A Comparison of the Effects of PNF, ESWT, and TPI on Pain and Function of Patients with Myofascial Pain Syndrome

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Abstract. [Purpose] The study aims to examine the effects of proprioceptive neuromuscular facilitation (PNF), extracorporeal shockwave therapy (ESWT), and trigger point injection (TPI) on pain reduction and functional improvement in patients with Myofascial pain syndrome (MPS) of the upper trapezius muscle and compares their treatment effects, thereby presenting precise and efficient treatment methods. [Subjects] Thirty-three patients with MPS in the upper trapezius muscle were divided into three groups: a PNF group (n=11), ESWT group (n=11), and a TPI group (n=11). [Methods] The degree of pain was measured using the visual analog scale (VAS). Pressure pain threshold (PPT) was measured at trigger points in the upper trapezius muscle by using a pressure algometer, and the Constant-Murley scale (CMS) and neck disability index (NDI) was applied for functional evaluation. [Results] A comparison of the effects of the different treatment methods revealed no significant differences among the groups in terms of PPT, but CMS (pain, range, and activities of daily living) and NDI showed significant differences among groups. [Conclusion] PNF treatment enhanced neck function, range of motion in the shoulder joint, and activities of daily living relative to the other methods; ESWT reduced degree of pain and improved functioning. TPI treatment reduced pain, but had limited effects in enhancing functional activities.

Key words: PNF, ESWT, TPI

A lot of research has been performed on treatment methods for MPS but research comparing the effects of different treatment methods (exercise, electrical, and drug therapies) has been lacking to date. The current study examines the effects of PNF, ESWT, and TPI on pain reduction and functional improvement in patients with MPS of the upper trapezius muscle and compares their treatment effects, thereby presenting precise and efficient treatment methods.

INTRODUCTION

Myofascial pain syndrome (MPS) is characterized by localized tenderness, taut band structure, convulsive response, and referred pain under compression and has been defined as a localized pain syndrome caused by pain trigger points. The etiologies of MPS include improper muscle contraction and relaxation resulting from inappropriate posture or excessive utilization of the joints and repetitive microtrauma of the muscles caused by muscle overuse. Stress, metabolic disorders, hormonal disorders, and infections have also been reported as stimulating factors for MPS.

Treatment methods for MPS are divided into invasive and non-invasive techniques. Representative invasive techniques are trigger point injection (TPI) and dry needling, both of which are effective in treating acute MPS. Non-invasive treatment methods include electrical treatment and exercise treatment. Electrical treatments include extracorporeal shockwave therapy (ESWT), transcutaneous electrical nerve stimulation, ultrasonic treatment, and magnetic field treatment; exercise treatments include stretching, massages, taping, stabilization exercises, and proprioceptive neuromuscular facilitation (PNF). Such non-invasive methods are effective for pain reduction and functional ability improvement.

SUBJECTS AND METHOD

Subjects
The subjects of this study were 33 patients who visited the Department of Rehabilitation, were diagnosed with MPS of the upper trapezius muscle, and who satisfied all intrinsic diagnosis elements by Simons. They had no neurological symptoms and tested negative for subacromial impingement syndrome. Subjects were randomly and equally assigned to one of three groups: a PNF treatment group, a shock wave treatment group, or a TPI treatment group. Treatment was applied twice per week for 4 weeks for a total of 8 treatment sessions. All the subjects participated in this experiment after sufficiently listening to the purpose and experimental procedure of this study (Table 1).
groups (p<0.05) (Table 4). Also, NDI showed significant differences among the groups, but VAS showed statistically significant improvement compared to the PNF group (p<0.05). In the present study, the ESWT group’s pain as measured by VAS and CMS and activities of daily living showed statistically significant improvement compared to the PNF group (p<0.05). These results are due to the effects of ESWT which destroys damaged tissues and initiates recovery in the damaged parts by facilitating the formation of new blood vessels and stimulating local growth factors.

TPI has been presented as an effective method to treat acute MPS. In TPI, injections are given in pain trigger points, which are areas where pain is triggered due to muscle tension or spasm. In a study that examined the effects of TPI, Kim et al. observed that application of TPI was effective in reducing pain and increasing range of motion. In the present study, the TPI group’s pain as measured by VAS and CMS showed statistically significant improvement compared to the PNF group (p<0.05). This was performed a total of 5 times.

Shock wave therapy was applied 1000 times to the pain trigger point of the upper trapezius muscle at 5 Hz using ESWT (JEST-2000, Joecn Medical) via an air cylinder method using the head of a 17-mm gun and low power. For TPI, the Travell method was applied by a specialist injecting 0.2 mL of 0.3% lidocaine in the pain trigger point.

