Effect of Algometric Pressure Release versus Post Isometric Relaxation on Myofascial Trigger Points of Upper Trapezius: A Randomized Controlled Study

Amir Mohamed Saleh[1], Nabil Mahmoud Abdel-Aal[2], Mai Ezzat Mousa Mohamed[3*], Mayada Ashraf Mahmoud Samy[4]

[1]*Professor, Department of Physical Therapy for Basic Sciences, Faculty of Physical Therapy, Cairo University, Giza, Egypt.*
[2]*Assistant Professor, Department of Physical Therapy for Basic Sciences, Faculty of Physical Therapy, Cairo University, Giza, Egypt.*
[3]*Assistant lecturer, faculty of physical therapy, Kafrelsheikh University, Egypt.*
[4]*Lecturer, Department of Physical Therapy for Basic Sciences, Faculty of Physical Therapy, Cairo University, Giza, Egypt.*
Corresponding author: Mai Ezzat Mousa Mohamed; Email: maiezzat042@gmail.com

KEYWORDS
Trigger points; Upper trapezius; Algometric pressure release; Post isometric relaxation.

ABSTRACT

Objective: To investigate the effect of Algometric pressure release (APR) versus Post isometric relaxation (PIR) on pain intensity, pain pressure threshold, range of motion, proprioception, muscle activity and neck functional abilities in subjects with myofascial trigger points (MTrPs) in upper trapezius.

Methods: Sixty patients (18-30 years) with active MTrPs in the upper trapezius were assigned randomly into 3 equal groups. Study group (1) received algometric pressure release and conventional physical therapy (CPT), Study group (2) received post isometric relaxation plus CPT, while the group control received conventional treatment alone. The frequency of intervention was 3 visits a week for 4 weeks. Pain intensity level, pain pressure threshold (PTT), cervical range of motion (CROM), proprioception, muscle activity, and the neck functions abilities were measured at baseline and after four weeks of interventions.

Results: After four weeks of intervention, the APR group outperformed the PIR group with statistically significant enhancements in all outcome measures ($p<0.05$). The (mean± SD) of VAS were 16.75 ± 3.73, 29.75 ± 4.43, and 42.75 ± 5.73 mm for APR, PIR, and CPT, respectively. The (mean± SD) of NDI were 3.60 ± 1.14, 5.95 ± 1.27, and 7.75 ± 1.21 for APR, PIR and CPT groups, respectively.

Conclusions: Algometric pressure release was more effective than the PIR in decreasing pain, improving ROM, cervical proprioception, muscle activity, and neck functions abilities in subjects with upper trapezius myofascial trigger points.

1. Introduction

Myofascial trigger points (MTrPs) are hyperirritable and palpable nodules located within the tight bands of muscle fibers [1]. The muscles of the neck and shoulders are commonly affected by MTrPs, with the trapezius muscle being the most commonly involved [2]. According to estimates, trigger points in the neck affect 85% of patients who visit pain clinics, with women experiencing this condition more frequently than men [3].

Myofascial trigger points cause pain, limitations in range of motion (ROM), proprioception impairment, and muscle weakness1.Proprioception loss and pain can result in compensatory postural mechanisms and significant functional impairment [4].

Myofascial trigger point treatments include a variety of techniques, such as spray and stretch, muscle energy technique, laser, massage and ultrasound. Nevertheless, there are no solid results to support the application of any particular method in the treatment of MTrPs [5, 6].

Manual pressure release (MPR) is a manual therapy techniques used for treating trigger points. It is applied by delivering painful, continuous manual pressure to tissue barrier of an MTrPs, usually with the thumb or fingertip. It is used to elongate the sarcomeres of contraction knots found in the affected muscle fibers. This method operates on the principle of a slow, sustained stretch, which lengthens the muscle fibers, leading to reduced tightness and pain relief [7].

Although scientific evidence supports the use of pressure release (PR) for treating MTrPs, there is still significant variability in research and clinical practice regarding the precise amount of applied pressure during PR. Additionally, manual therapists may struggle to maintain consistent pressure throughout the procedure [8]. Therefore, ergonomic therapeutic tools have been recommended to ensure consistent and effective PR application. Devices like algometers, which are objective and practical in clinical settings, may help maintain pressure consistency. Furthermore, the mechanical nature of these tools could lower the risk of work-related injuries linked to manual techniques [9].

Post-isometric relaxation (PIR), another direct and noninvasive manual therapy, is also employed to restore normal muscle length and improve range of motion, with its primary goal being the relaxation of hypertonic muscles. Unlike MPR, PIR uses the principle of post-isometric stretching to lengthen the sarcomeres in contraction knots within the affected muscles. This approach helps reduce tension in the muscle fibers, providing pain relief for patients with MTrPs [7].

Pressure release and post isometric relaxation are highly effective in combating pain and reducing muscle tension [7, 10-12]. Muscle tension results in pain due to the sustained contraction of intrafusal muscle fibers, driven by gamma motor neuron activity and increased sympathetic nerve stimulation. Using either PR or PIR offers an opportunity to reset both the neurological and musculoskeletal systems [7].

Therefore, the goal of this study was to evaluate the impact of algometric pressure release versus post isometric relaxation on pain intensity, pressure pain threshold, function abilities, muscle activity, range of motion, and proprioception in individuals with MTrPs in upper trapezius.

2. Material and Methods

Study Design

This is a randomized controlled trial study that was conducted from September 2022 to December 2023. The study protocol received approval from the Human Research Ethics Committee at the Faculty of Physical Therapy, Cairo University [No: P.T.REC/012/003354], and registered in the Pan African Clinical Trial Registry [reference No: PACTR202209502771025].

