ORIGINAL ARTICLE

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Effects of Manual and Instrumental Therapy on the Treatment of Myofascial Pain Syndrome in Descending Trapezius of Women: A Blind Randomized Clinical Study

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SUMMARY

Objective. To investigate the effects of Manual Ischemic Compression (MIC) and Instrumental Ischemic Compression (ICG) and Pressure Algometer (ICA), in the treatment of women with MPS in descending trapezius.

Patients and Methods. This is a double-blinded, randomized, placebo-controlled trial. Patients were randomized into 3 groups: MIC, ICG, and ICA. Pain, pressure pain threshold (PPT), electromyography, disability (NDI), anxiety (GAD-7), and adverse treatment effects (AE) were assessed. The Shapiro-Wilk test was performed to verify the normality of the data, followed by consistent tests, being considered significant when $p < 0.05$.

Results. There was no intergroup difference for any analyzed variables. In the intragroup comparison, MIC group presented pain reduction (F: 7.70; $p = 0.0002$), between baseline and 1 week; and anxiety ($p = 0.048$), between baseline and 4 weeks. All groups showed increase in PPT (F: 37.62; $p < 0.0001$) and decrease in NDI score (F: 53.29; $p < 0.0001$). About AE, the MIC group reported the highest mean value of discomfort after the technique, 7.22.

Conclusions. An intragroup improvement was observed in the pain and anxiety variables for the MIC group, when compared to the baseline with one week and four weeks, respectively. There was an improvement in all groups in the PPT and NDI; however, with no differences between groups in the post-treatment.

Study registration. Brazilian Registry of Clinical Trials: ReBEC: RBR-2q24nb.

KEY WORDS

Neck pain; trigger point; manual therapy; IASTM; myofascial pain.

INTRODUCTION

Neck pain represents a significant portion of musculoskeletal disorders (1, 2). Among them, the Myofascial Pain Syndrome (MPS) stands out, a common clinical condition that occurs in about 46.1-55.4% of the population (3). Its etiology is associated with biomechanical (4) and emotional changes (5), repetitive movements (6), and excessive muscle contraction (5). This mechanism alters the release of acetylcholine (ACh) in the synaptic cleft, causing uninterrupted contraction, which culminates in an energy crisis and local tissue hypoxia (5, 7).

The main feature is the emergence of trigger points (TP). These TP can be active, causing spontaneous or latent pain, generating pain only when pressed (8, 9). In addition to local and/or irradiated muscle pain, there may be a reduction in the range of motion (ROM) and muscle strength (5, 10).

The diagnosis is basically clinical (11), and the treatment seeks to normalize the local blood supply and restore the length of the sarcomeres and it can be done with different techniques (12). Among them, ischemic compression (IC), performed directly on TP (7). Generally, it is done manually and has proven to be effective in the treatment of active TP (13-15). Although, there is an increase in the clinical use of instruments (16-18).

There are different groups of instruments, such as IASTM (Instrument Assisted Soft Tissue Mobilization). It is believed that these tools can increase local blood flow, promoting pain reduction and gain in ROM (19-21). Additionally, the pressure algometer is a similar instrument, although it does not belong to the IASTM group, used for pain assessment, which has been shown to be effective for treating active trapezius TP (22).

The instruments are cited as an alternative to reduce the physical stress of the physiotherapist and replace the manual technique (23, 24). However, the literature is scarce regarding the investigation of the effects of different instruments and manual therapy on MPS. Therefore, the present study aimed to investigate the effects of manual and instrumental ischemic compression, using IASTM and a pressure algometer, on active descending trapezius TP in women with myofascial pain.

PATIENTS AND METHODS

Design

A randomized clinical study, in which an evaluation was performed, followed by intervention and reassessment. The sample was randomized into three groups: Manual Ischemic Compression (MIC); Instrumental Ischemic Compression with Gatilhex® (ICG); Instrumental Ischemic Compression with Pressure Algometer (ICA).

