Research Report

Effectiveness of a Home Program of Ischemic Pressure Followed by Sustained Stretch for Treatment of Myofascial Trigger Points

Background and Purpose. Myofascial trigger points (TPs) are found among patients who have neck and upper back pain. The purpose of this study was to determine the effectiveness of a home program of ischemic pressure followed by sustained stretching for the treatment of myofascial TPs. Subjects. Forty adults (17 male, 23 female), aged 23 to 58 years ($\overline{X}$=30.6, SD=9.3), with one or more TPs in the neck or upper back participated in this study. Methods. Subjects were randomly divided into 2 groups receiving a 5-day home program of either ischemic pressure followed by general sustained stretching of the neck and upper back musculature or a control treatment of active range of motion. Measurements were obtained before the subjects received the home program instruction and on the third day after they discontinued treatment. Trigger point sensitivity was measured with a pressure algometer as pressure pain threshold (PPT). Average pain intensity for a 24-hour period was scored on a visual analog scale (VAS). Subjects also reported the percentage of time in pain over a 24-hour period. A multivariate analysis of covariance, with the pretests as the covariates, was performed and followed by 3 analyses of covariance, 1 for each variable. Results. Differences were found between the treatment and control groups for VAS scores and PPT. No difference was found between the groups for percentage of time in pain. Conclusion and Discussion. A home program, consisting of ischemic pressure and sustained stretching, was shown to be effective in reducing TP sensitivity and pain intensity in individuals with neck and upper back pain. The results of this study indicate that clinicians can treat myofascial TPs through monitoring of a home program of ischemic pressure and stretching. [Hanten WP, Olson SL, Butts NL, Nowicki AL. Effectiveness of a home program of ischemic pressure followed by sustained stretch for treatment of myofascial trigger points. *Phys Ther.* 2000;80:997–1003.]

Key Words: *Home program, Ischemic pressure, Myofascial trigger points, Sustained stretch.*

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Myofascial trigger points (TPs) are thought by some authors[1–3] to cause neck and upper back pain. Some musculoskeletal conditions that cannot currently be classified by existing diagnostic tests or do not respond to treatments may, in our opinion, be the result of myofascial TPs. Eliminating the TPs may eliminate the problem.[1] Several therapeutic techniques are commonly advocated for decreasing TP pain,[1–3] but there is a limited amount of clinical research to support these techniques.

A myofascial TP has been described as an area of hyperirritability located in a taut band of muscle, variously described as resembling a small pea or as a rope-like nodular or crepitant (crackling, grating) area within the muscle[1] that is painful upon palpation and refers pain, tenderness, and an autonomic (functionally independent) response to a remote area.[2] Some authors[1–4] contend that when pressure is applied to a TP, a "jump sign" or "jump response" is elicited whereby the patient reacts with facial grimacing, by a verbal response, or by jumping away from the examiner. Muscle without TPs, or normal muscle, is not tender upon palpation and does not produce a "jump sign."[3,5]

Trigger points can be categorized as either active or latent.[2,4] Active TPs are those that cause pain at rest or with activity of the muscle containing the TP. According to Travell and Simons,[2] a latent TP does not cause pain, but may cause restricted movement and weakness of the muscle containing the TP. Some authors are of the opinion that trigger points may result from or be irritated by trauma,[1,2,6] overuse,[1,2] mechanical overload,[2] postural faults,[1,6] or psychological stress.[1,6,7]

The underlying physiological mechanism of TPs is not clearly understood. Several mechanisms have been proposed in the literature.[3,8,9] Disruption of the sarcoplasmic reticulum, leading to excess calcium in the muscle, has been suggested as an underlying factor.[8,9] Another author[3] suggested that TPs develop in muscle areas where energy supplies are diminished and metabolic activity is high. Regardless of the underlying mechanism of TP origination, the goal of treatment is to decrease TP sensitivity.[2,5,10]

