a deep breath and given an impulse at the end of expiration. The technique was applied perpendicularly and in parallel to the articular plane.⁷ After manipulation of this vertebra, the same procedure was performed for the manipulation of the fifth thoracic vertebra.

For placebo manipulation, the same position was adopted, but no impulse on the vertebrae was performed at the end of the expiration. Both the placebo and the true manipulation lasted for 5 seconds. The same person performed the ECG signal reception and the intervention. However, a second evaluator conducted the HRV assessment blindly.

Signal reception was carried out through surface electrodes connected to an ECG amplifier, using hardware developed by the Institute of Biomedical Engineering of the Federal University of Santa Catarina (Florianópolis, Santa Catarina, Brazil). The acquisition software, DATAQ Instruments Hardware Manager, was used. Data were collected using a heart monitor and were digitalized with a 12-bit digital-to-analog converter at a sampling frequency of 1000 Hz, and the resulting signal was digitally filtered (10–40 Hz range).

Electrocardiogram signals were digitally processed for HRV analysis, and linear methods were used for subsequent quantification in the time domain (TD) and frequency domain (FD).

The TD analysis used indices extracted directly from the temporal variations of respiratory rate (RR) intervals in milliseconds. The variability signal (RR intervals) was detected through a process of differentiation and selected by the mean value of RR intervals and 2 times the value of mean deviation. Thus, the following variables were used in the TD: RR (mean of the selected intervals, corresponding to parasympathetic activity), standard deviation between successive heartbeats (mean deviation of all RR intervals in the registration period, which corresponded to variability or global modulation), and root mean square of the successive differences (square root of the standard differences of successive RR intervals squared, which corresponded to parasympathetic activity).²⁵ Heart rate was also determined by TD and obtained from continuous ECG recording through interval verification between R waves.²⁵

Spectral analysis was used for FD and fast Fourier transform was used to calculate the power spectral density. Variables of HRV were analyzed in squared milliseconds. In this manner, the following variables were verified in the FD: HRV (variability of RR intervals in the very low frequency range, with variation between 0.003 and 0.04 Hz, for parasympathetic activity), low frequency (LF; RR interval variability in the LF range, with variation between 0.04 and 0.15 Hz, for the predominant manifestation of sympathetic ANS), high frequency (HF; RR interval variability in HF range, with variation between 0.15 and 0.4 Hz, for the predominant manifestation of parasympathetic ANS), and LF/HF (ratio of LF and HF components for sympathetic-vagal balance).²⁵

For the analysis of HRV, digital filtering of the RR intervals was performed to eliminate premature ectopic beats and signal artifacts. In addition, only RR intervals with a stable signal, in which the series of these intervals had more than 95% sinus rhythm, were included.

Statistical analysis was performed using the program Statistical Package for Social Sciences version 20.0 (IBM Corp, Armonk, New York) and Excel version 2010 (Microsoft, Redmond, Washington). Means and standard deviation were used for descriptive analysis. In relation to the dependent variables, the Shapiro-Wilk test was applied to verify data normality. When testing intragroup before and after, a normal distribution was obtained using the paired Wilcoxon test to assess pre and post means related to sex and age (divided into 5 age groups: 20–30 years, 30–40 years, 40–50 years, 50–60 years, and 60–70 years). This subdivision was performed because studies are conflicting regarding HRV behavior with respect to sex and age. For pre and post analysis between groups, the Kruskal-Wallis test was applied, considering that distribution was not normal. A significance level of 5% was adopted.

RESULTS

The sample of the study consisted of 90 volunteers, with 30 distributed into each group. The anthropometric

Table 1. Anthropometric Characteristics of the 3 Groups (Mean [Standard Deviation])

	Asymptomatic Group (n = 30)	Tendinitis Group (n = 30)	Placebo Group (n = 30)
Sex (women/men)	17/13	22/8	19/11
Age, y	42.0 (11.98)	46.0 (16.11)	44.4 (12.14)
Height, m	1.68 (0.12)	1.65 (0.09)	1.65 (0.09)
Weight, kg	76.8 (17.81)	69.7 (12.85)	78.7 (15.13)

characteristics of each group can be seen in Table 1. The average time of pain presented by the participants was 3.7 years, with the TG presenting an average of 3.2 years and the PG presenting an average of 4.3 years. The shoulder that presented the greatest involvement was the right, corresponding to 70% in the TG and 63.3% in the PG.