The study followed the ethical principles of the Helsinki Declaration for research with humans, and it was approved by the Human Research Ethics Committee of the Federal University of Santa Catarina, Santa Catarina, Brazil (CEP-UFSC 3,526,797 – Date of approval: August 22, 2019). It followed the CONSORT recommendations. The primary outcome sought was pain. Secondary outcomes were pain pressure threshold, NDI score, GAD-7 score electromyography and adverse effects.

Participants and randomization

The study included 52 women at a mean age of 25.67 ± 5.71 years, 95% of the sample was composed of UFSC students. The volunteers were referred to the Locomotor Apparatus Evaluation and Rehabilitation Laboratory (LARAL) at UFSC, Araranguá campus, Mato Alto Unit (Santa Catarina, Brazil), the Free and Informed Consent Form was presented and signed, followed by the clinical evaluation. Data collection took place between October 2020 and February 2021. The inclusion criteria were: presence of active TP on descending trapezius; acute neck pain starting within 3 months; pain level equals to or greater than 3 (VAS) on the day of evaluation. Exclusion criteria were: presence of injury or self-reported limitation in the cervical or shoulder region; undergoing drug or physical therapy treatment for neck or shoulder pain; have used medications (painkillers, anti-inflammatories or muscle relaxants) within 48 hours before the evaluation.

Following the Consolidated Standards of Reporting Trial (CONSORT) recommendations, the research team was composed of three evaluators: an independent evaluator who did the randomization, an evaluator who collected the variables, and a third evaluator, a physiotherapist with experience in the area, who performed all interventions. Finally, an external researcher monitored all stages of the research.

The Research Randomizer website (www.randomizer.org) was used to randomize the volunteers into blocks and the result was allocated in sealed envelopes, which were opened by the physiotherapist at the time of each intervention.

The volunteers were visually blinded by a dark blindfold, so they were unable to contact and identify their respective intervention groups. They also used a headset, playing music at high volume to prevent them from identifying noises coming especially from the pressure algometer.

During the evaluations, the physiotherapist remained outside the laboratory. The same occurred with the evaluator during the interventions. Assessments were carried out by trained researchers, unaware of participants' allocation.

Sample calculation

It was performed based on the main variable studied, subjective pain. The calculation was made using the G*Pow-

er version 3.1 software, for F tests, ANOVA with repeated measures, intra and intergroup interaction, effect size F 0.25, α 0.05, power (1-β) 0.95, for 3 groups and 5 measures, resulting in 13 volunteers per group, totaling a minimum of 39 subjects. However, 52 volunteers were evaluated, being: MIC = 18; ICG = 17; and ICA = 17.

Outcome measures

The main outcome variable was subjective pain, assessed using the Visual Analogue Scale (VAS). The other variables evaluated were: pressure pain threshold (PPT), assessed by pressure algometry; neck disability, assessed by neck disability index (NDI), generalized anxiety assessed by generalized anxiety disorder scale (GAD-7), and electromyographic parameters. In addition, adverse effects after intervention were investigated. The description of the outcomes measures are presented in **table I**.

The data collection and intervention sequence was: a) Baseline (Evaluation form, VAS, TP location, NDI, GAD-7, PPT, EMG); b) Intervention (90 seconds of therapy); c) Adverse effects (AE) (Degree of discomfort); d) 10 minutes (VAS); e) 30 minutes (VAS, PPT, EMG); f) One week (VAS, NDI, GAD-7, AE); g) Four weeks (VAS, NDI, GAD-7, AE). The assessments were carried out by trained researchers, unaware of participants' allocation.

Intervention

Initially, TP was located according to the main criteria (42): the presence of hypersensitive nodule, tense muscle band, limited range of motion, and when pressing the nodule, triggering familiar pain to the individual (43, 44). Palpation was performed medially to lateral and a dermographic pen was used to signal the TP location. In cases where there were more than one sensitized point or bilateral involvement, the intervention was performed on the most symptomatic TP (28).

