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# Correction of Psycho-Emotional Status Using Neuromuscular Relaxation of the Face: A Case Study

**Anastasia D. Dubinskaya**
Department of Medical Rehabilitation and Physical Therapy
Medical Research Center of Rehabilitation and Balneology
Ministry of Health of the Russian Federation
121099, 32 Novy Arbat Str., Moscow, Russian Federation

**Olga V. Yurova**
Medical Research Center of Rehabilitation and Balneology
Ministry of Health of the Russian Federation
121099, 32 Novy Arbat Str., Moscow, Russian Federation

**Anatoliy D. Fesyun**
Medical Research Center of Rehabilitation and Balneology
Ministry of Health of the Russian Federation
121099, 32 Novy Arbat Str., Moscow, Russian Federation

**Abstract.** At present, neuropsychiatric disorders are widespread among the population. Their occurrence is associated with the effect of chronic emotional stress. For many reasons, most people are not ready to seek help from a specialist psychologist or psychotherapist, experiencing stress or more serious disorders. The author's technique of stimulating the dynamics of muscle growth in healthy women in combination with an increase in bioelectric muscles, which has been developed and described in this study, can become an affordable and safe way to correct psychoemotional states and therefore improve the aesthetic appearance. The purpose of the study is to develop a modern method of correction of psychoemotional derivations, based on the use of neuromuscular relaxation techniques and the development of a facial feedback mechanism. The research methods include psychological, neurophysiological, and clinical-functional components that allow assessing the psychoemotional status and electrophysiological parameters of the facial muscles. The results of the study have shown a high efficiency of neuromuscular relaxation methods in the correction of psychoemotional disorders, which was manifested in reducing the level of depressiveness, trait and state anxiety and increasing the bioelectric activity of the facial muscles, as well as the state of parafunction. It became possible to establish a clear correlation between the presence of severe depression and anxiety and increased electrical activity of the facial muscles, and the data obtained suggest that the use of neuromuscular relaxation techniques is an effective psychocorrective tool that breaks the connection between prolonged muscle tension and the negative emotional state of the patient, which positively affected her psychological status. The practical significance of the study lies in the method of neuromuscular relaxation as a new effective tool for diagnosing psychoemotional derivations and increasing the tonus of facial muscles by creating facial feedback.
**Keywords:** stress, facial muscle tonus, facial feedback, emotional proprioception, myofascial massage, botulinotherapy.

## 1. Introduction

At present, neuropsychiatric disorders are widespread among the population. Their occurrence is associated with the effect of chronic emotional stress. The WHO data shows that more than 300 million people worldwide are diagnosed with depression and more than 284 million people suffer from various types of anxiety disorders (Depression: let's talk..., 2017). An increased tonic activity of muscle tissue can be called an indicator of mental stress at the physical level. This is a consequence of the activation of the sympathoadrenal system in response to mental stress. The mechanisms of facial expression depend on the mental state of the person – their functional state is associated with the neuropsychiatric state. That is why, according to observations, these muscles are more sensitive

to emotional experiences than all the others (Heller et al., 2014; Finzi and Norman, 2016; Jochum et al., 2019). Such emotional susceptibility is inherent in the masticatory (*m. masseter*), zygomaticus muscles (*m. zygomaticus*), orbicular muscle of mouth (*m. orbicularis oris*), and corrugator muscle (*m. corrugator*) (Komiyama et al., 2008; Baumeister et al., 2016; Dong et al., 2019; Jochum et al., 2019). Therefore, a number of authors call facial muscles "emotionally significant" or "valent-sensitive" (Dimberg and Söderkvist, 2011; Finzi and Norman, 2016). Facial expression is mainly the result of stereotypical movements of the facial skin and fascia (connective tissue) due to the contraction of the facial muscles in certain combinations. Such contractions create folds, lines, and wrinkles on the skin and cause movement of markings on the face, such as the corners of the mouth and eyebrows. Although such factors as skin colour and sweating may contribute to some facial expressions, the most important aspects of most facial expressions are a direct result of muscle action. The facial muscles are not the only muscles that respond to emotions. Striatal muscles of the neck, back, arms, etc., also contract in response to emotions, as do the smooth muscles of the blood vessels and digestive tract. However, nowhere in the body do emotions differ from each other as clearly as in the pattern of facial muscle tension.