Sample size

The sample size was determined in advance of the study to ensure the study was adequately powered and minimize type II error. The G*POWER software (version 3.1.9.6, Düsseldorf, Germany) was used for this purpose, using [F tests-MANOVA with repeated measures, within-between interaction], with a 0.44 effect size, an 80% power, and a two-sided alpha error of 0.05, to detect a minimal clinically important change of 20 mm in pain intensity between groups. Unpublished Pilot research with five volunteers per group helped determine the effect size. Anticipating participant dropout, the sample size was increased by 10%, resulting in 60 participants, up from the initially calculated 53.

Participants

Participants were recruited from the outpatient clinic of the Faculty of Physical Therapy at Kafr El-Sheikh University. They were fully informed about the study's purpose, benefits, withdrawal rights, and confidentiality of their data. Informed written consent was obtained before participation. The study was conducted following the CONSORT guidelines for proper reporting.

All patients referred with active MTrPs in the upper trapezius were assessed for eligibility in this study. A total of sixty participants with active MTrPs in the upper trapezius fibers, lasting no more than 12 weeks, from both genders were included. Their ages ranged from 18 and 30 years and body mass index (BMI) was 18.5–25 kg/m^2. Patients were excluded if they had fibromyalgia, other systemic rheumatic diseases, a history of whiplash injury, musculoskeletal disorders, cervical spondylosis, cervical trauma or surgeries, spondylolisthesis with radiculopathy, long-term steroid use, recent anti-inflammatory analgesic use within the last 24 hours, or had undergone MTrPs therapy within the last 3 months.

Randomization

Sixty participants were allocated randomly into three equal groups. The individual handling the randomization was not involved in data collection. A computer-generated block randomization, using block sizes of 6 to 9, was implemented to minimize bias and balance the variance across the groups. Randomization codes were enclosed in sealed, opaque envelopes, which were sequentially numbered to preserve allocation concealment. Envelopes were opened by the treating author to provide therapy based on the assigned group.

Interventions

Following baseline evaluations, the intervention was delivered by the treating author in accordance with the group assignments. All participants additionally received a conventional physical therapy program.

The participants in study group (I) underwent algometric pressure release therapy. They were instructed to sit in a relaxed position with their head in a neutral alignment. The algometer, with its rubber disk covered by a thin cloth to minimize discomfort, was used to apply slow pressure to the identified MTrPs. Pressure was gradually increased until the participant described the pain as "moderate but easily tolerable", corresponding to a 7 out of 10 on the VAS, which was about 25-50% higher than their initial PPT values. The pressure was then maintained, and if the participant's pain perception decreased (e.g., to a 3 or 4 on the VAS), the researcher gradually increased the pressure to bring it back to a 7. Pressure was held for one minute, and the process was repeated three times with 30-second breaks in between [10].

The study group (II) underwent Post Isometric Relaxation therapy. Participants were positioned supine, with the therapist stabilizing the affected shoulder using one hand while the opposite hand supported the ear/mastoid area on the same side. The head and neck were bent toward the opposite side, flexed, and rotated toward the affected side. The participant then performed a shoulder shrug towards the ear with a gentle, pain-free effort at 20% of their strength. This isometric contraction was held for 7-10 seconds while maintaining a normal breathing pattern. During the relaxation phase, the therapist gradually increased the side bending, flexion, and rotation of the head and neck to deepen the stretch on the muscle. Each stretch was held for 30 seconds and repeated 3-5 times per session [7].

The control group (III) received a conventional physical therapy program, which included ultrasound, stretching, strengthening and posture correction exercises [13, 14-17].

Full details of the conventional therapy program are included in (the supplementary file)

Outcome measures

All outcome measures were evaluated both at baseline and after completing the four-week treatment program.

Pain intensity level

It was assessed using the visual analogue scale (VAS), a 100 mm horizontal line where "no pain" is indicated on the left and "unbearable or worst pain" on the right. Patients mark the point on the line that best reflects their current pain level. The VAS has demonstrated strong validity and a test-retest reliability of 0.95 [18].

Pain pressure threshold (PPT)

It was measured by using the manual algometer on the MTrPs then increase pressure by 1 kg/cm per second until the participant felt a sensation of pain guided by using a standard metronome. When the participant indicated feeling pain by saying "now," the pressure level was recorded. The measurement was taken three times, with 30 seconds between each recording [10]. This method is recognized as a valid and reliable tool for assessing pain pressure threshold [19].

Cervical Range of Motion (CROM)

It was assessed using the CROM device, which is equipped with three inclinometers, each designed to measure movement in a different plane. The device is secured to the head, with one gravity dial meter measuring flexion and extension, another for lateral flexion, and a compass meter for rotation, its accuracy enhanced by two magnets placed over the participant's shoulders. The CROM device has demonstrated good criterion validity (Pearson r, 0.93–0.98) and reliability (intra-class correlation coefficients [ICC] = 0.89–0.98) [20].

Cervical proprioception

It was also evaluated using the CROM device. To assess joint position error (JPE), the therapist guided the participant's head slowly to the target position, set at 50% of their maximum CROM (previously recorded by the therapist), and held it there for 3 seconds. The participant memorized this target position, after which the therapist gently returned the head to a neutral position. The participant was then instructed to actively move their head to replicate the target position. Once they reached it, JPE was measured in degrees. The CROM device has shown strong criterion validity (r = 0.89–0.99) and reliability (intra-class correlation coefficients [ICC] = 0.92–0.96) [21].

Muscle activity

Surface electromyography (EMG) was utilized to measure root mean square (RMS) values. Two recording electrodes (one reference and one active) were placed parallel to the upper trapezius muscle, with a 2-3 cm distance between them, while the ground electrode was fastened around the wrist joint. The skin over the upper trapezius and wrist was cleaned with alcohol before electrode placement. The recording electrodes were positioned 2 cm lateral to the center of a line drawn from the C7 spinous process to the posterolateral aspect of the acromion. During the test, the participant, seated in a chair, was instructed to relax the trapezius muscle for six seconds, then elevate both shoulders and hold an isometric contraction for six seconds, guided by verbal commands. Participants were trained on these tasks in advance, with each task performed three times and a one-minute rest between trials. The RMS value was recorded, and normalized EMG activity values were calculated using the formula: Normalized RMS % = (EMG amplitude during resting / average of EMGMAX for the three trials) × 100 [22].