During evaluation and intervention, the participant remained seated, in a neutral cervical position and the feet in total contact with the ground and the descending trapezoid totally exposed. During the intervention, the physiotherapist stood behind the volunteer. Each volunteer received only one session lasting 90 s, controlled by a chronometer, triggered when the pressure started to be performed (13). IC was applied using the dominant upper limb of the physiotherapist and the collection environment was air-conditioned to maintain a temperature of 20 °C (45).

Manual ischemic compression protocol

The physiotherapist applied pressure using the thumb directly on TP, slowly and gradually until reaching a sensation of moderate, but tolerable pain, VAS = 7, and maintained it during 90 s. When reaching this pressure, the volunteer should say "now" and, when the pressure was reduced by half, the volunteer should communicate it again so that the physiotherapist could increase the pressure (**figure 1a**) (13, 46).

Instrumental ischemic compression protocol with Gatilhex®

IC was performed with the Gatilhex® instrument (Reabilitech Mioblaster, São Paulo, Brazil - **figure 1b**), which was positioned directly on TP, perpendicularly. The pressure increased gradually, until reaching a moderate sensation of pain (VAS 7). When reaching this pressure, the volunteer should communicate it to the physiotherapist, by saying "now", and when the pressure was reduced by half, she should report it back to the physiotherapist, so that the professional could increase the pressure, keeping the VAS score around 7 (13).

Instrumental ischemic compression protocol with pressure Algometer

IC was performed using an analog pressure algometer instrument, model NK-200 (Force Gauge, Elecall Electricl, China, **figure 1c**), positioned perpendicularly to TP, and with a load referring to the average of the three values measured in the evaluation of LDP and maintained throughout the intervention (15).

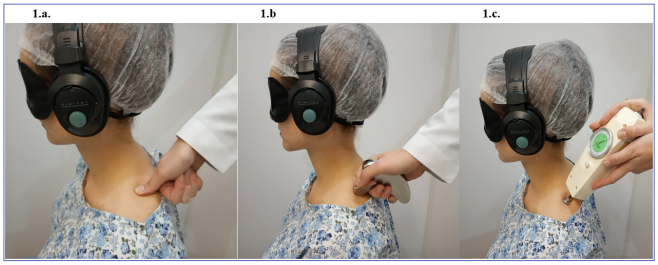

Figure 1. Demonstration of intervention protocols.
(a) Manual ischemic compression. **(b)** Ischemic compression by Gatilhex. **(c)** Ischemic compression by pressure Algometer.

Data analysis

The data were analyzed statistically with the GraphPad Prism® program, version 8.01 (GraphPad Software, La Jolla California, USA) by a researcher blinded to randomization and are presented as mean ± standard deviation. The normality of the data was verified with the Shapiro Wilk test. For the analysis of electromyographic activity, the mean values of RMS of dynamic contraction and FMed of isometric contraction were used, and the 15 seconds of isometric contraction were subdivided into 5 windows of 3 s, to facilitate the analysis.

The outcomes pain, PPT and NDI were analyzed using repeated measures ANOVA and Tukey *post-hoc*. GAD-7, RMS, and Fmed were analyzed using Kruskal-Wallis test and Dunn *post-hoc*.

Table I. Outcome measures.

