

# Effects of Strain Counter-Strain and Stretching Techniques in Active Myofascial Pain Syndrome

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**Abstract.** [Purpose] This study investigated the effects of passive stretching (STR) and strain counter-strain (SCS) techniques in subjects with myofascial pain syndrome (MPS) as measured by a visual analogue scale (VAS), pressure pain threshold (PPT), displacement pain threshold (DPT), active range of motion (AROM), and patients perception of change (PPC). [Subjects] Twenty volunteers with active MPS in the upper trapezius muscle participated in the study. [Methods] The subjects were randomly allocated to either a STR or SCS treatment group. Evaluations were performed at before, immediately, one hour, and one day after treatment. [Results] No significant difference between groups were found. However, there was a significant improvement of VAS an hour after SCS treatment. The improvement seemed to be maintained after treatment. The STR group showed a significant decrease of DPT between immediately and a day after treatment, indicating less tissue compliance. [Conclusion] The SCS treatment helps relieve the pain one hour after treatment in subjects with active MPS.

**Key words:** Myofascial pain syndrome, Stretching, Strain counter-strain

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## INTRODUCTION

Myofascial pain syndrome (MPS) is usually defined as muscle pain with a myofascial trigger point (MTrP) and a predictable referred pain zone<sup>1)</sup>. Typically, the symptoms found in patients with active MTrP are pain and dysfunctions of the affected muscles<sup>2-4)</sup>.

The integrated hypothesis proposed by Simons et al. in 1999 explains the relation between pain and excessive muscle activation of MTrP<sup>1)</sup>. The pain from MTrP can activate additional muscle contractions, called the 'pain-spasm-pain cycle'<sup>5)</sup>. For effective treatment, Esenyel et al. stated in 2007 that "The mainstream of treatment in myofascial pain is to break down the vicious cycle of pain through the elimination of MTrP"<sup>4)</sup>.

Strain counter-strain (SCS) and passive sustained stretching (STR) are manual techniques that are used to reduce pain and promote muscle relaxation. This helps to breaking the cycle of pain and spasm. The concepts behind these two treatment techniques are absolutely different. For the STR, the affected muscle is set in the most lengthened position in order to activate autogenic inhibition reflex<sup>6-8)</sup>, and to improve the viscoelastic property of the muscle and surrounding tissue<sup>9,10)</sup>. In contrast, in SCS, the affected muscle is set in a shortened and comfortable position in order to decrease the excessive impulse from the spindle muscles<sup>11)</sup>.

The effectiveness of STR in reducing MTrP had been investigated by several studies. The results are still controversial. Some studies have reported significant improvement through use of STR in combination with other

modalities as a part of MTrP treatment<sup>12-16)</sup>. The combination treatment has been proved to be effective in treating MTrP rather than STR alone<sup>14,16)</sup>. However, it cannot be concluded that the STR technique is inappropriate as some studies have reported the effectiveness of STR alone<sup>4,17)</sup>.

A few studies have examined the effect of the SCS technique. Darzinski et al. in 2000 reported the success of using SCS combined with physical therapy in reducing pain and increasing the function of patients with chronic resistant MPS<sup>18)</sup>. Recent studies have reported the effectiveness of SCS alone at improving pain and range of motion (ROM) in various conditions<sup>19,20)</sup>. However, there is also a study which reported the inability of SCS to improve ROM<sup>21)</sup>.

The differences in concepts, treatment maneuvers, and the conflicting results of previous studies of the two techniques led us to conduct this double blinded experimentally designed study. This study compared the effects of the two treatment techniques (STR and SCS) in subjects with active MPS of the upper trapezius muscle.

## SUBJECTS AND METHODS

### Subjects

Twenty volunteers (4 males, 16 females) with ages ranging between 20 and 56 years were recruited from the physical therapy clinic of the Faculty of Physical Therapy, Mahidol University. They were randomly allocated to either the STR or SCS group. Both groups had 8 females and 2 males. The STR group had 3 subjects with MTrP in the left and 7 subjects with MTrP in the right upper trapezius

muscles, while the other group had 5 subjects with MTrP in the left and 5 subjects with MTrP in the right upper trapezius muscles. All subjects were selected according to the following criteria:

- complaints of constant pain or altered sensation in the expected distribution of the referred pain zone of the upper trapezius muscle<sup>1,22</sup>;
- presence of a palpable taut band in the muscle identified by comparison with the other side and of at least one point exquisite spot tenderness at along its length<sup>1,13,22</sup>;
- and presenting some degrees of restriction of neck movement or regular stretching pattern<sup>15,16</sup>.

