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The Immediate Effects of a Combine Treatment Protocol with Manual Therapy and Physical Modalities on the Upper Trapezius Trigger Points in Subjects of Acute Neck Pain: a Randomized Controlled Trial

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Abstract

Background: The purpose of this study was to investigate the immediate effects of two treatment protocols of manual techniques and physical modalities in subjects with active trigger point of the upper trapezius muscle.
Objective: To evaluate the effectiveness of the therapeutic combination of the Integrated Neuromuscular Inhibition Technique (INIT), (manual trigger points deactivation technique), and physical therapy modalities (thermotherapy, laser, TENS and massage) in an integrated physiotherapy regimen for the management of the myofascial cervical pain.
Methods: Thirty-nine participants with active trigger points in the upper trapezius were randomly divided into two groups: physical modalities + INIT group, (n=20) and physical modalities group (n=19). Pain intensity, Cervical Range of Motion (ROM) and pressure pain sensitivity were measured before and after the intervention, (5 sessions in 2 weeks). The analysis of the variance with repeated measures ANOVA was applied, and the significance level was set at p <0,05.
Results: Statistically significant differences were observed in all variables tested before and after the intervention in both groups. Visual Analog Scale (VAS) pain score and pressure pain sensitivity was diminished while cervical lateral bending ROM was increased. However, participants in the combine treatment protocol group showed a greater, statistically significant improvement, compared to those in the control group.
Conclusions: The addition of a 10-minute INIT application to the upper trapezius muscle, to a physiotherapy program which included a combination of physical therapy modalities, seemed to have a better immediate effect on patients with severe pain, due to active trigger point in the upper trapezius muscles.
Keywords: Physical Therapy Modalities; Upper Trapezius Trigger Point Therapy; Manual Techniques; Integrated Neuromuscular Inhibition Technique.

1 Introduction

Myofascial trigger point (MTrP) has been defined as a hyperirritable spot within a taut band of skeletal muscle fibres that is painful on compression and can give rise to characteristics such as pain, tenderness, tightness, local twitch response and sometimes, autonomic phenomena. According to the intensity of symptoms, clinicians distinguish MTrP between active (causes severe local or referred pain) and latent (characterized by local tenderness and muscular discomfort) (Travell & Simons, 1999). Different studies reported that active MTrPs reproduce clinical pain features in several musculoskeletal pain conditions such as neck pain (Shah et al., 2008), lateral epicondylalgia (Fernandez-Carnero et al., 2007),

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shoulder pain (Hidalgo-Lozano et al., 2010), or headaches (Fernandez-de-las-Penas et al., 2008).

Pain caused by an active trigger point in the cervical area is strictly connected with mechanical or non-specific cervical pain. Cervical muscular spasm constitutes a common reaction in a series of neck disorders and it often leads to the existence of active trigger points among which trapezius shows very high prevalence (Fernandez-de-las-Penas et al., 2007).

Physical therapy management for the MTrP treatment in the upper trapezius muscle includes the application of various physical therapy modalities as thermotherapy, TENS (Rodriquez-Fernandez et al., 2011), laser therapy (Hakguder et al., 2003), ultrasound therapy (Esenyel et al., 2000), as well as MTrP deactivation techniques (Nagrale et al., 2010) (Ischemic compression, Strain Counterstrain, positional release Technique, Muscle, Energy Technique etc.). However, various authors have pointed out the need to discover the optimum combinations of physical modalities and manual therapy techniques as an integrated physiotherapy regimen much more applicable to the clinical practice. Hou and his colleagues (2002) applied different combinations of physical therapy modalities with or without the use of manual techniques, and they concluded that the combination of both seemed to had better results in pain caused by upper trapezius muscle trigger points. Acar and Yilmaz (2012), applying different combinations of physical therapy modalities: hot pack and ultrasound to the patients of the first group. Hot pack, ultrasound and exercise in the treatment group and two weeks' rest to the control group. The authors concluded that combined treatment was more effective in decreasing neck pain intensity, and increasing connective tissue mobility.

Despite the high incidence of MTrPs in the general population, Fleckenstein and his colleagues (2010) pointed out that there is a great controversy regarding the options of physical remedies and techniques that physiotherapists choose in clinical practice when they deal with patients with cervical pain, due to active trigger point. According to the authors, this happens due a lack of combine treatment protocol application. In fact, most of the authors are searching the effectiveness of individual therapeutic modalities or techniques, without evaluating the total effect of a treatment combination during a physiotherapy session.