Outcome	Test/tool	Description	Evaluation time
Pain	Visual Analogue Scale (VAS)	VAS is a unidirectional instrument that aims to measure the intensity of pain. It consists of a 10 cm line, in a continuum from 0 to 10, where 0 represents 'no pain' and 10 represents the 'worst pain'. Individuals were instructed to score the intensity of their pain at the time, by marking a number from 0 to 10 (25).	VAS was assessed in person, before the intervention, 10 min, and 30 min after the intervention; and electronically, through a follow-up form, one week and four weeks after the intervention.
Pressure Pain Threshold (PPT)	Pressure Algometry	PPT was measured using an analog pressure gauge, model NK-200 (Force Gauge, Elecall Electrical, China). The instrument was positioned perpendicularly to TP and increasing pressure was applied (26), in the proportion of 1 kg/cm²/s (Kilogram per square centimeter per second) (27, 28). The participant was instructed to remain relaxed and to signal when the sensation changed from pressure to pain, immediately interrupting the test (29).	Three measurements were performed, at an interval of 30 s between each one and, subsequently, the average of the values was calculated (29, 30). This procedure was performed at the pre-intervention and 30 minutes after.
Neck disability	Neck disability index (NDI)	NDI is a questionnaire developed and validated to investigate how pain in the neck region interferes with daily activities (31, 32). It has 10 sections with 6 alternatives each, and the participants are instructed to read and mark the one that most closely matches their symptoms. The scoring of the alternatives is given in ascending order from 0 to 5 and the questionnaire score ranges from 0 to 50 points. The score is 0-4 points, normal; 5-14, mild disability; 15-24, moderate disability; 25-34, severe disability; over 35, complete disability (31, 33).	It was applied in person, before the intervention, and then an electronic form was sent one week and four weeks after the evaluation.
Generalized anxiety	Generalized anxiety disorder scale (GAD-7)	GAD-7 is a simple questionnaire, reliable in diagnosing and monitoring the severity of generalized anxiety disorder. It features 7 sentences, each sentence has four alternatives: "none", "several days", "more than half the days" and "almost every day", with the score given in ascending order, from 0 to 3, respectively (36). The questionnaire must be answered based on the 2 weeks preceding the evaluation date; nevertheless, in the evaluation, one week after the intervention, the volunteer was instructed to answer it based on the previously week. The final score ranges from 0 to 21, where 0-4 means no anxiety; 5-9, mild anxiety; 10-14, moderate anxiety; and above 15, severe anxiety (34).	The scale was applied in person, before the intervention, and after one week and four weeks via electronic form (37).

Outcome	Test/tool	Description	Evaluation time
Electromyographic parameters	Surface electromyography (Miograph® Software, Porto Alegre, Brazil) was used to evaluate the electrical signal of the descending trapezius muscle. The equipment has an analog to digital converter (A/D) with 16 bits of resolution, with 2000 Hz amplification, common rejection mode of 126 dB, input impedance 10 Ohm // 2pF, and bandpass filter of 20-500 Hz.	A line was drawn between the acromion and the 7th cervical vertebra, and disposable electrodes (Kendall ™, Mansfield, USA), made of polyethylene foam with hypoallergenic medical adhesive, adherent solid gel, and Ag/AgCl bipolar contact, (silver/silver chloride) were placed at the midpoint. The application followed the recommendation of SENIAM (Surface Electromyography for the Non-Invasive Assessment of Muscles), with a distance of 2 cm between the poles, and the reference electrode was positioned over the styloid process ipsilateral limb ulna. Skin trichotomy was performed using a disposable razor, followed by asepsis with 70% alcohol (38). Initially, unilateral Isometric Maximum Voluntary Contraction (IMVC) was requested, with trunk control, on the side to be treated, for later data normalization. The participant was seated, in a neutral cervical position, with the arms along the body, and she was asked to perform a shoulder lift with a handle connected to the load cell. The movement was sustained in isometry for 5 s (39). For the assessment, the same position was maintained; however, without the shoulder strap. The volunteer repeated the shoulder lift dynamically 3 times, at an interval of 30 s between each measurement. Then, she repeated the movement, in an isometric way, 3 times for 15 s, at an interval of 30 s (39, 40). The analysis occurred in the time domain, using the Root Mean Square (RMS) percentage in relation to CVIM, and was presented in microvolts (μV). And in the frequency domain, through the median frequency (FMed), presented in Hertz. The mean value of dynamic and isometric contractions was used in the pre and post-treatment.	Measurement occurred pre-intervention and 30 minutes after. The signal processing was done in the MATLAB software, version R 2019 (MathWorks, Inc., Natick, USA), through a specific routine, developed by the laboratory.
Adverse effects	Questionnaire	Each volunteer was asked, immediately after the intervention, about the degree of perceived discomfort, grading between 0, less discomfort, and 10, greater discomfort. A week later, an electronic form was sent with two questions, one to investigate if there were any symptoms in that period and the other to analyze whether these symptoms affected the activities of daily living (daily activities are understood as basic day-to-day activities, such as eating, personal hygiene and mobility) or work. Both were open questions, in which the participant was asked to describe details of the eventual symptom.	After intervention, a week later and four weeks later.

