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Analgesic and myorelaxant use of selected manual therapy techniques in patients with stomatognathic system (SS) disorders

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Abstract

Modern physical therapy employs a wide range of methods, e.g. manual therapy, physical therapy, massage, physiotherapy, which are also successfully used in dental specialization. The main purpose of application of these methods is elimination of pain and increased muscle tone. The aim of the study was to examine the effectiveness of manual therapy in elimination of pain and increased muscle tone in patients with disorders of the stomatognathic system (SS). The study was conducted in a group of 26 women who reported SS pain and muscular rigidity in the face. Patients were diagnosed using various manual and instrumental techniques. Ten procedures of manual therapy of the masseter muscle were carried out. A VAS pain assessment was carried out after each treatment. After the treatment cycle was completed, electromyography was performed on patients' masseter muscles, and the range of jaw abduction was assessed. Manual therapy was proven to be an effective method of pain and increased muscle tone treatment in patients with an impairment of the SS. After a series of 10 treatments total pain relief and a decrease in the muscle tone were achieved, leading to an increase in the range of mandible abduction in all 26 female patients under study.

KEYWORDS: manual therapy, physical therapy, stomatognathic system.

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What is already known on this topic?
The main aim of the manual therapy is to eliminate pain and increased muscle tone. Symptoms reported by patients with myogenic disorders of the stomatognathic system (SS) are sufficient indication for using this form of therapy.

Introduction

Physiotherapy employs a wide range of therapeutic techniques [1, 2] usually categorized into physical therapy, physiotherapy, and massage [3, 4]. Changes in the field of physiotherapy in Poland have resulted in the introduction and implementation of new methods of working with the patient called Manual Therapy (MT) [5]. The use of "therapy by hand" as a therapeutic agent was recommended as early as the fifth century BC by Hippocrates, who described a method of manually positioning a dislocated jaw [6, 7, 8].

According to the current definition of MT by the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMT), MT is "a specialized area of physiotherapy, devoted to proceedings in neuro-musculo-skeletal diseases, based on clinical reasoning and application of highly specialized methods of treatment, including manual techniques and therapeutic exercises" [7, 9, 10]. MT is divided into two branches. The first, called "soft" manual therapy, is dedicated to the treatment of soft tissue. Its methodology includes post-isometric relaxation, deep tissue massage, musculo-fascial relaxation, transverse massage, and strain-counterstrain techniques [7, 11]. The other branch, called "hard" manual therapy, focuses on the hard tissues of the body. It is based on the performance of manipulations, which is a technique involving a rapid crossing of the physiological range of motion in the joint with a high speed but and a low amplitude [2, 12].

Until recently, the "hard" techniques have been the ones most commonly used in MT. It is currently believed, however, that the "hard" treatment is allowed only in the acute phase, and should not be used in treatment of chronic disorders. Taking the pain, increased muscle and fascia tone into consideration, the therapy of soft tissues appears to be an appropriate approach in patients with SS impairment.

Aim of Study

The study aimed to assess the effectiveness of manual therapy for elimination of pain and increased muscle tone in patients with myogenic disorders of the stomatognathic system.

Material and Methods

The study was conducted in a group of 26 women reporting SS pain and muscular rigidity in the face. The patients were subjected to manual and equipment-based diagnostics (electromyography of the superficial masseter muscle (sEMG)), assessment of pain using a visual analogue scale (VAS), and measurement of the range of jaw abduction. Ten procedures of manual therapy of the masseter muscle on the right and the left side of the face were performed on each patient. The duration of the treatment was 12 minutes for each side of the face. The sEMG, VAS pain assessment, and measurement of the range of mandible abduction were carried out before and after the series of 10 treatments.

The study was approved by the Bioethics Committee of the Pomeranian Medical University in Szczecin (KB – 0012/102/13).

The rehabilitation process included the following therapeutic procedures:

1. Trigger Point compression mobilization (Trigger Points – TrPs) of the masseter muscle:

Depending on the number of TrPs the therapy was performed in two ways:

a) In patients with two TrPs the technique involved applying light pressure on the TrPs for 8-10 seconds, and then releasing the pressure for approximately 30s and re-applying the pressure in the same place. The compression was performed several times to the feeling of relaxation and reducing the sensation of pain within the masseter muscle. The procedure lasted four minutes.
b) In patients with more than 2 TrPs circular compressions of the trigger point were performed with a finger. The movement started with light pressure, gradually increasing in strength. The expected result was a decrease in resistance felt in the TrPs, accompanied by a decrease in the intensity of the pain. The procedure lasted four minutes (Figure 1).