There is a correlation between the activity of the facial muscles and the emotional state – they always interact with each other on the principle of facial feedback, which is confirmed by the research by scientists (Giannakopoulos et al., 2010; Dimberg and Söderkvist, 2011; Finzi and Rosenthalb, 2016). The tonus of the facial muscles increases when a person experiences negative emotion. When the facial muscles are in tension for a long time, such processes as negative neuropsychiatric states only intensify. Therewith, persistent relaxation of the facial muscles through the afferent channels allows slowing these processes down and has a positive effect on the emotional background (Neta et al., 2009; Lewis, 2012; Söderkvist et al., 2018; Hao et al., 2019).

At present, specialists use botulinotherapy. This technique allows blocking afferent signals from the facial muscles to the emotional centres of the brain, thereby helping in the fight against depressive disorders (Davis, 2010; Hawlik et al., 2014; Dong et al., 2019; Finzi and Rosenthal, 2019). But recently, there has been growing evidence that such invasive methods can lead to impaired emotional reactivity, reduced emotional response, difficulty processing the subtleties and tones of emotional language, and decreased sexual function (Oberman et al., 2007; Lewis, 2012; Baumeister et al., 2016). For this reason, botulinotherapy has a controversial status – not all experts recommend its use. One of the non-invasive methods of working with depressive disorders and correcting hypertonia of the facial muscles are physiotherapy techniques (laser therapy, massage, oxygen therapy, magnetic therapy, Kinesio Taping, myogymnastics, acupuncture, as well as dental trainers). Notably, most of these methods are still prescribed for neurological diseases (Orlova, 2002). But when it comes to the signals associated with depressive and anxiety disorders in people who are physically healthy, the increased tonus of the facial muscles is already considered as a symptom and goes beyond medical care. However, muscle hypertonia sometimes remains hidden. It rarely has a noticeable negative impact on the quality of life. It is diagnosed during cosmetic, massage, or dental procedures (Sessle, 2014; Kaewcum and Siripornpanich, 2018; Luo, 2018).

For obvious reasons, most people are not ready to seek help from a specialist psychologist or psychotherapist, experiencing stress or more serious disorders. In addition, these people are often in unconscious internal stress (anosognosia), cannot evaluate and describe their emotions (alexithymia), and the use of cosmetic massage is often caused by dissatisfaction with their own appearance. This is always associated with a general negative neuropsychiatric background. The author's technique of neuromuscular relaxation of the facial muscles, which has been developed and described in this study, can become an affordable and safe way to correct psychoemotional states and improve the aesthetic appearance.

## 2. Materials and Methods

To illustrate the effectiveness of the neuromuscular relaxation method used to correct psychoemotional disorders, the authors of this study present a clinical observation and the results obtained during its use.

The patient K., 35 years old, went to the clinic with complaints about aesthetic changes in appearance. It was suggested that dissatisfaction with their appearance and the desire to correct aesthetic defects had been caused by a negative emotional background. Psychological testing, as well as neurophysiological and clinical functional diagnostics of the facial and cervical muscles, were performed to assess the psychological characteristics of the individual and the characteristics of the concomitant state of the facial muscles. According to the results of these studies, patient K. was offered a set of neuromuscular relaxation procedures. Life record: patient K. has a higher education, she is a high school English teacher, and often experiences emotional stress in the course of her professional activity. Divorced, has a son of 13 years (perhaps the present marital status leaves a negative imprint on self-esteem and encourages the desire to change her appearance). *Status praesens*: Patient K. is somatically healthy. Denies the presence of chronic diseases.

*Psychological examination* was carried out using the following methods:

1. Assessment of the subjective severity of depression on the Beck Depression Inventory (Giannakopoulos et al., 2010). The results were evaluated as follows: 0-9 points – no depressive symptoms, 10-15 points – mild depression (subdepression), 16-19 points – moderate depression, 20-29 points – severe depression (moderate severity), 30-63 points – severe depression.

2. Measuring the level of anxiety using the Ch. Spielberger's questionnaire modified by Yu. Khanin (Giannakopoulos et al., 2010). The study assessed the level of state and trait anxiety. The results were interpreted as follows: 0-30 points – low anxiety, 31-45 points – moderate anxiety, over 46 points – high anxiety.