Neck functions abilities

The Neck Disability Index (NDI) was used to assess neck functional abilities. This reliable and valid instrument includes10 items, each scored on a scale from zero (no disability) to five (complete disability), with a maximum possible score of 50. Participants were asked to select the response that best described their level of neck functional disability for each item. The individual scores were summed to produce a total score. A total score of 0–4 reflects no disability, 5–14 corresponds to mild disability, 15–24 indicates moderate disability, 25–34 signifies severe disability, and 35 or above suggests complete disability [23].

Statistical analysis

Statistical analysis was performed using SPSS software for Windows (Chicago, IL, USA) version 25.0. Descriptive statistics were calculated for both groups at baseline and after the fourth week. The Shapiro-Wilk test was used to check for data normality. A two-way mixed-design MANOVA was applied to assess differences between groups based on the combined mean change scores across all outcomes. The F value was based on Wilks' lambda, and if a significant effect was found ($P < 0.05$), follow-up univariate ANOVAs were conducted. Bonferroni correction was used for multiple comparisons to prevent type 1 errors. A significance level of $P < 0.05$ was used for all tests.

3. Results

Fig. 1 shows the flow diagram of participant progression throughout the study.

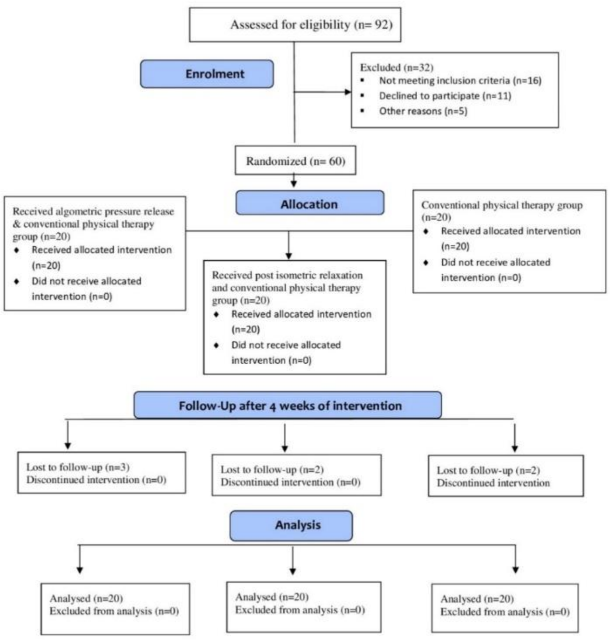

Fig. 1. Flow chart of the study

Table 1 provides an overview of subject characteristics and baseline data for the three groups: algometric pressure release, post-isometric release, and control. The groups showed no significant differences in age, sex distribution, or body mass index (p > 0.05).

Table 1. Demographic and baseline clinical characteristics of subjects (N = 60)*

	APR Group (n = 20)	PIR Group (n = 20)	Control Group (n = 20)
Age (years)	22.95 ± 2.06	21.80 ± 2.89	22.70 ± 2.47
Weight (kg)	60.28 ± 6.19	60.15 ± 7.46	60.50 ± 6.47
Height (cm)	162.50 ± 6.26	162.75 ± 6.69	164 ± 7.27
BMI (kg/m²)	22.81 ± 1.82	22.63 ± 1.52	22.47 ± 1.56
Sex, n (%)			
Females	17 (85%)	16 (80%)	15 (75%)
Males	3 (15%)	4 (20%)	5 (25%)
VAS (mm)	84 ± 9.40	79 ± 10.71	82 ± 12.39
NDI (score)	17.90 ± 4.96	16.65 ± 4.08	15.45 ± 3.52
PPT of right side (kg)	0.61 ± 0.26	0.57 ± 0.22	0.67 ± 0.23
PPT of left side (kg)	0.58 ± 0.19	0.52 ± 0.20	0.68 ± 0.27
RMS of right side (%)	6.07 ± 1.37	6.01 ± 1.29	6.19 ± 1.02
RMS of left side (%)	6.67 ± 1.35	6.37 ± 1.17	5.95 ± 0.92
ROM (degrees)			
Flexion	44.05 ± 4.79	46.30 ± 4.77	45.50 ± 3.94
Extension	47.25 ± 4.43	48.75 ± 5.09	47.50 ± 3.80
Right bending	33.05 ± 5.76	34.65 ± 4.21	32.75 ± 4.13
Left bending	31.90 ± 5.13	33.25 ± 4.81	32.25 ± 5.25
Right rotation	51.45 ± 3.96	52.50 ± 3.44	50.75 ± 3.73
Left rotation	52.60 ± 6.15	53.35 ± 6.20	51.15 ± 4.66
JPE (degrees)			
Flexion	5.45 ± 0.95	5.55 ± 0.76	5.70 ± 0.86
Extension	4.55 ± 0.88	4.85 ± 0.67	4.65 ± 0.74
Right bending	3.90 ± 0.97	3.70 ± 0.92	3.95 ± 0.94
Left bending	4.20 ± 0.89	3.95 ± 0.88	4.15 ± 0.74
Right rotation	5.25 ± 0.85	4.95 ± 0.68	5.05 ± 0.82
Left rotation	5.45 ± 0.94	5.30 ± 0.80	5.25 ± 0.72

APR, algometric pressure release; PIR, post isometric relaxation; VAS = visual analogue scale; NDI = neck disability index, PPT = pressure pain threshold, RMS, root mean square; JPE = joint position error, *Data are mean ± SD.

Regarding the effect of treatment on VAS, NDI, PPT, RMS, neck ROM and neck JPE: The mixed MANOVA findings showed a significant interaction between the type of treatment administered and the timing of the measurements (Wilk's Λ = 0.048, F = 7.917, p = 0.001, η^2 = 0.78). There was a significant main effect of time (Wilk's Λ = 0.003, F = 694.40, p = 0.001, η^2 = 0.99). There was a significant main effect of treatment (Wilk's Λ = 0.130, F = 3.95, p = 0.001, η^2 = 0.64).