The subjects were excluded from the study if they had any of the following criteria:

- signs of nerve root irritation<sup>12</sup>;
- a history of systemic disease or injury in the upper quarter musculoskeletal system which may cause instability or limitation of the movement<sup>15</sup>;
- or any other physical therapy treatments or medication that might have affected the symptoms during the last 48 hours before participation<sup>13</sup>.

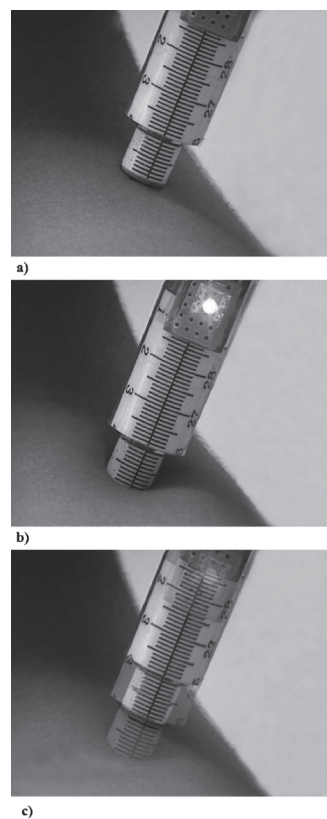
### Methods

The method of this study was ethically approved by the Mahidol University Institutional Review Board. Written informed consent was obtained from each subject before participation. This study involved 3 physical therapists. The first was assigned to recruit and screen subjects into the study, and measure all outcome parameters. The second was the physical therapist who treated the subjects with the SCS technique and also randomly allocated subjects to the groups for treatment. The third was the physical therapist who treated the subjects with the STR technique. The latter two therapists graduated from Mahidol University and hold a postgraduate diploma in manipulative physical therapy. They had more than 2 years experience of using these techniques. The evaluation and treatment were conducted in separated rooms. The evaluator was not allowed to know the therapist who was working in the treatment room.

This research assessed changes in muscles' responses which happen very rapidly; therefore, to ensure the process of data collection, the test-retest reliability of the assessments was examined before the actual data collection process. The intra-class correlation coefficient of the two-way mixed effects model ( $ICC_{3,k}$ ) was used to determine the test retest reliability of all parameters. The results of the test showed an ICC value greater than 0.7. The parameters consisted of the visual analogue scale (VAS), pressure pain threshold (PPT), displacement pain threshold (DPT), active range of motion (AROM), and patient's perception of change (PPC).

A VAS was used to assess resting pain intensity on a 10 centimeter line. Each line was printed on a separate page, so that the subjects would not know the point where they made a mark on the line in the previous assessment.

A pain algometer (Algometer<sup>TM</sup> commander, J Tech Medical Industries) was used to measure PPT in  $N/cm^2$ , which was the main measurement used in the present study. An additional light and sound signal producer was attached



**Fig. 1.** Video frame for DPT measurement a) when the probe touched skin, b) when the light was illuminated, and c) the superimposed image to measure the distance between image a and b.

on the probe of the algometer with a separate control switch. The switch was operated by the non-testing hand of the subject when the subject initially felt the pain elicited by the pressure. The use of the signal producer, rather than verbal communication, was to minimize the delay in communication between the examiner and the subject. DPT represents the displacement of the tissue when and where the PPT was recorded. The scale, in millimeters, for the displacement was attached on the tip of the dynamometer of the Algometer<sup>TM</sup> commander. Video images were taken during the algometer measurements of the scale touching and moving perpendicularly deep into the skin. They were taken using a digital video camera set 100 cm from the MTrP. The video frames of when the probe touched the skin and when the light was illuminated were superimposed (Fig. 1), and the superimposed image was used to calculate the probe. The test-retest reliability of DPT was 0.72.

The subjects were asked to rate their PPC on a separate 10 cm long visual analog scale. The point at the middle of the line indicated that the symptoms remained the same. To the left side of the middle point represented symptoms worsening, and the right, symptoms improving. The PPC was assessed at each evaluation period after the treatment.