The Integrated neuromuscular inhibition technique constitutes a combination of special TrPs deactivation techniques (Ischemic compression, Strain/counterstrain technique and Muscle energy technique) suggested by Chaitow and Deluny (2008).

The aim of this study was to investigate the immediate effect of a combine treatment protocol in people with severe myofascial pain due to the upper trapezius trigger point. In our point of view, the achievement of effectively diminishing the symptoms from the first two weeks increases the patient's adherence to the therapy procedure. We have seen in clinical practice that the application of INIT immediately improves the clinical figure of the patients with severe neck pain. We believe that the addition of the neuromuscular inhibition technique application for 10' in a series of 5 physiotherapy sessions consisted of the optimum physical therapy modalities can effectively diminish the pain symptoms from an acute to a sub-acute level.

Neck pain associated with active trigger points in the upper trapezius muscle shows a very high prevalence in the general population which reaches a percentage of 45-54%. It seems that it is a symptom directly connected with the modern way of life, as it is often witnessed to people who lead a sedentary lifestyle (Dewitte et al, 2013). Therefore, research on seeking the optimum therapeutic combination is of great scientific value for

physiotherapy as it is improving the level of health services, increasing the possibilities for the efficacy of the treatment.

2 Method

2.1 Participants

Thirty-nine outpatients (9 males and 30 females) with MTrPs in one side of the upper trapezius muscles were recruited consecutively from a physical therapy studio in a period of 5 months. The mean age was 51,26 (SD 9,49). After the patients were informed of the procedure, they signed a consent form. The diagnosis of an active myofascial trigger point in the upper trapezius muscle was based on the criteria described by Esenyel and his colleagues (2000): (1) tender spots in one or more palpable taut bands; (2) a typical pattern of referred pain in the ipsilateral posterolateral cervical spine, mastoid, or temporal areas; (3) palpable or local twitch responses on snapping palpation at the most sensitive spot in the taut band; and (4) restricted range of motion in lateral bending of the cervical spine to the opposite side; all measurements were performed by an experienced physiotherapist with great experience in algometry and special education in trigger point management.

The following exclusionary criteria were used: (1) having symptoms and signs meeting the 1990 American College of Rheumatology criteria for fibromyalgia (Wolfe et al., 1990), (2) having myofascial trigger point injections or receiving physical medicine in the year preceding this study; (3) having a history of acute trauma; (4) having a history of inflammatory joint or muscle disease, infection, or malignancy; (5) having evidence of neurologic deficit; and (6) exhibiting inadequate cooperation.

To ensure the homogeneity of the study's sample, after examining trigger points, patients completed a VAS pain. Only patients with a VAS score over 7 which corresponds to acute pain were concluded in this study.

During the period of 5 months, 45 patients with cervical pain came to our rehabilitation center. 44 of them followed the criteria described by Esenyel (2000), but 4 of them presented a VAS score lower than 7 and thus they were excluded from the study. 1 patient had injection treatment 5 months before the intervention started, thus he was excluded from the study too.

2.2 Design

The participants were randomly divided into 2 groups and the randomization procedure was conducted alternately, in order of arrival. The participants were not knowledgeable of the group they belonged to, that is to say, they were blind to the different groups. The state of blindness was not possible for the therapists, as all the treatment sessions were conducted by one therapist. The combine protocol group (CP group n=20) followed five sessions of a combined treatment protocol, which included the application of the appropriate physical modalities (thermotherapy, laser, TENS and massage) and the application of the INIT technique (ischemic compression, muscle energy technique and Strain Counterstrain) on the upper portion of the trapezius. This combined treatment protocol was compared to a second one, the physical remedies protocol group (PRP group n=19), which included only the application of the same physical modalities, excluding the INIT technique. The application of physical modalities in both groups took place according to specific protocols and each one of them was applied to the optimum parameters and time. The analysis of the variance with repeated measures ANOVA was applied, and the significance level was set at $p < 0,05$.