Between groups comparison

There was a significant reduction in VAS, NDI, and RMS, along with a significant increase in PPT in the algometric pressure release group compared to the post-isometric release group (p < 0.01) and the control group (p < 0.001). Similarly, the post-isometric release group showed significant decreases in VAS, NDI, and RMS, as well as a significant increase in PPT when compared to the control group (p < 0.01).

There was a significant increase in neck ROM of algometric pressure release group compared with that of post isometric release group (p < 0.05) and control group (p < 0.001). Also, significant increases were found in neck ROMs of post isometric release group compared with that of control group (p < 0.05).

There were significant reductions in flexion, extension, right and left bending, and right and left rotation JPE in the algometric pressure release group compared to the post-isometric release group (p < 0.05) and the control group (p < 0.001). Additionally, the post-isometric release group showed significant decreases in JPE compared to the control group (p < 0.05) (Tables 2 and 3).

Within group comparison

Following treatment, the pressure algometer release group, post-isometric release group, and control group all showed significant reductions in VAS, NDI, RMS, and JPE, as well as significant increases in PPT and ROM compared to their pre-treatment levels (p < 0.001) (Table 4).

Table 2. Clinical characteristics of subjects after 1 month of intervention (N = 60)*

Outcome	APR Group (n = 20)	PIR Group (n = 20)	Control Group (n = 20)	F value	p value
VAS (mm)	16.75 ± 3.73	29.75 ± 4.43	42.75 ± 5.73	152.753	0.001
NDI (score)	3.60 ± 1.14	5.95 ± 1.27	7.75 ± 1.21	59.128	0.001
PPT of right side (kg)	3.15 ± 0.77	2.02 ± 0.68	1.34 ± 0.54	36.394	0.001
PPT of left side (kg)	3.26 ± 0.76	1.96 ± 0.39	1.33 ± 0.40	64.735	0.001
RMS of right side (%)	1.54 ± 0.53	2.32 ± 0.61	3.03 ± 0.80	25.891	0.001
RMS of left side (%)	1.88 ± 0.46	2.52 ± 0.63	3.05 ± 0.54	22.280	0.001
ROM (degrees)					
Flexion	65.50 ± 5.59	61.10 ± 4.41	55 ± 4.87	22.403	0.001
Extension	69.45 ± 5.87	64.75 ± 4.13	58.25 ± 5.44	23.377	0.001
Right bending	47.75 ± 4.72	43.15 ± 4.34	38.75 ± 5.53	17.412	0.001
Left bending	46.5 ± 4.01	43 ± 3.40	39.75 ± 4.43	14.455	0.001
Right rotation	74.25 ± 4.37	69.50 ± 5.10	64 ± 6.99	16.769	0.001
Left rotation	75.20 ± 4.50	69.50 ± 4.84	65.25 ± 5.38	20.562	0.001
JPE (degrees)					
Flexion	1.60 ± 0.47	2.25 ± 0.78	2.80 ± 0.76	15.095	0.001
Extension	1.23 ± 0.47	1.70 ± 0.57	2.20 ± 0.52	17.329	0.001
Right bending	1.33 ± 0.43	1.83 ± 0.56	2.35 ± 0.58	18.345	0.001
Left bending	1.43 ± 0.47	1.90 ± 0.62	2.50 ± 0.68	16.188	0.001
Right rotation	1.85 ± 0.69	2.62 ± 0.70	3.17 ± 0.65	18.973	0.001
Left rotation	1.97 ± 0.49	2.63 ± 0.58	3.15 ± 0.75	18.180	0.001

APR, algometric pressure release; PIR, post isometric relaxation; VAS = visual analogue scale, NDI = neck disability index, PPT = pressure pain threshold, RMS = root mean square, JPE = joint position error, P = probability value, $p < 0.05$ indicates statistical significance, *Data are mean ± SD

Table 3. Between groups effects after 1 month of intervention.

Outcome	Group APR vs PIR		Group APR vs Control		Group PIR vs Control		Partial Eta Square
	MD (95% CI)	p value	MD (95% CI)	p value	MD (95% CI)	p value	
VAS (mm)	-13 (-16.58, -9.42)	0.001	-26 (-29.58, -22.42)	0.001	-13 (-16.58, -9.42)	0.001	0.843
NDI (score)	-2.35 (-3.27, -1.43)	0.001	-4.15 (-5.07, -3.23)	0.001	-1.8 (-2.72, -0.88)	0.001	0.675
PPT of right side (kg)	1.13 (0.62, 1.64)	0.001	1.81 (1.29, 2.31)	0.001	0.68 (0.16, 1.18)	0.007	0.561
PPT of left side (kg)	1.3 (0.88, 1.72)	0.001	1.93 (1.51, 2.35)	0.001	0.63 (0.21, 1.05)	0.002	0.694
RMS of right side (%)	-0.78 (-1.28, -0.28)	0.001	-1.49 (-1.99, -0.99)	0.001	-0.71 (-1.21, -0.22)	0.003	0.476
RMS of left side (%)	-0.64 (-1.06, -0.22)	0.002	-1.17 (-1.58, -0.74)	0.001	-0.53 (-0.95, -0.11)	0.01	0.439
ROM (degrees)							
Flexion	4.4 (0.61, 8.19)	0.019	10.5 (6.71, 14.29)	0.001	6.1 (2.31, 9.89)	0.001	0.440
Extension	4.7 (0.74, 8.66)	0.016	11.2 (7.24, 15.16)	0.001	6.5 (2.54, 10.46)	0.001	0.451
Right bending	4.6 (0.93, 8.27)	0.011	9 (5.33, 12.67)	0.001	4.4 (0.73, 8.07)	0.015	0.379
Left bending	3.5 (0.48, 6.52)	0.019	6.75 (3.73, 9.77)	0.001	3.25 (0.23, 6.27)	0.032	0.337
Right rotation	4.75 (0.49, 9.01)	0.026	10.25 (5.99, 14.51)	0.001	5.5 (1.24, 9.76)	0.008	0.370
Left rotation	5.7 (1.95, 9.45)	0.002	9.95 (6.20, 13.70)	0.001	4.25 (0.50, 8)	0.023	0.419
JPE to neutral (degrees)							
Flexion	-0.65 (-1.18, -0.12)	0.012	-1.2 (-1.73, -0.67)	0.001	-0.55 (-1.08, -0.02)	0.039	0.346
Extension	-0.47 (-0.87, -0.08)	0.016	-0.97 (-1.37, -0.58)	0.001	-0.5 (-0.90, -0.1)	0.010	0.378
Right bending	-0.5 (-0.91, -0.09)	0.012	-1.02 (-1.43, -0.62)	0.001	-0.52 (-0.93, -0.12)	0.008	0.392
Left bending	-0.47 (-0.93, -0.02)	0.039	-1.07 (-1.53, -0.62)	0.001	-0.60 (-1.06, -0.14)	0.007	0.362
Right rotation	-0.77 (-1.30, -0.25)	0.002	-1.32 (-1.85, -0.80)	0.001	-0.55 (-1.07, -0.03)	0.036	0.400
Left rotation	-0.66 (-1.12, -0.18)	0.004	-1.18 (-1.64, -0.71)	0.001	-0.52 (-0.99, -0.06)	0.025	0.389