The subject’s pain was measured using a 100-mm visual analog scale (VAS). The pain trigger point of the upper trapezius muscle was measured using pressure in order to determine the pressure pain threshold (PPT). The neck disability index (NDI) was used to assess each subject’s neck function. NDI consists of 10 items with zero to 5 points given to each item; the higher the score is, the more severe the disability is in the cervical area. The Constant-Murley Scale (CMS) was used to evaluate functioning of the shoulder joint in each subject. The evaluation items consist of pain, activities of daily living, range of motion, muscle strength, and total scores. The higher the score of each item and the total score are, the better the function is.

To describe the general characteristics of the treatment groups, a statistical analysis was conducted. For inter-group comparison, one-way ANOVA was used. For statistical analysis, SPSS version 12.0 was used and significance was accepted for values of α<0.05.

RESULTS

A comparison of pre-test on VAS, PPT, NDI, and CMS among the groups showed no significant differences (p>0.05) (Table 2). In terms of PPT, this was no significant differences among the groups, but VAS showed statistically significant differences among the groups (p<0.05) (Table 3). Comparison of CMS among the groups showed significant differences in pain, range, and activities of daily living (p<0.05). Also, NDI showed significant differences among groups (p<0.05) (Table 4).

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

<table>
<thead>
<tr>
<th></th>
<th>PNF group (n=11)</th>
<th>ESWT group (n=11)</th>
<th>TPI group (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>51.92 ± 7.53</td>
<td>51.61 ± 8.3</td>
<td>52.67 ± 7.58</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.48 ± 9.46</td>
<td>164.14 ± 8.69</td>
<td>164.48 ± 9.61</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>53.73 ± 8.22</td>
<td>54.7 ± 8.62</td>
<td>53.6 ± 8.08</td>
</tr>
</tbody>
</table>

* p<0.05, PNF = proprioceptive neuromuscular facilitation, ESWT = extracorporeal shock wave therapy, TPI = trigger point injection.

DISCUSSION

In the past, a key element in treating MPS patients was removal of pain. The importance of increased muscle tension caused by pain and the resulting disability has been gradually recognized. In particular, functional recovery in chronic pain patients is an important issue as the reduction of pain.

Wrong muscle tension and functional restriction decrease treatment effects and may trigger the recurrence of a disorder, and management is necessary through appropriate treatment interventions. There has been a lot of research on VAS and CMS, and this method has been reported to have positive effects on muscle activity adjustment, body balance, and functional improvement.

In a study that compared the treatment effects of functional electrical stimulus (FES) and PNF, Moon et al. observed improvement in the PNF group’s upper limb functioning. In a study that examined the effects of massage and PNF relaxation stretching on the myofascial trigger point (VAS) and the PPT, Trampas et al. reported pain reductions in the group receiving PNF relaxation treatment combined with myofascial trigger point therapy. In the present study, the PNF group’s neck function, shoulder range of motion, and activities of daily living improved by a statistically significant degree compared to the other groups (p<0.05).

Recent studies have reported that ESWT in musculoskeletal disorder patients was good for pain reduction and functional improvement, and ESWT has drawn attention as an alternative treatment method for such patients. Accordingly, the application of ESWT has been increasing, who examined the effects of ESWT on pain and functional improvement in 34 subjects, and Hsu, who looked at the effects of ESWT in 36 subjects, noted significant changes in VAS and CMS after treatment. In the present study, the ESWT group’s pain as measured by VAS and CMS of activities of daily living showed statistically significant improvement compared to the PNF group (p<0.05). These results are due to the effects of ESWT which destroys damaged tissues and initiates recovery in the damaged parts by facilitating the formation of new blood vessels and stimulating local growth factors.

Methods

All the groups received hot pack therapy for 20 minutes and ultrasound therapy for 5 minutes. The PNF group, the shock wave group, and the TPI group received upper trapezius muscle relaxation therapy, ESWT, and injection therapy, respectively.

Upper trapezius muscle relaxation therapy was conducted using the PNF hold-relax technique. The subject sat with the therapist holding the back of the head and pulling the head in the opposite direction from the extended muscles and stretched with the face toward the extended muscles. The subject relaxed for 10 seconds after isometric contraction; this was performed a total of 5 times.

Shock wave therapy was applied 1000 times to the pain trigger point of the upper trapezius muscle at 5 Hz using ESWT (JEST-2000, Joecn Medical) via an air cylinder method using the head of a 17-mm gun and low power. For TPI, the Travell method was applied by a specialist injecting 0.2 mL of 0.3% lidocaine in the pain trigger point.