Trigger points are typically located by palpation. Simons[4] described his criteria for identifying TPs. These criteria include identification of a taut band in a muscle if it is accessible; a tender spot on the taut band; referred pain or altered sensation, at least 2 cm beyond the spot, elicited by needle penetration or pressure held for 10 seconds; and restricted range of motion in the joint the muscle crosses. The reliability of identifying TPs with these criteria has been questioned.[11,12] Criteria for TP location that have led to reliable location of TPs in the quadratus lumborum and gluteus medius muscles are a palpable tender spot, reproduction of the person's pain, and a jump sign characterized by vocalization or withdrawal.[12]

We believe that measures of TP treatment effect are necessary for clinical and experimental purposes. *Pressure pain threshold* (PPT) is defined as the minimal amount of pressure producing pain.[13–15] Reeves et al[14] found pressure algometer (PA) measurements to be reliable in measuring the PPT of TPs, reporting high intratester reliability (r=.69–.97, N=15) and intertester reliability (r=.71–.89, N=15). They also demonstrated validity of the algometric measurement by its ability to discriminate between TPs and adjacent, non-TP locations. Based on generalizability coefficients, Tunks et al[15] also reported a high degree of relationship for test-retest reliability (.85, N=20) and interrater reliability (.85, N=20) of PPT measurements obtained with a PA.

Ice, heat, ultrasound, and massage have been used in the treatment of people with TPs.[1,2] We believe that these treatments are used because patients generally achieve temporary relief with them. However, there are no controlled studies that support their use in decreasing

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pain that may be arising from TPs. Several TP treatment methods have been studied for effectiveness. These methods include injection or dry needling,[16–18] spray and stretch,[19] transcutaneous electrical nerve stimulation (TENS),[11,20,21] and post-isometric relaxation.[22] Injection and spray and stretch are reported as the most common forms of therapy for TPs.[1,2,6,10,23]

Several authors have reported the effectiveness of injection in reducing TP pain using dry needling,[16,18] saline,[17] or local anesthetics.[16–18] This treatment involves an invasive procedure and, to varying degrees, produces post-injection soreness[18] and muscle necrosis.[2] Garvey et al[16] compared injection of a local anesthetic, injection of a local anesthetic plus steroid, acupuncture (dry needling), and acupressure with vapocoolant spray. The authors found that the acupressure plus vapocoolant spray, their control procedure and the only noninvasive procedure, was the most effective at relieving pain.[16]

Spray and stretch, using a vapocoolant spray along with passive stretching of the muscle containing the TP, has also been suggested as a method of TP treatment.[2] Jaeger and Reeves[19] found that TP sensitivity measured with a PA decreased following spray and stretch and that this decrease in TP sensitivity was accompanied by a decrease in VAS scores for pain intensity. Travell and Simons[2] hypothesized that decreasing TP pain utilizing spray and stretch is due to the elongation of the muscle to its full normal length. Lewit and Simons[22] demonstrated that muscle lengthening utilizing post-isometric relaxation appears to be successful in relieving pain due to myofascial TPs without the use of vapocoolant spray. Their study supports the idea that muscle lengthening is the process that provides pain relief. Trigger point sensitivity was not measured using a PA. It is not possible, therefore, to assess the effects of post-isometric relaxation alone on sensitivity of TPs.

Melzack[21] studied the effects of TENS over TP sites and found it effective compared with placebo stimulation in producing prolonged pain relief for patients with peripheral nerve damage or low back pain. Graff-Radford et al[20] compared the effects of 4 modes of TENS on myofascial pain and TP sensitivity measured with a PA. These authors reported that high-intensity TENS was most effective in decreasing pain measured with a VAS, but no mode produced a decrease in TP sensitivity.

Our interpretation of the literature suggests that stretching the muscle after TP treatment is necessary to provide longer pain relief.[2] This has been part of therapy, regardless of the method used to decrease TP pain.[2,10,23] We believe that the patient should be involved in his or her treatment, acting as the primary pain manager. We contend, therefore, that ischemic pressure with muscle stretching is ideal for self-treatment. The application of ischemic pressure can be performed using a device created specifically for this purpose. Methods for this technique, as well as self-stretching of the neck and upper back, in our experience, are easily taught. Using a home program reduces physical therapy visits.

The purpose of this study was to determine the effectiveness of a home program of ischemic pressure followed by sustained stretching for the treatment of myofascial TPs. The following null hypothesis was tested: no difference exists among groups of subjects receiving ischemic pressure followed by sustained stretching versus control treatment in reducing TP sensitivity, pain intensity, and percentage of time in pain.