A gravity goniometer was used to measure the degree of active neck movement. The neck AROM was measured in 4

**Table1.** Results of the pain, AROM of neck, and PPC of the subject in both STR and SCS groups

Variables		STR group				SCS group			
		P1	I	H	P2	P1	I	H	P2
VAS (cm)	Mean	2.86	2.86	1.95	2.27	3.62	2.03	2.35	2.27
	SD	1.51	1.33	1.65	2.15	1.86	1.68	1.60	1.90
PPT (N/cm <sup>2</sup> )	Mean	12.84	14.24	14.04	12.36	17.11	16.93	16.40	16.00
	SD	5.68	4.41	2.93	5.83	3.80	4.68	4.74	4.37
DPT (mm)	Mean	13.05	14.35	13.89	12.27	12.92	13.16	12.69	12.43
	SD	3.73	2.72	2.99	4.39	2.55	2.46	3.19	2.88
NF (degrees)	Mean	54.20	55.00	54.63	55.50	53.23	54.87	53.43	55.67
	SD	8.41	8.31	7.67	8.43	8.46	8.55	8.49	8.56
NE (degrees)	Mean	69.90	69.13	68.10	68.73	66.47	70.27	71.70	67.87
	SD	9.54	9.28	12.28	10.35	9.60	9.01	10.40	8.46
IF (degrees)	Mean	45.33	46.37	46.37	46.07	42.23	42.70	44.20	43.13
	SD	6.21	5.29	5.70	6.53	5.87	5.00	6.71	5.81
CF (degrees)	Mean	44.00	45.10	44.17	45.37	41.17	41.53	40.04	41.77
	SD	11.03	6.98	7.65	9.13	8.46	9.30	8.56	7.93
PPC (cm)	Mean	–	0.70	1.43	1.09	–	2.17	1.70	1.88
	SD	–	1.93	1.46	1.07	–	1.68	1.70	2.02

directions including neck flexion (NF) and extension (NE), ipsilateral flexion (IF), and contralateral flexion (CF) to the pain area. The test-retest reliability of AROM in this study was 0.7–0.9.

The treatment techniques used in this study were STR and SCS for the upper trapezius muscle. The treatment was conducted within 15 minutes. The treatment position for STR is supine lying while the neck is set in three different positions depending on the location of pain<sup>23</sup>: 1) flexion and lateral flexion to the opposite side; 2) flexion with rotation to the same side of the treatment; 3) flexion, lateral flexion to the opposite side, and rotation to the same side. Subjects must feel mild to moderate pain during the treatment and should not have too much overpressure on the upper cervical spine. The stretching session was 30 seconds with 10 seconds resting between treatment sessions<sup>24,25</sup>.

The treatment position for SCS is supine lying. With the head/neck passively flexed laterally to the treated side, the shoulder is set in flexion, abduction, and external rotation is applied as much as is comfortably possible for 90 seconds<sup>11,26</sup> with 10 seconds of resting between treatment sessions<sup>27</sup>. The subjects must feel comfortable in the passive position with at least two thirds of tenderness reduced<sup>11,26</sup>.

The data collection process took 2 days for each subject, and included subject recruitment, subject selection, before treatment (P1) evaluation, randomization, treatment, evaluation immediately after treatment (I), evaluation one hour after treatment (H), and evaluation 24 hours after treatment (P2).

Before the P1 evaluation, the tenderness spot was marked on the subject's skin with permanent ink and also mapped on a transparency sheet to ensure the reliability of the testing spot on the next day. A video camera was set up to take images during the test for PPT and DPT. The researcher informed subjects about the procedure and demonstrated the test on the non-tested side. Each evaluation was conducted in a specific order of

measurement. PPT, DPT, and AROM were measured 3 times at each evaluation.

For statistical analysis, Lavene's test was used to check the homogeneity of variance between the STR and SCS groups for all parameters. Two-way mixed ANOVA with Bonferroni post-hoc analysis was used to compare all parameters within and between groups receiving treatment. Statistical significance was chosen as  $p < 0.05$ .