In the AG, the majority of participants practiced physical exercise (56.5%). In the TG and PG, the majority did not practice any physical exercise (53.3% and 70%, respectively). Most participants did not smoke (AG = 13.3%; TG = 23.3%; PG = 3.3%).

In the intragroup analysis, only 1 variable presented a significant difference. In the TD, RR was significant in the TG and PG for men and women, with post mean being superior to pre mean. No differences between sexes were observed in the AG (Fig 1). Still with regard to the RR in the intragroup analysis, but in relation to age groups, only the PG presented a significant difference post intervention in the 40- to 50-year and 50- to 60-year age groups (Table 2).

On the other hand, HR in the intragroup analysis presented significant differences in both the TG and PG for women, although presenting a reduction post intervention. No significant differences were observed in the AG (Table 3). Still regarding HR in the intragroup analysis but now in relation to age, once again, only the PG presented a significant difference post intervention, revealing a decrease

Table 2. Respiratory Rate (in Milliseconds) Intragroup Pre- and Postintervention in Different Age Groups (Values Expressed as Mean [Standard Deviation])

Age Group	Mean Pre	Mean Post	P Value
Asymptomatic group			
20-30 y	913.0 (63.37)	911.8 (58.57)	.99
30-40 y	858.4 (133.19)	880.1 (131.15)	.14
40-50 y	811.2 (69.52)	835.2 (47.37)	.44
50-60 y	874.2 (132.74)	864.5 (148.47)	.99
60-70 y	886.3 (36.61)	898.6 (31.34)	.50
Tendinitis group			
20-30 y	951.2 (123.08)	975.1 (140.12)	.20
30-40 y	976.0 (0.00)	999.0 (0.00)	.99
40-50 y	907.2 (258.12)	916.8 (267.57)	.19
50-60 y	883.4 (142.37)	890.6 (132.26)	.28
60-70 y	963.4 (98.33)	1002.6 (62.90)	.06
Placebo group			
20-30 y	1012.3 (121.68)	1018.0 (110.73)	.50
30-40 y	808.3 (124.08)	834.3 (120.94)	.16
40-50 y	896.3 (166.23)	928.9 (183.69)	.03 ^a
50-60 y	922.1 (136.15)	954.7 (142.71)	.03 ^a
60-70 y	825.0 (65.05)	872.0 (56.57)	.50

^a Significantly different, $P < .05$.

in the 50- to 60-year age group (Table 4). In the analysis between groups, no differences were observed between sexes and ages in TD, FD, or HR.

Fig 1. Average respiratory rate (milliseconds) intragroup pre and post intervention in females (A) and males (B). The vertical lines above the plots represent standard deviation and * indicates a significant difference with $P < .05$.

Table 3. Heart Rate (in Beats per Minute) Pre- and Postintervention in Females and Males (Values Expressed as Mean [Standard Deviation])

	Females			Males		
	Mean Pre	Mean Post	P Value	Mean Pre	Mean Post	P Value
Asymptomatic group	73.82 (7.28)	72.65 (6.55)	.14	65.54 (7.26)	65.15 (7.41)	.39
Tendinitis group	67.55 (11.84)	66.45 (11.33)	.05 ^a	63.75 (6.43)	62.38 (7.23)	.29
Placebo group	71.95 (10.56)	69.65 (10.74)	.01 ^a	62.60 (9.25)	61.10 (9.55)	.09

^a Significantly different, $P < .05$.

DISCUSSION

In relation to RR, it was possible to note that both the TG and PG presented increases post intervention for both sexes (TG: female 14 ms; male 30.7 ms; PG: female 29.5 ms; male 29.6 ms). Some studies have considered this variable to reflect the reflex of sympathetic nervous system and

parasympathetic nervous system control of the heart, but it is also considered an indicator of vagal cardiac activity.²⁶ Thus, both groups demonstrated increases in parasympathetic activity post intervention. These results corroborate the findings of Roy et al,¹⁹ who observed an increase in mean RR of 18.6 ms post intervention in the group that received true spinal manipulation, although the PG presented a decrease of 0.01 ms post intervention. However, it was the lumbar region that received the manipulation, and the study involved acute low back pain.