Method

Subjects

Forty volunteer subjects, 17 males and 23 females, between the ages of 23 and 58 years ($\overline{X}$=30.6, SD=9.3) participated in this study. Exclusion criteria included a history of orthopedic surgery to the neck or back, cardiovascular or neurological conditions, and treatment of myofascial pain or TPs at the time of the study. Subjects were included if they had one or more active TPs in the neck or upper back. For the purpose of this study, TP inclusion criteria included a palpable tender spot in the neck or upper back, reproduction of the subject's pain upon palpation, and a "jump sign" characterized by patient vocalization or withdrawal. Subjects were required to sign an institutionally approved informed consent form prior to participation in this study.

Instrumentation

A PA* was used to determine the PPT of TPs. The PA used in this study was a handheld instrument, consisting of a 1-cm-diameter rubber-tipped plunger mounted on a calibrated spring. The gauge was calibrated in kilograms per square centimeter and ranged from 0 to 11 kg/cm^2 in 0.1 kg/cm^2 divisions. The gauge held the maximum applied pressure until tared.

Ischemic pressure was applied to TPs using a Thera Cane,† a plastic J-shaped cane with 6 knobs placed at various points on the cane. The cane was designed to allow minimal exertion by the user to create sustained pressure in hard-to-reach areas.

* Pain Diagnostics and Thermography, 17 Wooley Ln E, Great Neck, NY 11021.
† Thera Cane Co, PO Box 9220, Denver, CO 80262.

A VAS was used to measure intensity of the subject's pain. Reliability of data obtained with the VAS is reported to be high ($r=.99$),[24] with high construct validity.[25] The scale consisted of a 10-cm line marked at the extremes with "no pain" and "worst pain ever." Semipermanent henna ink[‡] was used to mark the primary TP for the duration of the subject's participation in the study.

Procedure

A reliability study of PPT measurements was performed prior to data collection. An intraclass correlation coefficient (ICC [3,1]) was calculated to determine the day-to-day reliability using the same PA for examiner 1 (ALN), the only tester of interest. The resulting reliability coefficient was .99, a value within the range reported in the literature.[14,15] Each subject was randomly assigned to either a treatment group (group 1) or a control group (group 2), using a table of random numbers. On day 1, the subject first met with examiner 2 (NLB) to complete the informed consent form and receive his or her group assignment. After being instructed by examiner 2 not to divulge the treatment to be received, each of the subjects entered a room with examiner 1. They reported their percentage of time in pain during waking hours over the past 24 hours. They then marked a VAS with the average pain intensity for their pain over the past 24 hours. The subjects then had a familiarization session to become acquainted with the sensation of the PA on an unaffected body part before the primary TP was determined. The PA was placed perpendicular to the area to be tested, and a steady, increasing pressure of approximately 1 kg/s was applied. To determine the area of possible TPs, each subject was asked to point to the most painful areas of the neck and upper back at or above T6. The subject was in the prone position with his or her face supported with a towel. Examiner 1 palpated the cervical and scapular regions and, with a nonpermanent marker, marked all TPs that matched the inclusion criteria. Each marked TP was measured for PPT in the same manner as in the familiarization session. The subject was advised that he or she would feel some pressure over the TP and that he or she should indicate when the sensation changed from one of pressure to one of pain by saying "there." The TP with the lowest PPT was designated the primary TP and was marked with semipermanent henna ink over the nonpermanent marker. The red mark stayed on the subject's skin for the 8 days required for the completion of the study. Examiner 1 recorded the PPT for the primary TP and then left the testing area.

