

The Effect of Proprioceptive Neuromuscular Facilitation Therapy on Pain and Function

JUNG-HO LEE, MS¹⁾, SOO-JIN PARK, PhD^{1)*}, SANG-SU NA, MS¹⁾

¹⁾ Department of Physical Therapy, Daegu University Graduate school of Physical Therapy, Daegu University: 15 Naeri-ri, Jinlyang, Gyeongsan-si, Gyeongsangbuk-do 712-833, Republic of Korea.
TEL: +82 10-5512-8603

Abstract. [Purpose] The present study examined the effects of treatment using PNF extension techniques on the pain, pressure pain, and neck and shoulder functions of the upper trapezius muscles of myofascial pain syndrome (MPS) patients. [Subjects] Thirty-two patients with MPS in the upper trapezius muscle were divided into two groups: a PNF group (n=16), and a control group (n=16) [Methods] The PNF group received upper trapezius muscle relaxation therapy and shoulder joint stabilizing exercises. Subjects in the control group received only the general physical therapies for the upper trapezius muscles. Subjects were measured for pain on a visual analog scale (VAS), pressure pain threshold (PPT), the neck disability index (NDI), and the Constant-Murley scale (CMS). [Results] None of the VAS, PPT, and NDI results showed significant differences between the groups, while performing postures, internal rotation, and external rotation among the CMS items showed significant differences between the groups. [Conclusion] Exercise programs that apply PNF techniques can be said to be effective at improving the function of MPS patients.

Key words: PNF, MPS, Trapezius

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INTRODUCTION

Myofascial Pain Syndrome (MPS) is characterized by local pressure pain, taut band structures, twitch responses, and referred pain on pressure, and it is defined as a local pain syndrome caused by pain trigger points¹⁾.

MPS treatment methods can be divided into invasive methods and non-invasive methods. Among the invasive methods, pain trigger point injections have been reported as being representative of, and effective at treating acute MPS^{2, 3)}. Non-invasive methods include Proprioceptive Neuromuscular Facilitation (PNF), stretching therapy, massage therapy, and taping therapy, and these techniques have been reported as being effective at relieving pain and improving functional abilities⁴⁻⁶⁾.

Among PNF techniques, the hold-relax technique is frequently used in clinics to relieve pain, and to increase the range of motion of joints. The stabilizing reversal technique is used to enhance the muscle strength of the postural muscles of the trunk, the shoulder girdle, and the hip joint, stabilizing the muscles and increasing the stability of the relevant joints^{7, 8)}. This technique is facilitated when the other changes to the synergy of static muscular activity. Agonist synergy and antagonist synergy occur alternately.

Some studies have reported the absence of a treatment effect of PNF, and few studies have used PNF as an intervention method for MPS treatment^{9, 10)}. Accordingly, the

present study examined the effects of treatment using PNF extension techniques on the pain, pressure pain, and neck and shoulder functions of the upper trapezius muscles of MPS patients.

SUBJECTS AND METHODS

Subjects

In the present study, 32 patients, who were diagnosed with upper trapezius muscle MPS by an orthopedic surgeon, who had no neurological symptoms, and who showed negative results in subacromial impingement syndrome tests (near collision signs, Hawkins collision signs, and pain arc signs), were selected as subjects from among the patients who were visiting the hospital. Using random sampling, the subjects were divided into an experimental group of 16 subjects and a control group of 16 subjects (Table 1).

Methods

After applying general physical therapy techniques (a hot pack for 20 minutes, ultrasound therapy for five minutes, and transcutaneous electrical nerve stimulation for 20 minutes), the experimental group received upper trapezius muscle relaxation therapy and shoulder joint stabilizing exercises. Subjects in the control group received only general physical therapies for the upper trapezius muscles.