Figure 1. Trigger Point compression mobilization (Trigger Points – TrPs) of the masseter muscle [source: archive SPFiOB]

2. Soft tissue mobilization (functional massage)

Soft tissue mobilization is a muscle and surrounding soft tissue massage in conjunction with an abuction in the temporomandibular-joint (TMJ).

Description of treatment: using the second and the third finger the therapist performs rubbing and stretching motions on the masseter muscle and the surrounding tissue, while the patient abducts the jaw until feeling the resistance of the tissue. 30 movements per minute are performed on each side, for a total of 4 minutes of functional massage (Figure 2).

Figure 2. Functional massage of the masseter muscle on the left side of the face [source: archive SPFiOB]

3. Mobilization of the cell – pain zones of the subcutaneous face tissue (Kibler folds)
Description of the treatment: the mobilization is carried out by gripping a skin fold between the index fingers and thumbs of both hands, then rolling the fold through the fingers (Figure 3). If the patient feels pain during rolling (the physiotherapist should simultaneously sense a thickening of the soft tissues) the movement should be stopped and pressure should be put on the fold until the patient has reported a decrease or complete disappearance of pain. The procedure is performed in three lines, in each case starting from the TMJ area and then following the upper, middle, and lower parts of the superficial masseter muscle. The right and then the left side of the face are mobilized by repeating every move twice. The treatment lasts 2 minutes for each side of the face.

Figure 3. Mobilization of the cell-pain zones of the subcutaneous face tissue (Kibler folds) [source: archive SPFiOB]

4. Postisometric relaxation (PIR) of the masseter muscle
PIR involves active relaxation of the irritated muscles after maintaining a period of isometric tension.
Description of the procedure: while the patient is in a lying position, the therapist places his fingers on the lower incisors. The physiotherapist then gently overcomes resistance, pushing the lower jaw down. The previously instructed patient gently opposes this force with approximately 20% of the maximum strength of adduction of the mandible (Figure 4). This procedure was repeated 4 times and lasted 4 minutes. At the end of the procedure in order to activate the antagonistic muscles, the therapist put his hand under the chin and applied gentle upward force to abduct the jaw. The patient opposed the action by pressing with his jaw into the therapist's hand.

Figure 4. PIR of the masseter muscle [source: archive SPFiOB]

During the treatment cycle the patients did not undergo any other medical treatment such as painkillers, myorelaxants, or hypnotics.
The results were analyzed using Statistica 2010. The data was subjected to statistical verification based on the following tests: Shapiro-Wilk, Wilcoxon test, t – Student's t-test, and Mann-Whitney U test. A 95% confidence interval was provided (CI).

Results
The tables below show statistical analysis results obtained during the application of selected manual therapy methods in patients with a SS impairment.

Table 1. Characteristics of the distribution of measurements of the left and right side of the resting masseter muscle sEMG [uV] right before and after the 10-day MT

Distribution characteristics		Resting masseter muscle sEMG [uV] (n = 26)			
		Face side			
		Right		Left	
		pre-treatment	post-treatment	pre-treatment	post-treatment
min. – max		18,8 – 53,4	1.0 – 9.9	24.5 – 58.5	1.8 – 8.5
$Q_1 – Q_3$		27.3 – 42.5	2.4 – 5.5	32.1 – 49.8	3.0 – 5.5
m_e		32,9	4.5	40.8	3.5
95% CI		27.3 – 35.5	2.4 – 5.4	32.1 – 46.6	3.0 – 4.4
$\bar{X}$ (SD)		33.9 (9.3)	4.4 (2.1)	41.6 (9.5)	4.2 (1.9)
	Shapiro-Wilk	0.54	0.21	0.32	0.02
significance level	Wilcoxon's matched pairs test	–		< 0.0001	
	Student's t-test (dependent samples)	< 0.0001		–	

n – group size; min. – minimum value; max – maximal value; Q_1 – the first quartile; Q_3 – the third quartile; m_e – median – the arithmetic mean; SD – standard deviation; CI – confidence interval

Statistical evaluation of the resting bioelectrical activity of the masseter muscle showed a statically significant reduction in the amplitude ($p < 0.0001$). The resting muscle activity amplitude median on the right side before the treatment was 32.9 μV (= 33.9 μV), and after the treatment 4.5 μV (= 4.4 μV). The resting muscle activity amplitude median on the left side before the treatment was 40.8 μV (= 41.6 μV), and after the treatment 3.5 μV (= 4.2 μV). A greater decrease in amplitude was achieved on the left side of the face (89.9%) than on the right side (87.0%) (Table 1).