RESULTS

Participants

53 volunteers were recruited for face-to-face evaluation, with a sample loss of one volunteer for having VAS < 3. There was no sample loss after allocation or in the follow-up. The flowchart (**figure 2**) presents the research steps (CONSORT), and, at baseline, demographic and clinical characteristics were similar for all the groups (**table II**). All randomized participants were analyzed with an intention to treat approach.

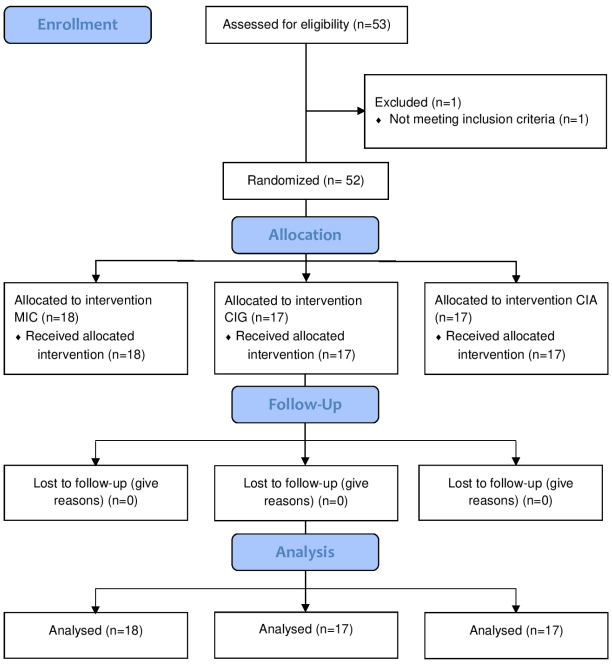

Figure 2. Recruitment and data collection flowchart.

Effect of the intervention

After analyzing the data, it was found that there was no statistical difference in the intergroup comparison. However, in the intragroup comparison, the MIC group showed improvement in 4 of the 5 variables investigated, reduction of pain and of the scores of the applied questionnaires, NDI and GAD-7, and increase in PPT. It was also the group in which the average feeling of self-reported discomfort was higher, with no reported impairment in daily or work activities. While the ICG and ICA groups showed significant reductions for the variables PPT and NDI, they were also the ones that most reported painful symptoms or interference in Activities of the daily living (ADLS) and work activities after the procedure.

Pain

VAS was analyzed in the entire sample. The MIC group showed a reduction in pain between times (F: 7.70; p = 0.0002). The mean reduction was 2.17 cm between baseline and one week, going from the average value of 4.18 ± 1.20 to 2.61 ± 1.94 cm (p = 0.021; 95%CI = 0.21-4.13). There was no statistical difference between groups (F: 0.13; p = 0.87) (**figure 3a**).

Pressure pain threshold

All groups showed an increase, intragroup, in the comparison between baseline and 30 min (F: 37.62; p < 0.0001). The MIC group went from the mean value of 2.30 ± 0.56 kgf to 3.08 ± 1.12 (p = 0.002; 95%CI 0.32-1.23). The ICG group went from 2.44 ± 0.85 kgf to 2.97 ± 1.15 kgf (p = 0.015; 95%CI 0.11-0.93). And the ICA group went from 2.73 ± 1.30 kgf to 3.41 ± 1.50 kgf (p = 0.0002; 95%CI 0.38-0.96). In the intergroup comparison, there was no statistical difference (F: 0.71; p = 0.49) (**figure 3b**).

Generalized disability and anxiety index

There was an improvement in NDI between baseline and one week, and four weeks later (F: 53.29; p < 0.0001). The MIC group reduced the mean score in the comparison between base-

Table II. Sample characteristics.