For the upper trapezius muscle relaxing therapy using the hold-relax PNF technique, with the patient in the sitting position, the therapist held the rear of the patient's head and pulled the head in the direction opposite to the affected side

*To whom correspondence should be addressed.
E-mail: rememversj@hanmail.net

Table 1. General characteristics of subjects (Mean±SD)

	Experimental group (n=16)	Control group (n=16)
Age (yrs)	48.1±13.2	47.7±10.7
Height (cm)	165.2±10.0	161.9±6.0
Weight (kg)	60.1±12.5	54.8±8.6
Affected side (left / right)	3 / 13	5 / 11
Gender (male / female)	7 / 9	4 / 12
Headache (yes / no)	6 / 10	9 / 7

Table 2. Comparison of VAS, PPT, and NDI between the pre-test and post-test in each group (Mean±SD)

	Experimental group (n=16)		Control group (n=16)	
	Pre-test	Post-test	Pre-test	Post-test
VAS	7.13±0.81	5.00±1.26	7.31±1.08	4.94±1.44
PPT	35.64±9.51	39.35±8.46	33.48±9.69	36.88±8.58
NDI	26.81±5.67	21.56±5.41	26.94±4.51	22.75±4.52

*p<0.05, VAS=visual analog scale, PPT=pressure pain threshold, NDI=neck disability index

to extend the muscle and rotate the patient's face toward the affected side. The muscle was induced to relax for 10 seconds after isometric contraction for 10 seconds and this process was repeated for a total of five times.

Shoulder joint stabilizing exercises using PNF were also performed for the scapular muscles. The contraction of the muscles was maintained for 10 seconds while each of the exercises was being performed. This was followed by 10 seconds of rest. Three sets of these exercises were repeated five times and a three-minute rest was given between each set.

The scapular muscle stabilizing exercises were performed using stabilizing reversal PNF techniques. A therapist gave the verbal instruction, "Please maintain", and isometric contraction of the scapular muscles were used. The isometric exercises were performed using manual resistance provided by the therapist to perform elevation, depression, upward rotation, and downward rotation of the scapular when the patient was in a sidelying position with the affected side facing upward.

The subjects were measured by directly noting the pain currently felt by the patients using a visual analog scale (VAS), a 100-mm straight line representing a continuum of pain intensity. A pressure algometer was used to measure the pressure pain threshold (PPT) of the pain trigger points of the subjects' upper trapezius muscles.

The neck disability index (NDI) was used to assess the subjects' neck functions. The NDI consists of 10 items, each item receives a score ranging from 0–5 points, and higher scores mean more severe neck disorders. The Constant-Murley scale (CMS) was used to assess shoulder joint functions. The assessment items comprise pain, activities of daily living, the ranges of joint motion, muscle power, and total score.

The independent t-test was used to compare the treatment effects of the two treatment methods. The data were processed using WIN-SPSS Version 18.0, and a signifi-

cance level (α) of 0.05.

RESULTS

The comparisons of the effects of the treatment on the two groups as measured by VAS, PPT, and NDI are shown in Table 2. None of the VAS, PPT, and NDI results showed significant differences ($p>0.05$) between the groups, while performing postures, internal version, and external version among the CMS items showed significant differences between the groups ($p<0.05$) (Table 3).

DISCUSSION

Muscles are distributed throughout the human body and they are the most dynamic and important tissues that control the maintenance of postures and the movements of the musculoskeletal system. Therefore, muscles are most frequently exposed to functional disorders or structural damage due to causes such as fatigue resulting from inappropriate activities, and movements and strains resulting from sudden external force. MPS accounts for a large number of these muscle-related disorders and the neck, the shoulder, and the lumbar regions are frequently damaged¹¹.

Since improper muscle tone and limited functions may reduce the effects of treatment and cause recurrent disorders, they should be controlled using appropriate therapeutic intervention methods^{12, 13}. To date, many studies of PNF have been conducted and these studies have reported positive effects on the control of inappropriate muscle activities and the enhancement of physical balance and functions^{14, 15}.

In a study conducted by Moon et al. that compared the effects of Functional Electrical Stimulus (FES) treatment and PNF treatment in 30 patients, the greatest enhancement of upper limb functions was observed in the group which received PNF treatment¹⁶. In a study conducted by

Table 3. Comparison of CMS between the pre-test and post-test in each group (Mean±SD)