In theory, upper thoracic spinal manipulation would result in stimulation or an increase in the activity of the sympathetic nervous system,²⁷ considering that the cell bodies of sympathetic fibers are in the lateral horns of the spinal segments T1 to L2. Sympathetic innervation predominates in these regions of the spine. Therefore, manipulation of the thoracic region could result in a sympathetic response, such as increased HR, increased blood pressure, and dilation of the pupils.²⁸

However, this trait was not confirmed in the present study because increased parasympathetic activity was observed. This result is consistent with other research that investigated the immediate effects of thoracic manipulation (T3-T4) and placebo manipulation on ANS activity in participants with chronic neck pain, in which it was found that the group that received true manipulation demonstrated no significant changes, but the PG presented increased parasympathetic activity. Autonomic modulation was evaluated through the pupil diameter, which presented a reduction and thus indicated activity of the parasympathetic system.²⁹

In relation to HR, both the TG and PG presented decreased HR post intervention, which was notably significant in women. Consistent with this result is another work that measured the effects of thoracic spinal manipulation in HRV and reported decreased HR after both interventions (manipulation and placebo). Unlike the present study, which included middle-aged symptomatic volunteers, this was performed only in young, healthy volunteers.³⁰

The fact that HR decreases post intervention may be due to stimulation of parasympathetic activity, which increased in both groups. Parasympathetic ANS arises from cell

Table 4. Heart Rate (in Beats per Minute) Intragroup Pre- and Postintervention in the Different Age Groups (Values Expressed as Mean and [Standard Deviation])

Age Group	Mean Pre	Mean Post	P Value
Asymptomatic group			
20-30 y	66.00 (4.47)	66.00 (4.06)	.99
30-40 y	71.56 (11.00)	69.56 (10.10)	.11
40-50 y	74.20 (6.38)	72.00 (4.12)	.34
50-60 y	69.88 (8.94)	70.75 (9.79)	.94
60-70 y	67.67 (2.52)	66.67 (2.08)	.37
Tendinitis group			
20-30 y	63.89 (8.01)	62.67 (8.97)	.31
30-40 y	61.00 (0.00)	60.00 (0.00)	.99
40-50 y	70.40 (18.47)	69.80 (18.13)	.49
50-60 y	69.50 (10.18)	68.70 (8.86)	.26
60-70 y	62.60 (6.58)	60.20 (3.83)	.18
Placebo group			
20-30 y	59.67 (7.09)	59.33 (6.03)	.77
30-40 y	75.33 (9.97)	73.17 (9.62)	.14
40-50 y	69.20 (13.24)	67.30 (14.13)	.15
50-60 y	66.22 (9.09)	64.00 (9.06)	.04 ^a
60-70 y	73.00 (5.66)	69.00 (4.24)	.50

^a Significantly different, $P < .05$.

bodies of the motor nuclei of several cranial nerves in the brainstem and in the second, third, and fourth sacral segments of the spinal cord. Among the cranial nerves is the vagus nerve.³¹ The vagus nerve is responsible for parasympathetic innervation of some organs, including the heart.³² Thus, cardiovascular responses due to parasympathetic stimulation may match the reduction in blood pressure and decreased HR, the latter being observed in this research.

The AG, which received the true manipulation, demonstrated no alterations in any of the domains assessed. This may be due to the participants of this group not presenting any pain. This hypothesis has already been suggested, pointing out that differences in autonomic modulation assessed by HRV may be related to the presence or absence of pain.¹⁹

Thus, it can be suggested that the AG had a balance of sympathetic and parasympathetic functions. Additionally, another fact that contributes to the balance of these systems is the practice of physical exercise. Physical exercise contributes to the sympathetic-vagal balance in the heart, thus providing increased vagal modulation and producing an adaptive change.³³ In this research, the AG group exhibited the highest percentage of participants who performed some kind of physical exercise, which may favor the balance between these systems.

Although studies show true manipulation produces certain effects that are not replicated by placebo manipulation,¹⁸ this result was not observed in the present study. Both interventions were able to decrease parasympathetic nervous system activation and decrease HR. Thus, the perceived effects cannot be attributed solely to manipulation, and this influence did not occur.