Subjects in group 1 received verbal and written instructions (Appendix), rationale, and a demonstration from examiner 2 on performing ischemic pressure using a Thera Cane, followed by sustained stretching for the neck and upper back musculature. Each subject was instructed to sit near the edge of an armless chair with both feet firmly planted on the floor. The subject was then shown how to place the muscle with the primary TP in a lengthened position using various combinations of head and shoulder girdle movements, depending on the location of the TP. While holding this position, the subject was instructed to place the Thera Cane over his or her primary TP, apply gradually increasing pressure to the TP, and hold that pressure until a release was felt. The examiner explained that the release would feel like a "letting go" or a "melting" of the muscle with the primary TP, accompanied by a decrease in pain. The Thera Cane was positioned so that one of the knobs was over the TP, and the subject gently pushed on the Thera Cane to apply pressure through the knob. The pressure was gradually increased in order to achieve additional "jump signs." The subject was instructed to repeat the process until no further release was obtained. Following the release, examiner 2 demonstrated and taught the sustained stretches for the neck and upper back (Appendix). All subjects in group 1 were instructed to perform all of the stretches and hold each stretch for 30 to 60 seconds. Each subject was then given time to practice the ischemic pressure application and sustained stretches, to ask questions of examiner 2, and to receive feedback. Examiner 2 instructed subjects to perform ischemic pressure to the primary TP and sustained stretching as demonstrated at least twice per day for 5 days (study days 1–5). Subjects were told that they could use the Thera Cane on TPs in other areas of the body for the 5 treatment days if desired. Examiner 2 asked subjects to perform no treatment on days 6 and 7.

Subjects in group 2 received identical verbal and written instructions, rationale, and a demonstration from examiner 2 on performing active neck flexion, neck lateral flexion, and neck rotation while seated near the edge of an armless chair with both feet firmly planted on the floor. This group received instructions to perform these exercises 10 times each, at least twice per day for 5 days (study days 1–5). They were instructed to perform no treatment on days 6 and 7 to determine short-term effects of the intervention without confounding effects from the treatment just completed.

All subjects returned on day 2 for a session with examiner 2, who assessed their technique and answered questions. On day 8, examiner 1 again obtained measurements for each subject. All subjects reported adherence to the program as prescribed. A PPT measurement of the primary TP, a percentage of time in pain during waking hours over the past 24 hours, and a VAS score for the average pain intensity for the past 24 hours were recorded.

[‡] New York Body Archive, 9 Ninth Ave, New York, NY 10011.

Table 1.
Raw Score Means and Standard Deviations of Pretest, Posttest, and Difference Scores for Visual Analog Score (VAS) Pain Intensity (in Millimeters), Percentage of Time in Pain During the Past 24 Hours, and Pressure Pain Threshold (in Kilograms)

	Pretest		Posttest		Difference	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
VAS pain intensity[a]						
Group 1	25.7	15.3	13.2	16.0	−12.5	20.7
Group 2	26.6	19.1	24.7	20.9	−1.9	16.4
Percentage of time in pain						
Group 1	25.1	22.0	15.0	17.9	−10.1	16.6
Group 2	28.7	25.2	24.9	24.1	−3.9	21.8
Pressure pain threshold[a]						
Group 1	4.5	1.6	5.7	1.8	1.2	1.0
Group 2	3.7	1.6	3.4	1.3	−0.3	1.3

[a] Group outcomes were significantly different.

Data Analysis

For each subject, the distance between "no pain" and the subject's mark on all VASs was measured and recorded to the nearest millimeter. Raw score means and standard deviations of the VAS score for pain intensity, the percentage of time in pain, and the PPT scores were calculated for pretest, posttest, and difference scores. In order to determine whether there were differences ($P<.05$) between the 2 groups on the posttest scores, a multivariate analysis of covariance (MANCOVA), with the pretest scores as the covariates, was performed. This analysis was done to control statistically any initial difference in the subjects that might have been present and that might confound differences between the groups of subjects. Because this analysis was significant, 3 analyses of covariance (ANCOVAs) were conducted, 1 for each variable.

Results

Pretest, posttest, and difference means and standard deviations of the VAS score for pain intensity, the percentage of time in pain, and the PPT values of each group are recorded in Table 1. The scores reflect greater improvement for group 1 than for group 2 on all the variables. However, there was marked variability for percentage of time in pain in both groups.