	Experimental group (n=16)		Control group (n=16)	
	Pre-test	Post-test	Pre-test	Post-test
Pain	6.88±2.50	11.88±2.50	5.63±3.10	9.69±3.40
Work	2.44±0.51	2.88±0.50	2.31±0.70	2.69±0.48
ADL	2.38±0.50	2.81±0.54	2.26±0.74	2.71±0.73
Sleep	1.19±0.54	1.31±0.48	1.44±0.51	1.48±0.50
Position*	6.63±0.96	7.13±1.03	6.38±1.09	6.42±1.15
Flexion	7.19±1.22	8.88±1.03	7.13±1.03	8.25±1.24
Abduction	6.94±1.00	8.00±1.27	6.88±1.26	7.75±1.24
Range	6.19±1.05	7.13±1.03	6.00±1.27	6.50±1.16
Internal rotation*	6.63±0.96	7.38±1.20	6.13±1.54	6.50±1.15
External rotation*	6.63±0.96	7.38±1.20	6.13±1.54	6.50±1.15
Power	17.56±2.42	19.06±2.72	16.13±3.78	18.44±3.52
Total	64.19±9.79	76.63±9.12	60.13±9.31	70.56±9.60

*p<0.05, ADL=activities of daily living

Trampas et al. that examined the effects of treatment using massage and stretching therapy PNF techniques, pain at myofascial pain trigger points, and pressure pain threshold relief was observed in the group treated with massage combined with stretching therapy PNF techniques¹⁷).

In the present study, the experimental group, which received PNF techniques, showed statistically significant differences in VAS, from 7.13±0.81 before treatment to 5.00±1.26 after treatment, and in PPT, from 35.64±9.51 before treatment to 39.35±8.46 after treatment (p<0.05). Pain relief and an increase in the pressure pain threshold are considered to have been the result of stretching therapy applied with PNF techniques, and the stabilizing exercises stimulating the proprioceptive myoreceptors of the muscles and tendons, thereby to improving the efficiency of the nerves' control of muscles, normalizing muscle tone, and increasing the circulation of blood and tissue fluid.

The functional activities of the neck and the shoulders can be performed without damage only when the surrounding structures, such as muscles, bones, and ligaments are normally arranged and organically cooperate and act. However, in the case of MPS patients, the surrounding structures are prevented from performing normal functions due to pain and physiological or psychological causes.

PNF is frequently used as a treatment method to treat physical dysfunction resulting from damage or disease^{18, 19}. A study conducted by Gonzalez-Rave et al. examined increases in the ranges of motion of the shoulder and the hip joints of 51 patients following the application of PNF techniques²⁰. They observed larger increases in the ranges of motion of joints in a group which received PNF techniques, compared to other groups (p<0.05). A study conducted by Kofotolis and Kellis examined changes in muscle endurance, flexibility, and functional ability to perform activities following stabilizing exercises and muscle power training using PNF techniques for 86 patients²¹. They reported significant increases in all items in a group which performed an exercise program with PNF techniques (p<0.05). In the present study, the experimental group, which received PNF techniques, showed statistically significant changes in NDI,

ranging from 26.81±5.67 before treatment to 21.56±5.41 after treatment (p<0.05), and also in all CMS items except for sleeping under the daily living items (p<0.05).

We consider the increases in functional activities found in the present study occurred because the exercise program performed with PNF techniques stimulated both the myoreceptors and the exteroceptors, promoted motor-skill memory, and triggered neurophysiological changes. In addition, the neurophysiological changes must have increased functional activities by more accurate control of muscle activities and surrounding structures. These results are consistent with the results of a study conducted by Fasen et al. who observed changes in the ranges of motion of joints following stretching therapy for 100 patients, and reported that applying active stretching therapy using PNF was effective at increasing the ranges of motion of joints²²). Additionally, in a study conducted by Decicco and Fisher, it was suggested that stretching therapy using PNF was effective at increasing the ranges of motion of joints²³).

The present study examined the effects of PNF on the pain and functions of the upper trapezius muscles of MPS patients. VAS, PPT, and NDI showed significant changes in both groups (p<0.05) and the experimental group which received PNF techniques showed significant changes in all the CMS items, except for sleeping (p<0.05). In a comparison of the effects of the different treatment methods, statistically significant differences were found between the two groups in performing postures and the internal and external versions of the shoulder joints among the CMS items (p<0.05). Therefore exercise programs using PNF techniques can be said to be effective for the functional improvement of MPS patients. However, it should be noted that in the present study, the experimental period was short, the number of study subjects was small, and the effects of anodyne medication might have contributed to the outcomes. The authors hope that diverse, effective treatment methods using PNF techniques will be used to treat MPS patients based on the findings of this present study.

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