2.3 Outcome measurement

The following outcome measures took place before (pre-treatment) and after the intervention (after the 5th session)

Pain Intensity (PI) of MTrP. Pain intensity was assessed by the Visual Analogue Scale (VAS) Pain, which was a card with an uncalibrated scale, ranging from zero to ten on the one side (with zero representing no pain and ten representing the worst pain in life) with each centimeter representing one pain level. The patient subjectively estimated their pain level by marking a vertical line on the uncalibrated scale between zero and ten. Then the exact value of pain intensity could be obtained with a single ruler.

Cervical Range of Motion (ROM). The range of motion of the cervical spine was measured as the amount of lateral bending to the opposite side of the involved upper trapezius muscle by a large-scale goniometer (Baseline® Fabrication Enterprises USA Metal Goniometers) using the zero method. The person was sitting with lumbar and thoracic spines supported and the centre of the goniometer was placed to the spinous process of C7 vertebra.

Pressure Pain Sensitivity. Pressure Pain Sensitivity was assessed by pressure algometry measurement. Pressure Pain Threshold (PPT) of MTrP and Pressure Pain Tolerance (PPTol), were evaluated before and after the treatment with an analog Algometer (FPN 200 Wagner Instruments USA). For the procedure of PPT measurement, the protocol recommended by Fischer (1998) was applied. At first, the procedure was clearly explained to the patient. Then the patient, in a sitting position, was made comfortable and encouraged to maintain complete relaxation. When a MTrP of the upper trapezius muscle was identified, it was marked with a marker. The pressure algometer was applied on this marked area with the metal rod perpendicular to the surface of the skin. The pressure of compression was gradually increased at a speed of 1 kg/s approximately. The patient was asked to say “Stop” when he began to feel pain or any kind of discomfort. Then the examiner stopped the compression and recorded the indication. The same procedure was followed for the pain tolerance assessment with the difference that the patient should say ‘Stop’ when the pain reached the limits of resistance or when the pain was more intense than they could stand. Three repetitive measurements at an interval of 20-60 s were performed on the affected side and the average value was calculated for data analysis of the pain threshold. After the PPT assessment, the procedure of pain tolerance assessment followed in an identical way.

2.4 Combine group protocol

The combination of the following physical remedies was applied for five sessions in 2 weeks:

1. Hot pack on the cervical area for 10 minutes. Hot pack therapy. In this superficial heat modality, a hydrocollator hot pack was placed on the person’s cervical paraspinal and upper thoracic areas (including the upper trapezius muscle with MTrPs) for 10 minutes.

2. Burst Transcutaneous Electrical Nerve Stimulation (TENS) for 15 minutes. A burst-TENS with a pulse width of 200μs, a pulse frequency of 100Hz, and a burst frequency of 2Hz was applied for 10 minutes in comfortable intensity, able to induce contraction of the upper trapezius muscle. This was conducted with a BTL 5000a electrical stimulation device. The active electrode was placed over the upper trapezius MTrP, whereas the ground electrode was placed over the deltoid insertion. The above protocol was suggested by Rodriges-Fernandes and his colleagues (2011)

3. Gallium Arsenide Aluminum (Ga-As-Al) laser therapy. A device (EndolaserTM476 Enraf-Nonius) which has the probe with 0.5 cm beam diameter and emitting laser beam with 780 nm wavelength was used. The maximum power output of the device was 10 mW. The energy intensity given to the trigger points was adjusted to be 5J/cm2, by applying a continuous 5 mW power output (50% of the maximum) for 3 minutes and 16 seconds duration per trigger point in each session. The above protocol was suggested by Hakguder and his colleagues (2003).

4. Massage on the cervical muscles for 10 minutes. Five sessions of upper body massage, consisting of deep tissue techniques in addition to softer techniques in the beginning. When found, the trigger points were carefully and forcefully massaged. This combination lasted for 45 minutes and right after, a brief (10 minutes) protocol of the INIT technique application was followed.

5. Integrated neuromuscular inhibition technique constitutes a combination of special TrPs deactivation techniques (Ischemic compression, Strain/counterstrain technique and Muscle energy technique) suggested by Chaitow and Deluny (2008). For TrPs identification on the upper trapezius muscle, patients were placed supine to reduce muscle tension. The TrPs identification procedure (person positioning, pincer grasp etc.) as well as the sequence and manner of the technique application, were conducted according to Nagrale and his colleagues (2010). For the application of the method, the following steps were trailed.