The MANCOVA for the variables of VAS, percentage of time in pain, and PPT was found to be significant ($F=8.1$; $df=3,33$; $P=.000$) by the Wilks lambda criterion. The ANCOVA for the variable VAS score for pain intensity revealed a difference ($F=4.4$; $df=1,37$; $P=.043$) between groups 1 and 2 (Tab. 2). The ANCOVA for the variable PPT revealed a difference ($F=23.0$; $df=1,37$; $P=.000$) between groups 1 and 2 (Tab. 3). The ANCOVA for the variable percentage of time in pain revealed that there was no difference between the groups (Tab. 4).

Table 2.
Analysis of Covariance for the Variable of Visual Analog Scale Pain Intensity Using the Pretest as the Covariate

	df	SS	MS	F	*P*
Main effects–group	1	1224.4	1224.4	4.4	.043
Covariates pretest	1	2862.3	2862.3	10.2	.003
Residual	37	10336.4	279.4		
Total	39	14423.2	369.8		

Discussion

The results of our study demonstrate the effectiveness of ischemic pressure followed by sustained stretching, performed as a home program, in reducing TP sensitivity as measured with a PA and pain intensity scored with a VAS. Direct comparison of these results with the results found in other TP treatment experiments is only possible in a general way due to different treatment techniques, subject populations, measurements taken, duration of treatment, and time between treatment cessation and posttest measurement. We did not examine effectiveness relative to any other outcome such as functional limitation or disability.

Garvey et al[16] found injection of a local anesthetic, injection of a local anesthetic plus steroid, acupuncture (dry needling), and acupressure with vapocoolant spray to be effective in relieving pain. Furthermore, they reported that the acupressure plus vapocoolant spray procedure was the most effective at relieving pain. This led Garvey et al to propose that relief is likely due to mechanical stimulation of the TP by the needle or the acupressure, not the injection of a particular substance.

Stretching of the affected muscle is believed by some authors[2,10,19,23,26] as well as our investigative team to be an integral part of TP therapy. Lewit and Simons[22] found the post-isometric relaxation technique to be effective in reducing TP sensitivity and pain intensity. The technique involved stretching the muscle containing the TP, followed by an isometric contraction against minimal resistance. After the contraction, the muscle was first allowed to relax, and then it was stretched. Jaeger and Reeves,[19] who reported the effectiveness of spray and stretch in decreasing pain intensity and increasing pressure pain threshold, indicated that vapocoolant spray could not produce anesthesia in the subcutaneous tissues or muscle because of the depth of the tissue. They suggested, therefore, that it is the stretch that resulted in the decrease in TP sensitivity, not the spray. Travell and Simons[2] also argued that the mechanism of relief in spray and stretch is the stretch.

Table 3.
Analysis of Covariance for the Variable of Pressure Pain Threshold Using the Pretest as the Covariate

	df	SS	MS	F	*P*
Main effects–group	1	27.1	27.1	23.0	.000
Covariates pretest	1	73.9	73.9	62.8	.000
Residual	37	43.5	1.2		
Total	39	144.4	3.7		

Table 4.
Analysis of Covariance for the Variable of Percentage of Time in Pain in the Past 24 Hours Using the Pretest as the Covariate

	df	SS	MS	F	*P*
Main effects–group	1	601.9	601.9	2.2	.149
Covariates pretest	1	7190.8	7190.8	2509.0	.000
Residual	37	10264.1	277.4		
Total	39	18056.8	463.0		

Based on the information presented, we hypothesized that a form of stimulation could relax the muscle to a point where sustained stretching would be tolerated without protective spasm or guarding contraction. Because noninvasive procedures can produce stimulation, we chose to combine ischemic pressure with sustained stretching.

No difference was found between the groups in the percentage of time in pain during waking hours for the 24 hours prior to testing. Subjects reported difficulty determining this number when asked at initial testing. When the final measurements for the study were obtained, subjects were prepared to report this information. We believe it is possible that the initial and final values do not represent the same information because of the differences that exist between recalling information and prospectively gathering information.