	MIC (n = 18)	ICG (n = 17)	ICA (n = 17)
Age	27 ± 6.05	25 ± 6.01	25 ± 4.47
Weight	63 ± 11.21	59.5±15.04	62 ± 13.96
Height	1.64 ± 0.07	1.62 ± 0.09	1.64 ± 0.06
BMI	23.42	22.67	23.05
TP location (R/L)	14/4	12/5	9/8
VAS	4.18 ± 1.20	5.0 ± 1.44	4.5 ± 1.10
PPT	2.38 ± 0.56	2.46 ± 0.85	2.26 ± 1.31
NDI	14.5 ± 5.80	13.0 ± 6.14	11.0 ± 4.32
GAD-7	10.0 ± 4.87	9.0 ± 5.34	11.0 ± 5.05

Mean ± Standard deviation; MIC: Manual Ischemic Compression group: ICG: Ischemic Compression by Gatilhex group; ICA: Ischemic Compression by Pressure Algometer group; BMI: Body Mass Index; TP: trigger point; R: right; L: left; VAS: Visual Analogue Scale.

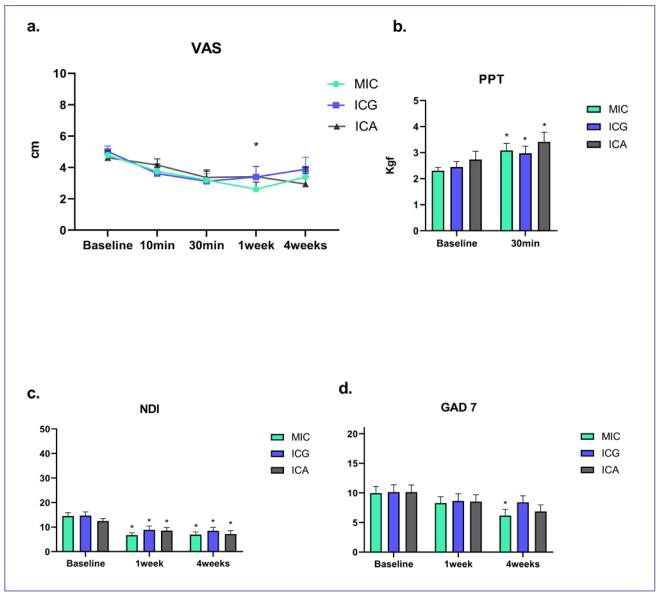

Figure 3. (a) Measures of the Visual Analogue Scale in the five moments of collection; **(b)** Measures of pressure pain threshold at baseline and 30 minutes after intervention; **(c)** Score from the Neck Disability Index questionnaire; **(d)** Score from Generalized Anxiety Disorder Scale. Both in the three moments of collection, baseline, after one week, and after four weeks.

(a) Data on mean ± SEM. *Demonstrates a statistically significant difference in the MIC group, according to the intragroup analysis, when comparing baseline and 1 week; **(b)** Data on mean ± SEM. *statistically significant difference for all groups, in the intragroup analysis, between baseline and 30 minutes after the intervention; **(c)** *Demonstrates statistically significant difference intragroup of all groups, between baseline and 1 week after the intervention, and baseline and 4 weeks after the intervention; **(d)** Data on mean ± SEM. *Demonstrates a statistically significant difference for the MIC group, in the intragroup analysis, between baseline and 1 week after the intervention.

line and one week, from 14.50 ± 5.80 to 6.66 ± 4.27 ($p < 0.0001$; 95%CI -11.83 to -3.83), and baseline and four weeks (6.88 ± 4.71; $p < 0.0001$; 95%CI -11.61 to -3.61). The same happened in the ICG group, which went from the mean of 14.71 ± 6.14 in the baseline to 8.88 ± 6.34 after one week ($p = 0.022$; 95%CI -10.94 to -0.70), and to 8.47 ± 6.02 after four weeks ($p = 0.013$; 95%CI -11.35 to -1.11). The ICA group went from 12.47 ± 4.31 at baseline to 7.17 ± 5.73 after 4 weeks ($p = 0.012$; 95%CI -9.60 to -0.98). There was no intergroup difference (F: 0.45; $p = 0.635$, **figure 3c**).