- *Ischemic compression.* The Upper trapezius muscle TrP was identified by palpation methods. Trigger point pressure release was applied in either a sustained or intermittent manner with a pincer grasp, placing the thumb and index finger over the active TrP. Pressure was maintained until a release of the tissue barrier was felt. At that time, pressure was applied again until a new barrier was felt.
- *Strain/counterstrain SCS.* When referred or local pain begins to diminish, the upper portion of the trapezius muscle was placed to a position of ease and was held for approximately 20-30 seconds. Moderate digital pressure was applied to the identified TrP as subjects rated their level of pain on a scale 1-10. Ease was defined as the point where a reduction in pain of at least 70% was produced. Once the position of ease was identified, it was held for 20–30 seconds and was repeated for three to five times.
- *Muscle energy technique MET.* The technique was applied to the affected upper portion of the trapezius muscle. Each isometric contraction was held for 7–10 seconds and was followed by further contralateral side bending, flexion, and ipsilateral rotation to maintain the soft tissue stretch. Each stretch was held for 30 seconds and it was repeated from three to five consecutive times during the treatment session.

The entire treatment protocol duration of the CP group lasted for 55 minutes.

2.5 Physical modalities group protocol

The control group followed an identical combination of the same physical remedies, in the same series and by the same therapist in five sessions in 2 weeks, but the second part of the manual techniques was excluded. The time of the session was 45 minutes.

3 Results

Descriptive analysis of participants' demographic characteristics revealed that the majority were women (76,9%, n=30), middle aged (Mean=51.26), and major prevalence of right side versus the left regarding the symptoms (79.5%, n =31). Regarding the period of the

symptoms, a large percentage (41%, n = 16) exhibited symptoms for more than 3 months, and 64,1%, (n =25) had a previous history of neck pain and previous physiotherapy treatment. Both groups showed a high degree of identification with regard to their general characteristics (Table 1).

Table 1. General characteristics of participants per group

	Intervention group (n=20)		**Control group (n=19)**	
Age	52,55 Mean	10,57 SD	49,89 Mean	8,27 SD
Gender (%)	Men 25% n=5 Women 75% n=15		Men 21,1% n=4 Woman 78,9% n=15	
period of symptoms (%)	1 month 40% n=8 1-3 months 10% n=2 3 months+ 50% n=10		1 month 42,1% n=8 1-3 months 26,3% n=5 3 months + 31,6% n=6	
Previous physiotherapy (%)	Yes 70% n=14	No 30% n=6	Yes 57,9% n=11	No 42,1% n=8
Side of symptoms (%)	Right 75,0% n=15	Left 25,0% n=5	Right 84,2% n=16	Left 15,8% n=3

3.1 Visual analogue Scale (VAS) results

Analysis of variance with repeated measures revealed a significant group × time interaction (F=63,739 η2=0,633 p<.001) for changes over VAS score. Also, a main effect on measurements on the "time of measurement" factor was observed (F=491,766 η2=0,933 and p <0,001), as well as a main effect on the "group" factor (F=22,050 η2=0,373 and p <0,001). Post-hoc pairwise comparisons also revealed a significant difference between evaluation before and after the treatment (t=13,750 and p<0,001). Conclusively, the intervention group exhibited a greater decrease in pain intensity in comparison with the control group (Table 2, Figure 1).

Table 2. Mean values and standard deviations for VAS score for the two groups at different time of measurement.

	Group	**Mean**	**Std. Deviation**	**N**
VAS SCORE SESSION 1 BEFORE	intervention groop	7,8850	,40559	20
	control groop	7,9737	,45685	19
	Total	7,9282	,42794	39
VAS SCORE SESSION 5 AFTER	intervention groop	4,6750	,86138	20
	control groop	6,4632	,94234	19
	Total	5,5462	1,26945	39