In our study, we demonstrated the short-term effectiveness of our treatment in reducing perceived pain and TP sensitivity. However, it is widely argued that in order to prevent an ongoing cycle of TP treatment and relapse, contributing or perpetuating factors should be considered.[2,8,18,22,23,26] Travell and Simons[2] contended that the following are perpetuating factors for TP pain: mechanical stress, such as poor posture or muscle injury; nutritional inadequacies; metabolic or endocrine disorders; psychological factors; chronic infection; impaired sleep; radiculopathy; allergies; and chronic visceral disease. Many of these factors are controllable. Hong[18] proposed that continued pain following TP treatment is likely the result of an etiological factor such as an intervertebral disk lesion, a muscle lesion, or an abnormal interneuronal circuit in the central nervous system that alters the TP pain loop. There are no studies that address the duration of pain relief associated with control of these contributing factors.

Studies of TP pain typically focus on patients with chronic pain, most of whom are being medically treated for TPs.[16–22] The subject sample in our study did not include anyone undergoing treatment for TPs or myofascial pain. The differences in subject groups should be noted when comparing results. We believe that our results might have been different if we had studied a clinical population of individuals with chronic pain.

A limitation of our study is that it may be possible that either the ischemic pressure or the sustained stretching produced the results independently. This study could be repeated with one group performing only ischemic pressure, one group performing only sustained stretching, and one group performing both techniques together.

Conclusion

The purpose of our study was to investigate the effectiveness of a home program of ischemic pressure followed by sustained stretching in reducing TP sensitivity, average pain intensity, and percentage of time in pain in individuals with neck and upper back pain. Our results indicate that clinicians can manage neck and upper back pain associated with TPs through a home program of ischemic pressure and sustained stretching with periodic monitoring by a physical therapist. We do not know, however, whether the pain relief influences patients' functional abilities or disability status. These results were obtained with minimal patient-clinician contact, providing evidence of effective treatment in the age of managed care, which places emphasis on shorter treatment times and decreased number of clinic visits.

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Appendix.[a]

Group 1 Instructions—Right/Left Side Primary

Day 1: _____

Day 2: Meet with examiner 2 at _____ **.**

Perform the following at least twice per day for 5 days (days 1–5).

1. Sit near the edge of an armless chair with both feet firmly planted on the floor.
2. Gently stretch the appropriate muscle to the point of pain and then back off slightly. To put this muscle on a stretch, do the following:

   _____

   _____

   _____

   _____
3. Hold the stretch and position the Thera Cane[b] over your primary TP, as determined by examiner 1.
4. Apply gradually increasing pressure to the TP and hold until a release is felt. This will feel like a melting of the TP, and it may allow further stretch of the muscle.
5. Repeat step 4 until no further release is obtained.
6. Perform each of the following stretches, holding each for 30 to 60 seconds.
   a. *R/L upper trapezius and scalene muscles:* Hold on to the edge of the chair on the R/L side to keep the R/L shoulder from elevating. Side bend your head to the L/R. Gently pull your head over to the L/R with your L/R hand.
   b. *R/L levator scapula muscle:* Hold on to the edge of the chair on the R/L side to keep the R/L shoulder from elevating. Side bend your head to the L/R. Rotate your head to the L/R. Flex your neck. You should be looking down at your L/R shoulder. Gently pull your head into the direction of the stretch with your L/R hand.
   c. *R/L sternocleidomastoid muscle:* Support your head from behind on the L/R side with your L/R hand to prevent your neck flexors from having to work to keep your head up. Side bend your head to the L/R. Rotate your head slightly to the R/L. Extend your neck slightly until you feel a mild stretch, letting the weight of your head rest in your L/R hand.
   d. *Posterior neck musculature:* Lace your fingers together and place them behind your head just below the ridge at the base of your skull. Drop your chin to your chest and at the same time lower your shoulders. The goal is to stretch the musculature at the base of the skull, not that at the base of the cervical spine. By keeping your shoulders down and back, the emphasis of the stretch is on the correct musculature.
   e. *Middle trapezius and rhomboid muscles:* Find a door with 2 doorknobs, 1 on either side. Open the door and hold 1 doorknob in each hand. Place your feet close to the door. Lean back and allow your shoulder blades to come forward around your body. While you are doing this stretch, keep your shoulders down; do not allow them to come up around your ears.

On days 6 and 7, perform no treatment.

Day 8: Meet with examiner 1 at _____ **.**

[a] R=right, L=left, TP=trigger point.

[b] Thera Cane Co, PO Box 9200, Denver, CO 80262.