APR, algometric pressure release; PIR, post isometric relaxation; VAS = visual analogue scale, NDI = Neck disability index, PPT = pressure pain threshold, RMS = root mean square, JPE = joint position error. MD = mean difference, CI = confidence interval, P = Probability value, $p < 0.05$ indicates statistical significance, *Data are mean ± SD

Table 4. Within groups changes pre-1 months of intervention.

Outcome	APR Group		PIR Group		Control Group	
	MD (95% CI)	p value	MD (95% CI)	p value	MD (95% CI)	p value
VAS (mm)	67.25 (62.59, 71.90)	0.001	49.25 (44.59, 53.90)	0.001	39.25 (34.59, 43.90)	0.001
NDI (score)	14.3 (12.40, 16.2)	0.001	10.7 (8.8, 12.6)	0.001	7.7 (5.8, 9.6)	0.001
PPT of right side (kg)	-2.54 (-2.81, -2.26)	0.001	-1.45 (-1.72, -1.17)	0.001	-0.67 (-0.94, -0.39)	0.001
PPT of left side (kg)	-2.68 (-2.91, -2.43)	0.001	-1.44 (-1.67, -1.20)	0.001	-0.65 (-0.87, -0.40)	0.001
RMS of right side (%)	4.53	0.001	3.69	0.001	3.16	0.001

	(4.04, 5.02)		(3.21, 4.19)		(2.67, 3.66)	
RMS of left side (%)	4.78 (4.31, 5.26)	0.001	3.85 (3.37, 4.33)	0.001	2.9 (2.42, 3.38)	0.001
ROM (degrees)						
Flexion	-21.45 (-24.11, -18.79)	0.001	-14.8 (-17.45, -12.14)	0.001	-9.5 (-12.15, -6.84)	0.001
Extension	-22.2 (-24.87, -19.53)	0.001	-16 (-18.67, -13.33)	0.001	-10.75 (-13.42, -8.07)	0.001
Right bending	-14.7 (-16.79, -12.61)	0.001	-8.5 (-10.58, -6.41)	0.001	-6 (-8.09, -3.91)	0.001
Left bending	-14.6 (-16.35, -12.84)	0.001	-9.75 (-11.50, -7.99)	0.001	-7.5 (-9.25, -5.74)	0.001
Right rotation	-22.8 (-25.67, -19.92)	0.001	-17 (-19.87, -14.12)	0.001	-13.25 (-16.12, -10.37)	0.001
Left rotation	-22.6 (-25.32, -19.88)	0.001	-16.15 (-18.87, -13.43)	0.001	-14.1 (-16.82, -11.38)	0.001
JPE (degrees)						
Flexion	3.85 (3.44, 4.25)	0.001	3.3 (2.89, 3.71)	0.001	2.9 (2.49, 3.31)	0.001
Extension	3.32 (3.04, 3.61)	0.001	3.15 (2.86, 3.43)	0.001	2.45 (2.17, 2.73)	0.001
Right bending	2.57 (2.19, 2.95)	0.001	1.87 (1.49, 2.25)	0.001	1.6 (1.22, 1.97)	0.001
Left bending	2.77 (2.51, 3.03)	0.001	2.05 (1.78, 2.31)	0.001	1.65 (1.38, 1.91)	0.001
Right rotation	3.4 (3.04, 3.75)	0.001	2.33 (1.97, 2.68)	0.001	1.88 (1.52, 2.23)	0.001
Left rotation	3.48 (3.16, 3.78)	0.001	2.67 (2.36, 2.98)	0.001	2.1 (1.79, 2.41)	0.001

APR, algometric pressure release; PIR, post isometric relaxation; VAS = visual analogue scale, NDI = neck disability index, PPT = pressure pain threshold, RMS = root mean square, JPE, joint position error, mean difference, CI = confidence interval, P = probability value, p < 0.05 indicates statistical significance, *Data are mean ± SD

4. Discussion

This study aimed to evaluate the impact of adding algometric pressure release versus post-isometric relaxation to a conventional physical therapy program on pain intensity, pain pressure threshold, range of motion, proprioception, muscle activity, and neck functional abilities in individuals with upper trapezius MTrPs. The key results revealed statistically significant improvements across all outcomes in favor of the algometric pressure release group. Nonetheless, both the algometric pressure release and post-isometric relaxation groups showed greater improvements in all measures ($p < 0.001$) compared to the control group.