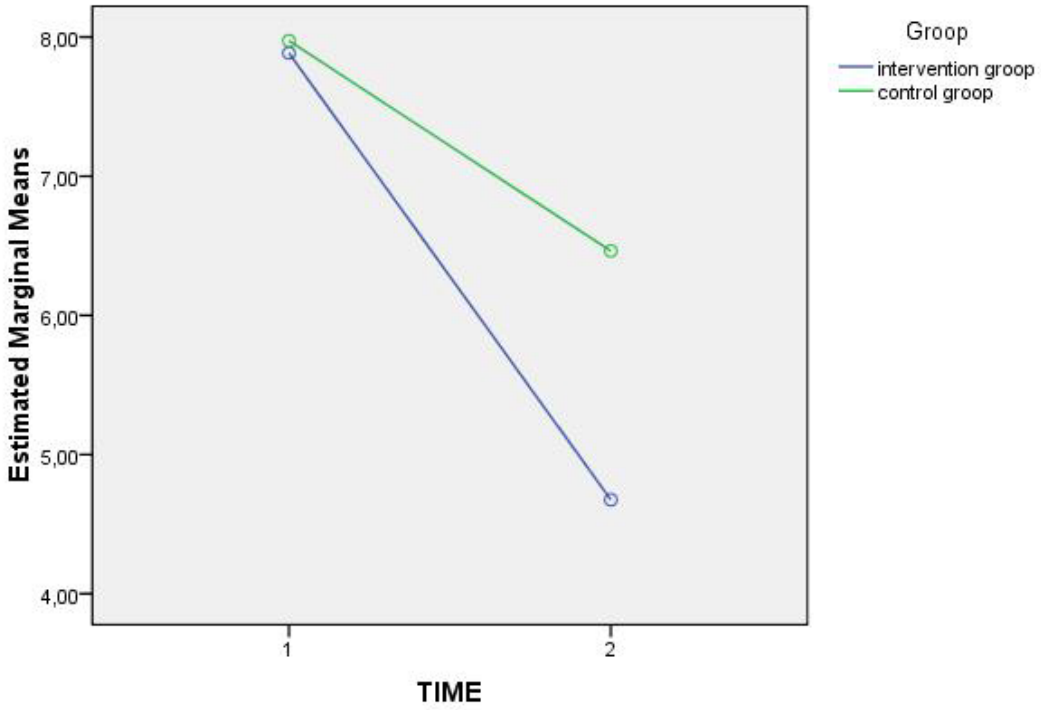

Figure 1. Mean values and standard deviations for VAS score for the two groups at different time of measurement.

3.2 Cervical Range of motion (Cervical ROM) results

Analysis of variance with repeated measures revealed a significant group × time interaction (F=14,456 η^2=0,281 p<0.05) for changes over cervical ROM. Also, a main effect on measurements on the "time of measurement" factor was observed (F=459,590 η^2=0,925 and p <0,001), along with a main effect on the "group" factor (F=4,255 η^2=0,103 and p<0.001). Post-hoc pairwise comparisons also revealed a significant difference between evaluation before and after treatment (t=-18,513 and p<0,001). Conclusively, the intervention group exhibited a greater improvement in cervical ROM compared to the control group (Table 3, Figure 2).

Table 3. Mean values and standard deviations for cervical lateral bending ROM for the two groups at different time of measurement.

	Group	Mean	Std. Deviation	N
CERVICAL LATERAL BENDING ROM SESSION 1 BEFORE	intervention group	28,9000	4,02492	20
	control group	26,4737	5,33717	19
	Total	27,7179	4,80651	39
CERVICAL LATERAL BENDING ROM SESSION 5 AFTER	intervention group	34,7000	5,00631	20
	control group	30,5263	5,70933	19
	Total	32,6667	5,69549	39