The analysis of bioelectrical activity masseter muscle during strain showed a statistically significant decrease in the amplitude ($p < 0.0001$). The muscle activity during

Table 2. Characteristics of the distribution of measurements of the left and right side of the masseter muscle sEMG [uV] during strain, right before and after the 10-day MT

Distribution characteristics		Resting masseter muscle sEMG [uV] (n = 26)			
		Face side			
		Right		Left	
		Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
min. – max		168 – 376	63.6 – 89.8	145 – 379	61.5 – 88.9
$Q_1 – Q_3$		232 – 325	65.6 – 74.4	209 – 308	66.3 – 74.3
m_e		292.5	68.1	283	68.1
95% CI		232 – 322	65.6 – 73.2	209 – 300	66.3 – 70.4
$\bar{X}$ (SD)		282 (65)	72.1 (8.6)	263 (61)	71.3 (8.4)
	Shapiro-Wilk	0.04	< 0.001	0,18	0,001
significance level	Wilcoxon's matched pairs test	< 0.0001		< 0.0001	

n – group size; min. – minimum value; max – maximal value; Q_1 – the first quartile; Q_3 – the third quartile; m_e – median – the arithmetic mean; SD – standard deviation; CI – confidence interval

Table 3. Characteristics of the distribution of VAS [mm] after each treatment

Distribution characteristics	VAS scale of pain intensity (n = 26)					
	Diagnostics	Day of treatment				
		1	2	3	4	5
min. – max	50 – 86	30 – 56	14 – 31	10 – 21	0 – 13	0 – 8
$Q_1 – Q_3$	60 – 70	35 – 46	20 – 27	13 – 17	6 – 10	0 – 0
m_e	65.5	42.0	21.5	15.0	8.0	0
$\bar{X}$ (SD)	65.6 (9.2)	41.5 (7.1)	22.6 (4.7)	14.9 (3.3)	7.4 (3.8)	1.2 (2.6)
95% CI	60 – 69	35 – 45	20 – 25	13 – 16	6 – 10	0 – 0
significance level (Shapiro-Wilk)	0.55	0.18	0.15	0.12	0.002	< 0.0001
Wilcoxon's matched pairs test	VAS (diagnostics) v. VAS (10 days of treatment); $p < 0.0001$					

n – group size; min. – minimum value; max – maximal value; Q_1 – the first quartile; Q_3 – the third quartile; m_e – median – the arithmetic mean; SD – standard deviation; CI – confidence interval

strain amplitude median on the right side before the treatment was 292.5 μV (= 282 μV), and after treatment – 68.1 μV (= 72.1 μV). The muscle activity during strain amplitude median on the right side before the treatment was 283 μV (= 263 μV), and after treatment 68.1 μV (= 71.3 μV). A greater decrease in the amplitude was obtained on the right side of face (74.4%) compared to the left side (72.8%) (Table 2).

After 6-10 days of treatment no patients suffered from pain (VAS = 0 mm). The statistical analysis of VAS distribution before and after 10 MT treatments revealed a statistically significant difference ($p < 0.0001$). Pain intensity in the VAS median before the treatment was 65.5 mm (= 65.6 mm), and after 6 days of therapy all patients reported pain relief (VAS = 0 mm) (Table 3). The largest percentage decrease in pain intensity occurred after the 6th treatment and it amounted to 100%.

Data in Table 4 show that all patients who underwent a series of 10 treatments experienced an increase in the mandible abduction range. In 10 patients the mandible abduction range was equal to 43 mm (in line with the median of the control group). The difference was statistically significant ($p < 0.0001$).