As for GAD-7, in the MIC group, there was a reduction in the comparison between the baseline and 4 weeks after the intervention, going from the average value of 9.94 ± 4.86 to 6.16 ± 4.50 (F: 2.95; $p = 0.048$; 95%CI -7.54 to -0.01) (**figure 3d**). There was no intergroup difference (F: 0.25; $p = 0.774$).

Electromyography

There was no significant change in the electromyographic signal, for the RMS value (intergroup = F: 1.00; $p = 0.37$; intragroup = F: 0.01; $p = 0.91$). The same occurred with Fmed (intergroup = F: 0.915; $p = 0.515$, intragroup = F: 0.682; $p = 0.841$).

Adverse effects

For the adverse effects regarding the discomfort of the technique, the mean value was 7.22 points in the MIC group, 6.58 points ICG, and 6.23 in the ICA group. Sixteen volunteers reported some symptoms between 24h and one week after the intervention, and only 2 reported interference with their ADLS (according to these volunteers, there was an exacerbation of pain at the treatment site, within a period of up to 24 hours after, and this limited the movements of the ipsilateral upper limb and neck). Other symptoms are shown in **table III**.

Table III. Self-reported adverse effects.

	MIC (n = 18)	CICG (n = 17)	ICA (n = 17)
Pain, n (%)	4 (22.2%)	5 (29.1%)	3 (17.3%)
Ipsilateral with remission within 24h	3 (16.6%)	1 (5.8%)	2 (11.4%)
Ipsilateral with remission up to 1 week	1 (5.5%)	2 (11.7%)	0
Contralateral with remission within 24h	0	0	1 (5.8%)
Bilateral with remission within 24h	0	1 (5.8%)	0
Irradiated	0	1 (5.8%)	0
Other, n (%)	-	1 (5.8%)	-
Numbness in the Upper Limb	0	1 (5.8%)	0
Damage, n (%)	-	2 (11.7%)	1 (5.8%)
ADLS	0	2 (11.7%)	1 (5.8%)
Labor	0	0	0

n: Number of individuals; h: hours; ADLS: activities of daily living; MIC: Manual Ischemic Compression group: ICG: Ischemic Compression by Gatilhex group; ICA: Ischemic Compression by Pressure Algometer group.

DISCUSSION

The present study investigated the effects of manual and instrumental ischemic compression on pain, pressure pain threshold, disability level, generalized anxiety, and electromyographic activity in women with active descending trapezius TP, as well as the adverse effects of the techniques.

Regarding pain, the reduction of 2.17 cm found in the MIC group is approximately 2.5 times greater than the 0.85 cm, which is the minimum clinically significant difference when measured by VAS (47, 48). The reduction in pain is thought to result from the improvement in local blood flow due to the mechanical stimulus applied to the muscle, which promotes sarcomere lengthening (7, 15, 49). The increase in tissue blood flow breaks the cycle of energy crisis, thereby interrupting pain signaling (50).

According to Bialosky *et al.* (51), after manual therapy, a cascade of physiological events occurs in both the central and peripheral nervous systems that control the response of inflammatory mediators and nociceptors. It is also known that the contact surface with the tissue, as well as the pressure applied, will stimulate different nociceptors responsible for the information input and consequent symptomatic effect (52, 53).

Thus, it is clear that 90 s of manual IC can reduce pain. In addition, this finding corroborates other studies that used a single IC intervention in the descending trapezius (27, 54, 55), as well as the systematic review by Cagnie *et al.* (13), which indicates the moderate effect of IC in the treatment of descending trapezius TP.

The ICG group did not show a statistically significant reduction in pain, in contrast to studies investigating the effects of IASTM on pain (21, 57). However, most studies used larger instruments that treated the entire muscle or even a greater number of sessions to stimulate local circulation (16, 18).