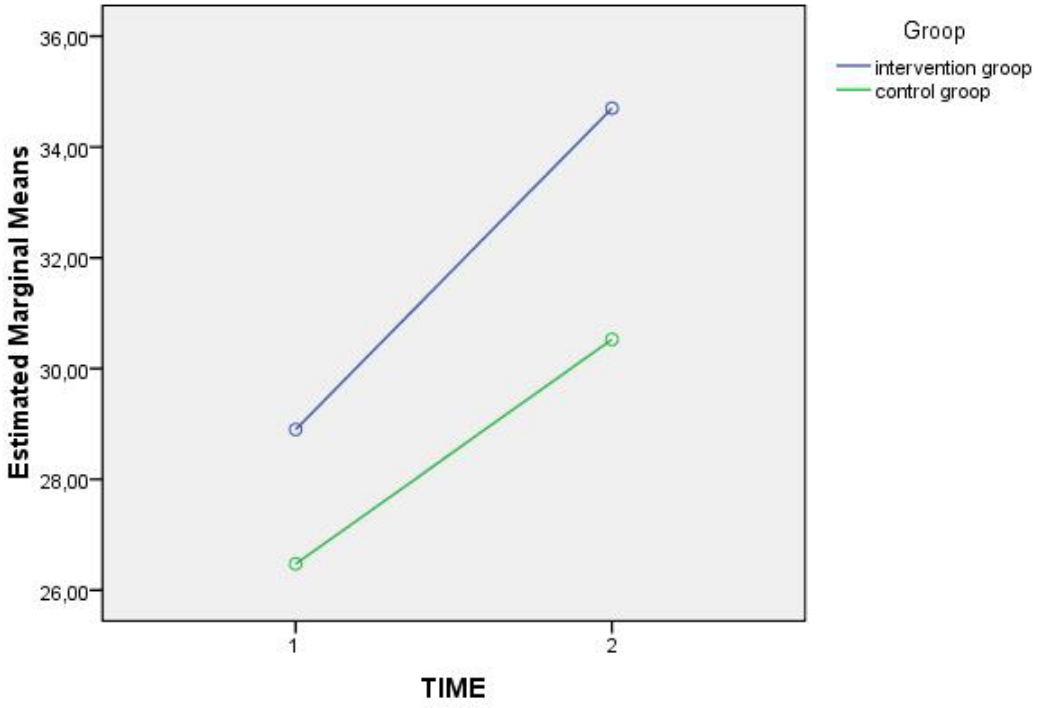

Figure 2. Mean values and standard deviations for VAS score for the two groups at different time of measurement.

3.3 Pressure Pain Threshold (PPT) results

Analysis of variance with repeated measures revealed a significant group × time interaction (F=21,282 η2=0,365 and p<0.001) for changes over PPT measurements. Also, a main effect on measurements on the "time of measurement" factor (F=197,328 η2=0,842 and p<0.001) was observed and a main effect on the "group" factor (F=17,686 η2=0,323 and p<0.001). Post-hoc pairwise comparisons also revealed a significant difference between evaluation before and after treatment (t=-11,442 and p<0,001). Conclusively, the intervention group exhibited a larger reduction in pressure pain sensitivity compared to the control group (Table 4, Figure 3).

Table 4. Mean values and standard deviations for Pressure Pain Threshold score for the two groups at different time of measurement.

	Group	Mean	Std. Deviation	N
PRESSURE PAIN THRESHOLD SCORE SESSION 1 BEFORE	intervention group	2,4700	,25976	20
	control group	2,3842	,24098	19
	Total	2,4282	,25126	39
PRESSURE PAIN THRESHOLD SCORE SESSION 5 AFTER	intervention group	3,8650	,57241	20
	control group	3,0895	,41082	19
	Total	3,4872	,63086	39