The results of this study showed a significant reduction in pain intensity, as measured by the VAS, after using algometric pressure release (APR) on MTrPs of the upper trapezius. The pain reduction may be due to the consistent pressure applied throughout the session, which likely influenced tissue sensitivity. APR generates a slow, sustained stretch that lengthens muscle fibers, alleviating tightness and relieving pain in MTrP cases [7]. These findings are consistent with Abu Taleb et al. [10] who observed that algometer-applied pressure on upper trapezius trigger points reduced pain more effectively than manual pressure release.

The results of this study indicated an increase in PPT after applying algometric pressure release on upper trapezius MTrPs. The improvement in PPT is likely due to the algometer's perpendicular application, which focuses pressure on a smaller, more targeted area compared to thumb pressure [11]. This pressure release likely reduced pain through reactive hyperemia in the myofascial trigger point region. Additionally, the spinal reflex mechanism may help relax muscle spasms by equalizing sarcomere length at the MTrPs, thus reducing the palpable knot and associated pain [24].

The results of this study were consistent with the findings of Hodgson and Fryer [25] who compared MPR and conventional treatment effects on pain and PPT, showing a significant increase in mean PPT of upper trapezius MTrPs after MPR. However, the current findings contrast with those of Abu Taleb et al.[10], who found no significant differences in PPT between the study groups ($p>0.05$). The conflicting results could be due to factors such as the small sample size (45 patients) and the study's focus on only a single session.

This study found that cervical ROM, assessed by the CROM device, improved following the application of algometric pressure release on upper trapezius MTrPs. The improvement in ROM is likely due to the more effective disruption of trigger point mechanics by algometric pressure, reducing muscle tension and providing a longer-lasting release, which helps to increase ROM [10]. These findings align with those of Abu Taleb et al. [10], who reported significant gains in passive side bending ROM compared to other groups, and improvements in active ROM in the APR group versus the US group ($p<0.05$). However, their study had limitations, including a small sample size of 45 patients and only a single session of treatment.

The findings of this study showed improvements in cervical proprioception as measured by the CROM device following the application of algometric pressure release on MTrPs of the upper trapezius. The improvement in cervical proprioception could be due to the stimulation of articular mechanoreceptors through the continuous pressure technique, which may activate gamma motor neurons, enhance muscle spindle sensitivity, and ultimately lead to better proprioceptive awareness [10]. The pressure release may stimulate sensory receptors, enhancing proprioceptive feedback in the cervical region. Additionally, algometric pressure could promote better blood flow and tissue responsiveness, potentially contributing to improved cervical proprioception [26].

The findings of this study demonstrated improvements in neck functions abilities as measured by neck disability index after the application of algometric pressure release on MTrPs of the upper trapezius. The improvement of neck functions and the ability to manage the activities of daily living may be attributed to decrease in pain and improvement in muscle tone and elasticity after treatment [27].

The outcomes of this study are in line with De Meulemeester et al. [27] who compared manual pressure technique and trigger point dry needling for treating shoulder and myofascial neck pain. The application of manual pressure for 4-weeks significantly improved disability in the short and long terms.

On the other hand, the study results were in contrast with Kashyap et al. [7] who compared the efficacies of manual pressure release and the muscle energy technique for treating upper trapezius trigger points. The results emphasized the importance of manual pressure in the reduction of neck disability with no significant difference between both experimental groups. However, the reasons of these conflicting results because of limited sample size (N= 45), the restricted inclusion of females, and the relatively short duration of the treatment (5 days).

Improvements in muscle activity, as measured by surface electromyography, were observed in this study after the application of algometric pressure release. By generating a negative pressure, the treatment improves blood circulation to the targeted area upon release, which helps resolve the energy and oxygen deficits in the contracted sarcomeres and diminishes the sensory signals from the muscle spindle. Additionally, the vertical pressure applied elongates the shortened sarcomeres to their normal length, avoiding the activation of the stretch reflex [25].

The results of this study align with Rodríguez-Jiménez [12], who compared dry needling with manual trigger point pressure release on active trigger points in the upper trapezius. The manual pressure therapy significantly improved muscle activity after treatment. However, the previous study was limited by a relatively small sample size and only measured the immediate effects. In contrast, the current study differs from Pérez-Bellmunt et al. [28], who found that manual compression did not significantly impact muscle activity in trigger point cases. The limited effectiveness might be related to the application of just one session of ischemic compression.

This study revealed that post-isometric relaxation significantly reduced pain intensity, measured via VAS, in participants with upper trapezius MTrPs. The pain reduction could stem from isometric exercise, which boosts endorphin production and enhances neuromuscular control. The muscle contractions during these exercises activate stretch receptors, leading to the release of beta-endorphins and endogenous opioids from the pituitary gland, contributing to pain relief. Furthermore, post-isometric relaxation affects pressure sensitivity, lowering pain intensity of latent trigger points in the upper trapezius [5, 29].

The results of this study in the line with Hassan et al. [30] who found that combining Muscle Energy Technique (MET) with conventional physiotherapy led to more significant improvements in pain intensity compared to conventional therapy alone

The findings of this study indicated an improvement in PPT, as assessed by an algometer, following the use of post-isometric relaxation (PIR) on upper trapezius MTrPs. The observed improvement in PPT may be due to the effect of PIR, which decreases muscle tone after short periods of isometric contraction. Pain relief from PIR might be linked to the Golgi tendon reflex, which is activated during isometric contraction and leads to muscle relaxation. Additionally, the stimulation of muscle and joint mechanoreceptors can trigger sympathetic excitation and activate the periaqueductal gray matter, aiding in pain modulation [11]. These results are in agreement with those of Ghulam et al. [31] who compared PIR with conventional therapy and found that PIR alone effectively improved PPT in individuals with mechanical neck pain associated with myofascial trigger points.