The position of the body affects HRV variables and, consequently, autonomic activities. In the position of supination, parasympathetic activity proves predominant in relation to sympathetic activity.³⁴ Therefore, this condition may have contributed to its dominance because the participants were evaluated in the supine position. In addition, both interventions involved compression of the upper thoracic region and manual contact. Relatively small changes have been proposed in the point of application of force on the thorax as a whole and can have significant effects on autonomic responses.³⁵ In this way, only exerting manual pressure, without necessarily applying the impulse for the manipulation, may have been enough to cause some changes. Some studies have shown that other types of therapies, such as myofascial massage, on trigger points of the head and shoulder area cause reductions in HR and blood pressure, thus suggesting an increase in vagal production of the heart.³⁶

Moreover, the arterial baroreceptors are considered a key determinant in vagal excitability, largely due to the baroreceptor reflex.³⁷ Upon stimulation with pressure on the thoracic spine, a brief increase in blood pressure may

have occurred. With that, innervation of baroreceptors (located on the walls of the aortic arch and carotid sinuses) transmits the information to the central nervous system through the nucleus of the solitary tract. This is a sensitive nucleus, and it receives afferent fibers of several cranial nerves, including the vagus nerve. Thus, the processing of information leads to increased activity of the parasympathetic system and inhibition of sympathetic activity.³² One of the final events of this reflex arc is a decrease in HR, which was observed in the present study.

In relation to age group, it was possible to verify differentiation in the RR (40-50 years and 50-60 years) and HR variables (50-60 years), although only in the PG. Despite the literature indicating HRV reduction in some variables in TD with advancing age, especially in the age group between 40 and 60 years,³⁸ these may have occurred only as an indication of an adaptive response to incoming stimulation.

Regarding the influence of sex on HRV, studies have shown that HRV variables can influence both sexes, with significance in women for certain HRV variables, as perceived by the present study in RR. This occurs in women mainly because of hormones (estrogen) and prolonged use of estrogen associated with progestin (oral contraceptives), which can affect cardiac autonomic modulation.³⁹ However, information on the influence of sex on HRV, and on hormonal questions, is still conflicting.

In the TG and PG, no differences in FD were observed. This result differs from other studies, which used spinal manipulation and detected changes at HF, LF, and very low frequency.¹⁹ However, the manipulated region was the lumbar in the case of acute pain.¹⁹ Thus, the fact that the participants of the present study had chronic pain in addition to manipulation being performed only once and aimed at a single vertebral level may have contributed to the lack of differences detected in FD variables.

Limitations and Future Studies

The analysis was conducted in the short term (1 session) and with a specific manipulation technique; thus, we are unable to predict whether these results could vary in the long term and when using another technique of thoracic manipulation. However, this manipulation, and the positioning of the participants, were chosen because the upper limbs remained in extension; therefore, the participants did not present complaints of shoulder pain at the time of manipulation. This fact could influence the outcome variables.

Second, regarding the type of manipulation used, other studies already mentioned in the Discussion validated the simulated manipulation for the thoracic spine and referred to aspects of range of motion and pain, not its effects on ANS. There was also no assessment of the restriction of thoracic vertebral movements, standardizing all groups to

the same manipulation region (T4-T5), a factor that may have contributed to the lack of changes detected in HRV. Another limitation regards the duration of HRV collection (8 minutes): There is no evidence regarding whether a longer collection time could vary these parameters. Therefore, manipulation did not exert an influence on the aspects analyzed. It is suggested that increased parasympathetic activity and decreased HR are due to factors such as body position, upper thoracic compression and manual contact, baroreceptor reflex, and the presence of pain.

For future studies, we suggest the implementation and evaluation of long-term manipulation and absence of hormone replacement therapy to avoid possible hormonal interference. We also recommend, if possible, performance of the same procedure in participants with chronic pain and acute pain to verify differences in these 2 conditions.

CONCLUSIONS

Upper thoracic manipulation applied to participants with RCT under these experimental conditions did not influence autonomic modulation or HR.

FUNDING SOURCES AND CONFLICTS OF INTEREST

Coordination of Improvement of Higher Education Personnel provided funding for this study. Clínica FisioAtiva provided space for examinations performed for this study. No conflicts of interest were reported for this study.

CONTRIBUTORSHIP INFORMATION

Concept development (provided idea for the research): A.C.d.S.

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Practical Applications

- Of the individuals who had rotator cuff tendinopathy, both the true manipulation group and the placebo group showed the same autonomic behavior after the intervention, suggesting stimulation of the parasympathetic activity.
- The results of this study suggest that parasympathetic activity can be influenced by body position, upper thoracic compression and manual contact, baroreceptor reflex, breathing, and the presence of pain.

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