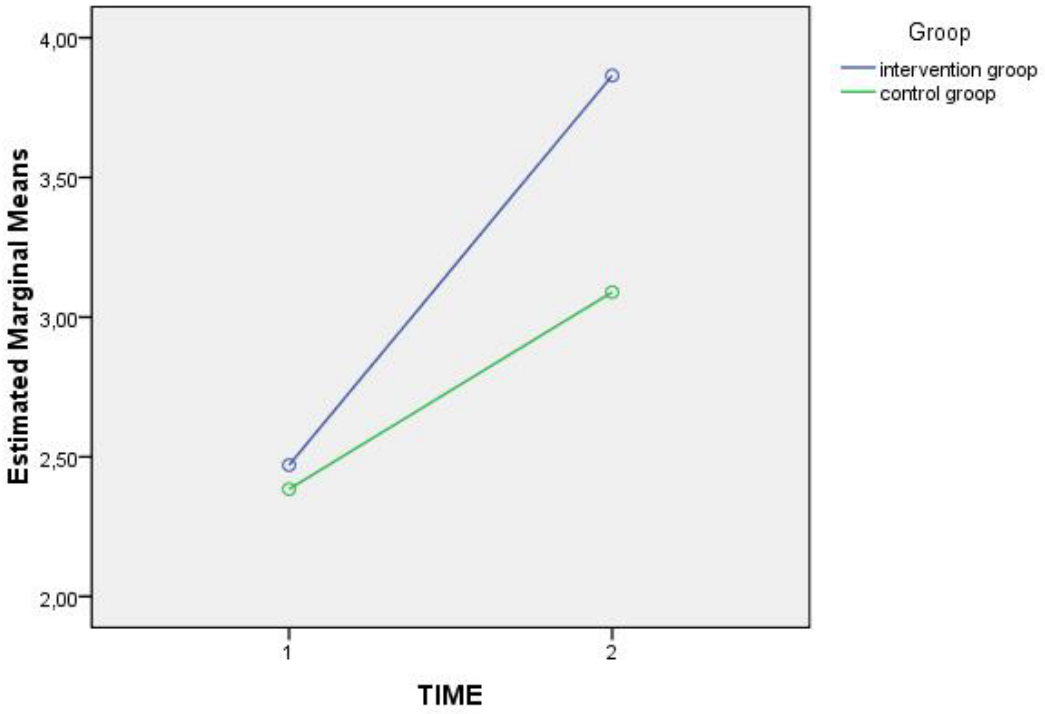

Figure 3. Mean values and standard deviations for Pressure Pain Threshold score for the two groups at different time of measurement.

3.4 Pressure Pain Tolerance (PPTOL) results

Analysis of variance with repeated measures revealed a significant group × time interaction (F=37,143 η2=0,501 and p<0.001) for changes over PPTOL measurements. Also, a main effect on measurements on the "time of measurement" factor (F=210,192 η2=0,850 and p<0.001) was observed, as well as a main effect on the "group" factor (F=55,723 η2=0,601 and p<0.001). Post-hoc pairwise comparisons also revealed a significant difference between evaluation before and after treatment (t=-10,495 and p<0,001). Conclusively, the intervention group exhibited a larger reduction in pressure pain sensitivity in comparison with the control group (Table 5, Figure 4).

Table 5. Mean values and standard deviations for Pressure Pain Tolerance score for the two groups at different time of measurement.

	Group	Mean	Std. Deviation	N
PRESSURE PAIN TOLERANCE SCORE SESSION 1 BEFORE	intervention group	4,4900	,23819	20
	control group	3,9526	,34216	19
	Total	4,2282	,39733	39
PRESSURE PAIN TOLERANCE SCORE SESSION 5 AFTER	intervention group	5,8700	,67520	20
	control group	4,5158	,40588	19
	Total	5,2103	,88103	39

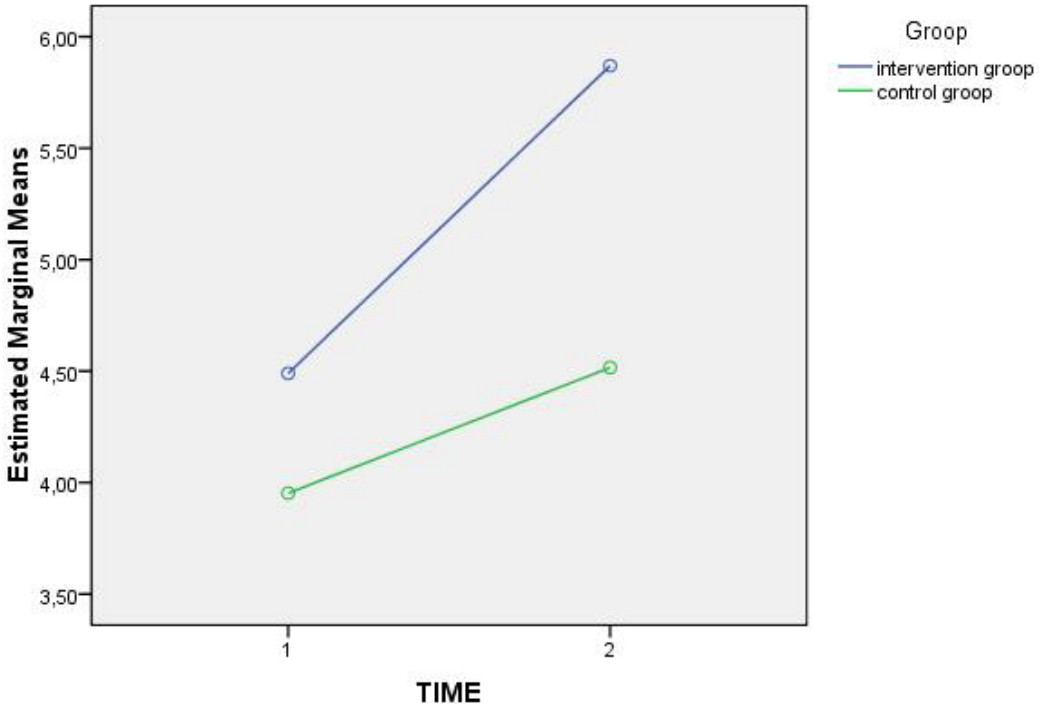

Figure 4. Mean values and standard deviations for Pressure Pain Threshold score for the two groups at different time of measurement.