The ICA group did not show much reduction in pain. It is possible that the fact of keeping the pressure constant for 90 s promotes tissue adaptation, but with a lower total pressure level to produce satisfactory hyperemia and break the actin-myosin bridge to desensitize the region (15). Studies using an algometer or similar device and gradually increasing pressure have shown a significant reduction in pain (22, 58, 59).

The increase in PPT corroborates the pain reduction obtained by VAS and indicates the local increase in blood supply produced by both friction on the tissue and sustained point compression, thus minimizing inflammatory responses and consequent sensitization of the region (60, 61). The ICA group showed a slightly higher gain than the others, confirming the findings of Abu Taleb *et al.* (22). The algometer is also used to measure this variable, suggesting that there may be tactile familiarization.

Furthermore, the results in the MIC group confirm the authors who obtained an increase in PPT after a single session (27, 62). While the increase in the ICG group confirms the results of studies using IASTM in the treatment of TP, both for the descending trapezius (16, 63) and for other muscle groups (57). When comparing manual therapy with IASTM, manual therapy is superior, confirming the results of the present study (16).

Another positive factor for both interventions was the reduction of the NDI score. The CIM group had an even greater reduction than the others, confirming other studies that used manual therapy in different protocols (14, 30, 58, 64). Nevertheless, studies using instruments also showed improvement in NDI scores and muscle function (16, 17, 24, 65), which is related to the reduction in pain found by both VAS and PPT, generating an increase in functionality (66). In addition, Simons (7) points out that the compressive and sustained stimulus on the TP restores the biomechanical properties of the muscle and its functionality.

Emotional factors can interfere and even trigger MPS. According to the present study, the groups presented an average score of 9.94 points on the GAD-7, representing mild anxiety (34), and after the intervention, the MIC group showed a reduction of 3.78 points, higher than the minimum clinically significant difference, which would be 3 points (67). Previous studies suggest that the relationship between pain and anxiety is directly proportional, such that individuals who report more pain tend to report more anxiety (68, 69).

In addition, women tend to have more anxiety in response to the painful experience (70, 71). Thus, it is reasonable to assume that the MIC group who experienced greater pain reduction may have also experienced a reduction in anxiety, supporting other studies that have used manual therapy in the cervical region and found a reduction in anxiety (72, 73).

Studies suggest muscle hyperactivity in the presence of active TP (12, 74) and changes in motor recruitment in the presence of musculoskeletal disorders (75-77). The present study found no changes in electromyographic activity after treatment, confirming the findings of Dibai-Filho *et al.* (78) who performed a similar study and found no changes in RMS and Fmed after a manual therapy session.

In terms of adverse effects, the group that received ICG was the most likely to report some type of discomfort that showed interference with ADLS, exceeding the 10% level that can be classified as a very common effect (79). Regarding the level of discomfort immediately after the intervention, the MIC group had the highest mean value and was the group with the greatest reduction in pain after treatment, suggesting that there is a relationship between the effect and the pressure exerted on the TP. However, further studies with larger samples should be conducted to investigate the effects of these therapies.

Finally, it is important to emphasize that the objective of the study was to compare three different modalities and the effects of manual compression were similar to instrumental in the sample and methodology used in the present study.
Some limitations were identified in the study: protocol with only one intervention session, limited to the immediate effects; EMG and PPT were checked only on the affected side; no muscle strength test was performed to analyze the recruitment of a motor unit to produce the same strength before and after treatment.

CONCLUSIONS

In conclusion, an intragroup improvement was observed in the pain and anxiety variables for the MIC group, when comparing the baseline with one week and four weeks, respectively. There was an improvement in all groups in the pressure pain threshold variables, between baseline and one week; neck disability, between baseline and one week and four weeks, respectively. However, no differences were observed between groups in the post-treatment. Additionally, the application of MIC showed fewer adverse effects than ICG and ICA.

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DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

VF: analysis of participants, data collection, writing – original draft. BB: analysis of participants, data collection. AD: writing – original draft, translation into English. HK, FD: data evaluation, statistical analysis. ECG: writing – original draft, translation into English. AM: writing – review & editing. RIB: research, supervision.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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