The findings of this study revealed improvement in ROM as measured by CROM device after the application of post isometric relaxation on MTrPs of the upper trapezius. This improvement in ROM can be attributed to physiological changes in muscle extensibility, which enhances muscle length through a combination of creep and plastic deformation in connective tissues. Additionally, neurophysiological factors, such as improved stretch tolerance, and mechanical factors, including viscoelastic alterations in connective tissue, may contribute to the increased muscle extensibility [11].

These results are consistent with previous studies [29, 30]. Junaid et al. [29] reported significant improvements in neck ROM with PIR compared to routine physical therapy. Furthermore, Hassan et al. [30] demonstrated that adding MET to a conventional program enhanced ROM in cases with MTrPs.

The findings of this study revealed improvement in proprioception as measured by CROM device after the application of post isometric relaxation on MTrPs of the upper trapezius. The observed improvements in proprioception may be due to the impact of isometric relaxation on enhancing blood flow to the cervical muscles, leading to greater relaxation. By alleviating muscle contractions with PIR, abnormal neural signals to the central nervous system may be reduced. Moreover, relaxing the cervical muscles can decrease the strain on myofascial structures, like the thoracolumbar fascia, which are essential for maintaining proprioception and balance [32].

Improvements in neck functional abilities were observed in the findings of this study after the application of post isometric relaxation on MTrPs of the upper trapezius. This improvement can be attributed to the influence of PIR on proprioceptive sensory receptors. When a muscle is contracted isometrically, the proprioceptive feedback inhibits the muscle, leading to relaxation upon release of the contraction. This technique is particularly effective when muscle tightness significantly contributes to somatic dysfunction, thereby reducing disability and enhancing function [33].

The findings of this study were in line with previous studies [29, 30]. Junaid et al. [29] observed that PIR reduced neck disability more effectively than routine physical therapy. Additionally, Hassan et al. [30] reported that combining MET with conventional therapy improved neck function more than conventional therapy alone.

In This study, application of post-isometric relaxation to MTrPs in the upper trapezius enhanced muscle activity, as measured by surface electromyography. This increase in muscle activity can be explained by the suppression of Ib afferents from the Golgi tendon organs, Ia and IIa afferents from the muscle spindles [7]. This altered afferent input is believed to modulate the activity of alpha motor neurons, potentially increasing muscle extensibility and reducing tightness, leading to decreased pain and a gradual return to normal muscle function. Additionally, the stretching action helps normalize the length of sarcomeres in muscle fibers, thereby restoring the function of the muscle's contractile components [7].

The limitations of this study include a small sample size, which necessitates further evaluation with a larger cohort to validate the findings. Additionally, the study did not include follow-up assessments, and the intervention lasted only four weeks, which may be insufficient for assessing long-term effects. Future studies should investigate the long-term effects of the treatment and include follow-up assessments.

5. Conclusions

Algometric pressure release was more effective than the PIR in decreasing pain, improving ROM, cervical proprioception, muscle activity, and neck functions abilities in subjects with upper trapezius myofascial trigger points.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

Funding information

The funding played no role in the design, conduct, or reporting of this study.

Author contribution

Conceptualization: Nabil M Abdel-Aal, Amir M Saleh. Methodology: Mai EM Mohamed, Nabil M Abdel-Aal. Formal analysis: Amir M Saleh. Funding acquisition: Mai EM Mohamed. Data curation: Mayada AM Samy. Software: Nabil M Abdel-Aal. Visualization: Mayada AM Samy, Mai EM Mohamed. Supervision: Nabil M Abdel-Aal, Amir M Saleh. Writing – original draft: Amir M Saleh, Mayada AM Samy, Mai EM Mohamed. Writing – review and editing: Nabil M Abdel-Aal, Amir M Saleh. Approval of final manuscript: all authors.

Acknowledgements

We would like to thank all participants who volunteered to participate in this study.

References

[1] Jafri M S. Mechanisms of Myofascial Pain. Int Sch Res Notices 2014; 2014 (1): 523924.

[2] Chang C W, Chang K Y, Chen Y R, Kuo P L. Electrophysiologic evidence of spinal accessory neuropathy in patients with cervical myofascial pain syndrome. Arch Phys Med Rehabil 2011; 92 (6): 935-940.

[3] Gulick D. Evidence-based interventions for myofascial trigger points. Phys Med Rehabil Res 2016; 1 (3): 41-47.

[4] Jagadevan M, Mohanakrishnan B, Bhavanani A B, Shristhudhi D, Arumugam P, Subbiah B, et al. Additive effect of "Brahma Mudra" on pain, proprioception and functional abilities in non-specific mechanical neck pain. Bodyw Mov Ther 2021; 27: 717-722.

[5] Ahmed H, Jarrar M A, Ahmed R, Alqhtani R, Alshahrani A, et al. Effect of post-isometric relaxation and laser on upper trapezius trigger point pain in patients with mechanical neck pain. Niger. J Clin Pract 2020; 23 (12):1660-1666.

[6] De las Peñas C F, Campo M S, Carnero J F, Page J C M. Manual therapies in myofascial trigger point treatment: a systematic review. J Bodyw Mov Ther 2005; 9 (1): 27-34.

[7] Kashyap R, Iqbal A, Alghadir A H. Controlled intervention to compare the efficacies of manual pressure release and the muscle energy technique for treating mechanical neck pain due to upper trapezius trigger points. J Pain Res 2018; 11: 3151-3160.

[8] Fernández-de-las-Peñas C, Alonso-Blanco C, Fernández-Carnero J, Miangolarra-Page J C. The immediate effect of ischemic compression technique and transverse friction massage on tenderness of active and latent myofascial trigger points: A pilot study. J Bodyw Mov Ther 2006; 10: 3-9.

[9] Nordin N A, Leonard J H, Thye N C. Work-related injuries among physiotherapists in public hospitals: a Southeast Asian picture. Clinics (Sao Paulo) 2011; 66 (3): 373-378.

[10] Abu Taleb W, Rehan Youssef A, Saleh A. The effectiveness of manual versus algometer pressure release techniques for treating active myofascial trigger points of the upper trapezius. J. Bodyw Mov Ther 2016; 20 (4): 863-869.