The subject’s pain was measured using a 100-mm visual analog scale (VAS). The pain trigger point of the upper trapezius muscle was measured using pressure in order to determine the pressure pain threshold (PPT). The neck disability index (NDI) was used to assess each subject’s neck function. NDI consists of 10 items with zero to 5 points given to each item; the higher the score is, the more severe the disability is in the cervical area. The Constant-Murley Scale (CMS) was used to evaluate functioning of the shoulder joint in each subject. The evaluation items consist of pain, activities of daily living, range of motion, muscle strength, and total scores. The higher the score of each item and the total score are, the better the function is.

To describe the general characteristics of the treatment groups, a statistical analysis was conducted. For inter-group comparison, one-way ANOVA was used. For statistical analysis, SPSS version 12.0 was used and significance was accepted for values of α<0.05.
only pain in the PNF group (p<0.05). These results are due to the effects of local anesthetics by lidocaine injection.

The present study examined and compared the treatment effects of PNF, ESWT, and TPI on patients with MPS of the upper trapezius muscle. In this evaluation of different treatment methods, pain, range of motion, and activities of daily living as measured by VAS, NDI, and CMS significantly differed among the groups (p<0.05). PNF treatment enhanced neck function, range of motion in the shoulder joint, and activities of daily living relative to the other methods; ESWT reduced degree of pain and improved functioning. TPI treatment reduced pain, but had limited effects in enhancing functional activities.

The present study had the limitations of a short experimental period; a small number of subjects; and the possibility that administration of medication may have increased effects of specific techniques. Future research should apply the studied treatment methods of PNF, ESWT, and TPI in patients with MPS in different areas of the body.

**REFERENCES**


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**Table 2.** A comparison of pre-test on VAS, PPT, NDI, and CMS among groups (Mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>PNF group (n=11)</th>
<th>ESWT group (n=11)</th>
<th>TPI group (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual analog scale</td>
<td>7.09 ± 1.04</td>
<td>7.18 ± 0.98</td>
<td>7.36 ± 0.67</td>
</tr>
<tr>
<td>Pressure pain threshold</td>
<td>33.56 ± 8.70</td>
<td>31.42 ± 7.98</td>
<td>37.00 ± 9.09</td>
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<tr>
<td>Neck disability index</td>
<td>24.45 ± 4.57</td>
<td>28.00 ± 4.96</td>
<td>26.73 ± 5.92</td>
</tr>
<tr>
<td>Constant-Murley scale</td>
<td>65.27 ± 10.33</td>
<td>62.09 ± 13.73</td>
<td>65.01 ± 10.76</td>
</tr>
</tbody>
</table>

* p<0.05, PNF = proprioceptive neuromuscular facilitation, ESWT = extracorporeal shock wave therapy, TPI = trigger point injection

**Table 3.** A comparison of effects on VAS and PPT among groups (Mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>PNF group (n=11)</th>
<th>ESWT group (n=11)</th>
<th>TPI group (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual analog scale</td>
<td>2.26 ± 0.91</td>
<td>3.28 ± 1.03</td>
<td>3.22 ± 0.84</td>
</tr>
<tr>
<td>Pressure pain threshold</td>
<td>−2.71 ± 2.11</td>
<td>−2.50 ± 1.99</td>
<td>−2.63 ± 1.43</td>
</tr>
</tbody>
</table>

* p<0.05, PNF = proprioceptive neuromuscular facilitation, ESWT = extracorporeal shock wave therapy, TPI = trigger point injection

**Table 4.** A comparison of effects on NDI and CMS among groups (Mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>PNF group (n=11)</th>
<th>ESWT group (n=11)</th>
<th>TPI group (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck disability index</td>
<td>6.26 ± 1.53</td>
<td>5.26 ± 1.26</td>
<td>5.19 ± 1.15</td>
</tr>
<tr>
<td>Pain*</td>
<td>−4.18 ± 2.34</td>
<td>−5.62 ± 3.45</td>
<td>−5.54 ± 2.67</td>
</tr>
<tr>
<td>Range*</td>
<td>−5.78 ± 2.47</td>
<td>−4.48 ± 3.22</td>
<td>−3.74 ± 3.19</td>
</tr>
<tr>
<td>Activities of daily living*</td>
<td>−6.45 ± 3.53</td>
<td>−5.34 ± 2.98</td>
<td>−2.67 ± 3.78</td>
</tr>
<tr>
<td>Strength</td>
<td>−2.63 ± 2.21</td>
<td>−2.82 ± 2.18</td>
<td>−2.77 ± 2.68</td>
</tr>
<tr>
<td>Total</td>
<td>13.15 ± 8.63</td>
<td>14.77 ± 6.64</td>
<td>11.73 ± 8.78</td>
</tr>
</tbody>
</table>

* p<0.05, PNF = proprioceptive neuromuscular facilitation, ESWT = extracorporeal shock wave therapy, TPI = trigger point injection
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