4 Discussion

Myofascial trigger points have been described by Travell and Simons (1999) as painful palpable nodules located along a taut band of the skeletal muscle belly. Active trigger points in the upper trapezius muscle can cause severe symptoms, such as local and referred pain, limitation of lateral bending range of motion and reduced function. These symptoms are closely related to the clinical figure of patients with acute neck pain due to most painful musculoskeletal syndromes (Vazquez-Delgado et al., 2010).

The value of the visual analogue pain scale reflects the subjective perception of pain experienced by each participant before and after the intervention. The mean values of VAS score for the two groups before the intervention ranged around 8 (Table 2, Figure 1). According to Hawker and colleagues (2011) values of the VAS over 7.5 correspond to acute pain regardless of which group they belonged to, experienced acute pain at the beginning of the intervention. After a statistical analysis of the results, it was observed that the subjective perception of pain was reduced in both groups. However, the decrease of VAS score was much greater in the intervention group compared to the control group and this fact points out the immediate effectiveness of the intervention treatment protocol. The reduction of pain for these patients is due to the targeted effect that manual deactivation techniques offer on the trigger points management. The impact of these techniques is so immediate and specialiazed, so that it would not be possible to be compared with any other kind of physical remedy. Pain constitutes the main symptom in people with active myofascial TPs and it is the main reason they are coming for physiotherapy treatment. In our view, the fact that pain perception was further diminished in the CP group in only five

sessions promotes patient satisfaction, improves the cooperation between patient and therapist and can offer a better perspective of the treatment process.

Cervical range of motion is often restricted in patients with active trigger points in the upper trapezius muscle. According to Esenyel and colleagues (2000), lateral bending restriction to the unaffected side constitutes a common symptom in patients with active upper trapezius trigger points and it takes place due to muscular spasm and trapezius disability for elongation. In fact, the majority of patients, considering the 45 degrees physiological rate (Youdas et al., 1992), were found to show a restriction of more than 15 degrees in their cervical lateral bending. Although there was an improvement in cervical ROM at both groups after the intervention, it is clear that the intervention group showed further improvement, since the values of cervical ROM were closer to the physiological rates (Table 3 Figure 2).

Pressure algometry constitutes an accurate method of trigger points of local sensitivity evaluation before and after treatment (Park et al., 2011). In fact, mean values of pain threshold and pain tolerance were corresponding to patients with active trigger point. On the other side, pain threshold and pain tolerance was increased in both groups, which means that local sensitivity was diminished in both groups. However, the increase was much greater in the intervention group, which at the end of the session approached rates closer to normal (Table 4, 5 & Figure 3, 4).

In conclusion, the combined treatment protocol improved more effectively the clinical figure of patients with active trigger points in the upper trapezius muscle in five sessions. This fact agrees with the conclusions of Nagrale and colleagues (2010) about the effectiveness of manual technique in trigger points deactivation. On the other side, though, it reinforces the belief of other authors like Fleckenstein and colleagues (2010) that treatment protocols by the form of integrated physiotherapy regiments can be more efficient.

The results of the current study suggest that the application of a combine treatment protocol with physical modalities and INIT had a more effective immediate result in the improvement of the clinical figure of patients with active MTrPs in the upper trapezius muscle. These results point out the need to apply combine treatment protocols in the form of an integrated physiotherapy regimen which is more practically applicable to clinical practice.

5 Limitations of the study

The small number of participants, along with the gradual recruitment of the sample, may have affected its depiction, concerning the general population. Furthermore, the clinical figure of the participants showed great diversity. Quite a few patients showed trigger points in more than one muscles on both sides of the body. However, for the sake of research purposes and the validity of safe conclusions, both measurements and therapeutic applications were applied in the upper portion of the trapezius muscle, while the affected side was considered to be the side with the most intense symptoms. This fact may have confined the outcomes of the research.

6 Conclusions

The combination of INIT with the appropriate physical modalities is having a better immediate effect on the improvement of the clinical figure of patients with active trigger points. Further studies are necessary for the investigation of combine treatment protocols for a longer time period.

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