## RESULTS

The data of all parameters were normally distributed. Lavene's test revealed equal variances between the STR and SCS groups for all parameters. Table 1 shows the mean values of parameters of pain (PPT, DPT, VAS, and PPC) and AROM of the neck (NE, NF, IF and CF) at before, immediately, one hour and a day after treatment of STR and SCS. The result of two-way mixed ANOVA with Bonferroni post hoc analysis showed no significant difference in any parameter at before, immediately, one hour and a day after treatment between the STR and SCS groups ( $p > 0.05$ ).

There was no significant difference of VAS in the STR group, whereas, the SCS group indicated significant difference of VAS between the P1 and H evaluations ( $p = 0.04$ ). Moreover, in the SCS group, there was a tendency of decrease of symptoms immediately after the treatment (P1 and I,  $p = 0.06$ ) which remained until the next day.

The results showed no significant differences for PPT and DPT between and within-groups, except for DPT at I and P2 in the STR group ( $p = 0.02$ ). This finding indicates an improvement of DPT immediately after the treatment followed by a worsening on the next day. Interestingly, there appears to be a relationship between DPT and PPT, since the graphs seem to duplicate each other.

The results of this study revealed no significant difference of neck AROM within and between groups of treatment in any movement direction. A slight increase in NE was detected after treatment in the SCS group, but it didn't lasted not long.

Both groups showed a positive PPC result, but, there were no significant differences in PPC between or within the STR and SCS groups. Interestingly, the STR group showed a lower PPC than the SCS group at every period of evaluation.

## DISCUSSION

This study recruited subjects with active MTrP in the upper trapezius muscle as it is most frequently affected and commonly cited in clinical settings<sup>22</sup>). The subjects were suffering from pain, even at rest, a likely reason for them seeking treatment. The subjects of this study had mild levels of pain which may have marked differences in pain reduction between the two techniques. However, the within-group comparison showed a significant improvement after using SCS.

The results showed a significant improvement in VAS at one hour after SCS treatment. This result is in agreement with some previous studies which reported reduction of pain after treatment with SCS<sup>19,20</sup>). These previous studies were conducted on different groups of subjects with different protocols, and they did not have a follow up at one day after treatment. The present study found a pain reduction one hour after treatment, which remained until the next day. Ibanez-Gracia reported a reduction in pain intensity of latent MTrP of the masseter muscle after treatment in 3 weekly SCS treatment sessions, but they did not report the effect at each treatment session.

The DPT in the STR group at one day after treatment was less than that of immediately after treatment. This suggests that the tissue became less compliant. Moreover, a trend of PPT reduction was also presented in the same period. These results indicate that MTrP has greater sensitivity and lower compliance. The stretching applied in this study might have caused muscle contraction via spindle muscle activation and its reflex, as Simons et al. (1999) reported that stretching may induce pain<sup>1</sup>). An appropriate sustained stretch would relax the muscle without protective guarding muscle<sup>14</sup>). Simons and coworkers suggested using STR with other desensitization modality<sup>1</sup>) gave better results as proven by the studies of Jaeger<sup>12</sup>), Hanten<sup>14</sup>) and Edwards<sup>16</sup>). In addition, STR as a long term home program (without other combined treatment) in subjects with MTrP was found to provide some benefits<sup>4,17</sup>).

The findings of PPT and AROM did not show any significant improvement after one session of SCS treatment. This result confirmed the study of Blanco and co-workers in 2006. They reported that the SCS did not improve AROM. They conducted in the subjects with latent MTrP of masseter muscle. MTrP are mainly characterized by hypersensitivity of MTrP and referred pain more than the restricted ROM<sup>1,21</sup>). In addition SCS may reduce pain by stimulating A $\delta$  fiber<sup>20</sup>). These statements were different from the findings in several reports that using SCS several times as treatment for MTrP can improve PPT and AROM<sup>18,19</sup>). They reported effects of several session of SCS treatment in improving PPT and AROM.

In conclusion, the present study did not reveal any significant differences between SCS and STR techniques in

treating active MTrP. Using the SCS technique was found to have benefit in pain reduction more than STR technique whereas the STR technique was found to introduce less tissue compliance. This study suggested the SCS as one choice of treatment. For further study, patient with more severe symptoms should be recruited. It would be also interesting to investigate the effects of multi-treatment sessions in patient with active MTrP.

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