Discussion

An important component of treatment of dysfunctions of the SS is the use of therapeutic methods which are non-invasive, reversible, and possible to replicate and

Table 4. Mandible abduction [mm] before and after 10 TM

Mandible abduction [mm] Before treatment	Mandible abduction [mm] After treatment					Total
	40	41	42	43	45	
33	**1**					1
34	**1**					1
35	**2**	**1**		1		4
36	**2**	**1**	**3**	**2**		8
37	**1**			5		6
38		1	2	2		5
40					**1**	1
Total	7	3	5	10	1	26

Wilcoxon matched pairs test $p < 0.0001$

modify. In the SS disorders, in which the pain is triggered because of increased muscle tension, the first procedures that should be carried out are procedures designed to eliminate these problems. In the initial stage of treatment physiotherapy can be used. They result in analgesia and myorelaxation. The next step should be conducting adequate dental treatment, for example, dental splinting. While rehabilitation in the form of splints and removable braces has an established position in modern dentistry, the use of MT is marginal. Available research results confirm the efficacy of MT in the treatment of functional disorders of the stomatognathic system.

Manual therapy is one of the oldest and leading therapeutic methods used in present-day physiotherapy. MT is becoming increasingly popular in dental diagnostics (Manual Functional Analysis of the Masticatory System by A. Bumann) and therapy [13, 14]. MT has been used in the treatment of musculo-fascial pain syndromes of the face. SS tissue massage leads to a reduction in headaches, decrease in chewing muscles tension, and helps restore the muscle balance between the left and the right side of the face [15, 16, 17, 18, 19]. The purpose of the use of SS in muscular disorders is elimination or reducing the pain reported by the patient, and decreasing muscle rigidity by improving mobility across all layers of soft tissue.

In our study MT proved to be an effective form of therapy, leading to a decrease in the bioelectrical activity of the masseter muscle at rest and in exercise. Due to the application of appropriate therapeutic maneuvers the SS function was improved. All layers of tissue, including the skin, have to move in relation to each other by contraction and expansion to adapt to the SS function. Impairment in the form of loss of mobility of individual layers of tissue and loss of flexibility leads to pathologies in the SS such as pain and decreased range of jaw abduction [20]. The application of massage decreased the soreness of soft tissue and improved the mobility in the TMJ by nocyceptive stimulation. Subcutaneus face tissue mobilizations of cell-pain zones with the Kibler fold resulted in the reduction of pain and improvement of muscle fascia function by restoring their mobility. The use of PIR led to the relaxation of muscles and an increased range of motion in the joint abduction restricted by increased muscle tone and the shortened muscle. The TrPs therapy contributed to the relaxation of overly tense muscle fibers by reducing the pressure on the nerves and blood vessels, and it caused an improvement of local muscle under oxygenation [21]. Other authors specializing in MT also obtained an analgesic and myorelaxant effect using these therapeutic methods [22, 23, 24, 25].

The strong myorelaxant effect of the therapy resulted in complete pain relief in all patients after the 6th day of treatment (VAS = 0). The analgesic and relaxing effects of MT resulted in an increase in mandible abduction. Jaw abduction values improved in all patients (n = 26). The range of motion in the mandible after 10 treatments was within a range of 40-45 mm. These values are consistent with those in a group of people not suffering from SS pain.

From a SS biomechanical point of view achieving a similar size sEMG amplitude of the masseter muscle on the right (rest 4.5 μV, strain 68.1 μV) and the left side of the face (rest 3.5 μV, strain 68.1 μV) led to a symmetric TMJ load causing a reduction in pain and muscle tension. Similar results were obtained by Kerstein et al. who found that achieving a balanced load of both dental arches resulted in therapeutic improvement in patients with muscle pain US [26].

The results of the present study indicate the importance of MT in the treatment of SS disorders. Restoring the proper soft tissue mobility led to a symmetrical tension of the masseter muscle, and the proper mandible abduction range, which in turn eliminated the pain within the face. The results of sEMG, linear measurement of mouth opening, and VAS pain intensity confirm the results.

Conclusions

1. The use of manual therapy eliminates pain and decreases SS muscle tone.
2. The use of manual therapy leads to the restoration of physiological mandible abduction values in patients with SS disorders.
3. The use of physiotherapy in dentistry should be considered.
4. Manual therapy should be included in the standard treatment in patients with SS disorders.

What this study adds?

In literature, there are few reports showing the usefulness of manual therapy in dentistry. Results of this study indicate the importance of using TM in the disorders of the stomatognathic system (SS).

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