[11] Laithy M, Fouda K: Effect of post-isometric relaxation technique in the treatment of mechanical neck pain. Phys Ther Rehabil 2018; 5:20.

[12] Rodríguez-Jiménez J, Ortega-Santiago R, Bonilla-Barba L, Azhdari N, Mohamadi M. Immediate effects of dry needing or manual pressure release of upper trapezius trigger points on muscle activity during the craniocervical flexion test in people with chronic neck pain: A randomized clinical trial. Pain Med 2022; 23 (10):1717-1725.

[13] Yildirim MA, Öneş K, Gökşenoğlu G. Effectiveness of ultrasound therapy on myofascial pain syndrome of the upper trapezius: Randomized, single-blind, placebo-controlled study. Arch Rheumatol 2018; 33 (4): 418-423.

[14] El-Khateeb Y S, Mahmoud A G, Mohamed M H, Abd El-Azeim A S. Influence of adding strain-counterstrain to standard therapy on axioscapular muscles amplitude and fatigue in mechanical neck pain: a single-blind, randomized trial. Eur J Phys Rehabil Med. 2020; 58(4): 621.

[15] Phadke A, Bedekar N, Shyam A, Sancheti P. Effect of muscle energy technique and static stretching on pain and functional disability in patients with mechanical neck pain: A randomized controlled trial. Hong Kong Physiother J. 2016;35:5-11.

[16] Salo P, Ylinen J, Mälkiä E, Häkkinen AH. Isometric strength of the cervical flexor, extensor, and rotator muscles in 220 healthy females aged 20 to 59 years. J Orthop Sports Phys Ther. 2006;36:495-502.

[17] El-Gendy M, Lasheen Y, Rezkalla W. Multimodal approach of electrotherapy versus myofascial release in patients with chronic mechanical neck pain: a randomized controlled trial. Physiother. Quat. 2019; 27(4): 6-12.

[18] Begum M.R, Hossain M. Validity and reliability of visual analogue scale (VAS) for pain measurement. J Med Case Rep Rev 2019; 2 (11): 394-402.

[19] Pontinen P. Reliability, validity, reproducibility of algometry in diagnosis of active and latent tender spots and trigger points. J Musculoskelet Pain 1998; 6: 61-71.

[20] Audette I, Dumas J P, Côté J N, De Serres S J. Validity and between-day reliability of the cervical range of motion (CROM) device. J Orthop Sports Phys Ther 2010: 40 (5): 318-23.

[21] Reddy R S, Alahmari K A, Silvian P S. Test-retest reliability of assessing cervical proprioception using cervical range of motion device. Saudi J Sports Med 2016; 16 (2):118-123.

[22] Elhafez H M, Ali I A, Embaby E A, Karkousha R N. Effect of different intensities of ultrasound on pain and myoelectric activities of upper trapezius myofascial trigger points. Indian Journal of Public Health Research & Development 2020; 11(4):1092-1097.

[23] Shaheen A A M, Omar M TA, Vernon H. Cross-cultural Adaptation, Reliability, and Validity of the Arabic Version of Neck Disability Index in Patients with Neck Pain. Spine 2013; 38(10): 609-615.

[24] Hou C R, Tsai L C, Cheng K F, Chung K C, Hong C Z. Immediate effects of various physical therapeutic modalities on cervical myofascial pain and trigger-point sensitivity. Arch Phys Med Rehabil 2002; 83 (10):1406-1414.

[25] Hodgson L, Fryer G. The effect of manual pressure release on myofascial trigger points in the upper trapezius muscle. Int J Osteopath Med 2006; 9: 33.

[26] Sarrafzadeh J, Ahmadi A, Yassin M. The effects of pressure release, phonophoresis of hydrocortisone, and ultrasound on upper trapezius latent myofascial trigger point. Arch Phys Med Rehabil 2012; 93 (1): 72-77.

[27] De Meulemeester K E, Castelein B, Coppieters I, Barbe T, Cools A, Cagnie B. Comparing trigger point dry needling and manual pressure technique for the management of myofascial neck/shoulder pain: a randomized clinical trial. J

Manipulative Physiol Ther 2017; 40 (1): 11-20.

[28] Pérez-Bellmunt A, Simon M, López-de-Celis C, Ortiz-Miguel S, González-Rueda V, Fernandez-de-Las-Peñas C. Effects on neuromuscular function after ischemic compression in latent trigger points in the gastrocnemius muscles: A randomized within-participant clinical trial. J Manip Physiol 2022; 45 (7): 490-496.

[29] Junaid M, Yaqoob I, Shakil Ur Rehman S, Ghous M. Effects of post-isometric relaxation, myofascial trigger point release and routine physical therapy in management of acute mechanical neck pain: a randomized controlled trial. J Pak Med Assoc 2020; 70 (10): 1688-1692.

[30] Hassan W, Ali M O, Mohamed R R, Baraka H M. Effect of muscle energy technique on non-specific neck pain in military air crew. Egy J Appl Sci 2021; 36 (5-6): 68-83.

[31] Ghulam H S, Alqhtani R S, Alshahrani A, Ahmed H, Khan A R, Khan A. Efficacy of cervical mobilization with post-isometric relaxation in managing mechanical neck pain, ROM, and functional limitations associated with myofascial trigger points. J. Med. 2023; 102 (52): e36710.

[32] Rojhani-Shirazi Z, Barzegar A, Nouraddini E, Azhdari N, Mohamadi M. Can muscle relaxation affect balance in patients with tension-type headache? A pre-post study. J Rehabil Sci Res 2017; 2017 (3): 84-87.

[33] Zibiri R A, Akodu A K, Okafor U A. Effects of muscle energy technique and neck stabilization exercises on pain, psychological status, and sleep disturbance in patients with non-specific chronic neck pain. Middle East J Rehabil Health Stud 2019; 6 (2): e87192.