*The neurophysiological study* included conducting interference electromyography on the "Neuro-MVP-Neurosoft" device. The degree of bioelectric activity of the muscles most actively involved in the manifestation of negative emotional states was evaluated: corrugator (*m. corrugator supercilii*), masticatory (*m. masseter*), depressor anguli oris (*m. depressor anguli oris*). Neurophysiological indicators of the facial muscles were evaluated using standardised methods of interference myography.

The first stage of the study was to monitor and record the results of facial muscles activity of the study participants in a state of relative rest. To ensure the continuity of the results and the correct interpretation, the authors of the study decided to use the standards of interference myography proposed by J. Clam (1990). The activity of the masticatory muscles is normally 0-3.1 mkV. With a low degree of tension, muscle biopotentials are recorded in the range of 3.2-5.2 mkV, an average degree of tension of 5.3-7.3 mkV, a high degree – 7.4-9.4 mkV, and a very high degree – more than 9.4 mkV. The activity of facial muscles is normally 0-5 mkV, the values of biopotentials 5-8.1 mkV indicate a weak degree of tension, 8.1-11.2 mkV – medium, 11.2-14.3 mkV – high, more than 14.3 mkV – very high.

The second stage of the study was the recording of data on voluntary muscle activity by the method of samples with maximum tension. The facial muscles, being in a state of chronic excitation, exhibit inappropriate parafunctional activity, which is recorded in the form of increased amplitude of fluctuations in electrical potentials. When studying the neurophysiological parameters of the corrugator muscle (*m. corrugator supercilii*), the patient was asked to contract eyebrows as much as possible; the depressor anguli oris (*m. depressor anguli oris*) – to lower the corners of the mouth (face of discontent); the masticatory muscle (*m. masseter*) – to clench the jaws as much as possible.

*Clinical-functional diagnostics* included an assessment of the degree of pain during palpation of the following areas: the postaural, parotideomasseteric, submandibular, superciliary ridge area, upper section of the sternocleidomastoid muscles, trapezius muscles (Figure 1). Pain was evaluated on a visual-analogue scale (VAS) from 0 to 10 points, where 1 – no pain; 2-4 – mild pain; 5-7 – moderate pain; 8-9 – severe pain. Based on the severity of the pain syndrome, the overall functional state of the muscles was evaluated. The absence of pain was regarded as a muscle normotonus, pain from 1 to 3 points – as a weak degree of tension, 4-6 points – moderate tension, 7-9 points – high degree of muscle tension.

**Figure 1.** An assessment of the degree of pain in the submandibular area (left) and parotideomasseteric area (right) using palpation

*Caliperometric study*. Measurement of the fold thickness in various areas of face and neck - parotideomasseteric, submandibular, buccal areas, the upper part of the sternocleidomastoid muscle was performed using caliperometry (assessment of the thickness of skin and muscle folds on the head and neck area of the caliper) (Figure 2). The volume of myofiber directly depends on the degree of its contraction, and an increase in the volume of the skin-muscle fold shows specialists the presence of interstitial edema. Thus, its thickening can be used as an additional criterion for diagnosing the dynamics of the level of muscle tension before and after the study. The measurements were carried out twice, after which the average value of the data was displayed. The authors of the study chose this method for diagnosis since caliperometry data makes it possible to assess the dynamics of the level of muscle tension before and after neuromuscular relaxation procedures and the severity of intercellular edema. A decrease in the thickness of the skin-muscular fold after the procedure indicates a pronounced drainage effect of the massage, which is achieved by increasing the rate of lymphatic and venous outflow from the facial muscles.

**Figure 2.** Caliperometry in the parotideomasseteric area (left) and the upper section of the sternocleidomastoid muscles (right)

The technique of neuromuscular relaxation included conducting a myofascial massage in the clinic, which was accompanied by the patient's homework on performing self-massage of the face and gymnastics for the neck. The duration of correction was 2.5 months. Myofascial massage was a procedure for inactivating facial muscle hypertonias in accordance with the patent programme No. 2705237 "The Method of neuromuscular relaxation of facial muscles" according to the method "Revitonica" (Method of neuromuscular relaxation..., 2019). When correcting the increased tone of the facial muscles, the following techniques were used: ischemic compression, deep sliding palpation,

pincer palpation, kneading. A total of 10 60-minute massage treatments were performed. The procedures were performed once a week (Figure 3).

**Figure 3.** Conducting myofascial massage

Training in face and neck self-massage was conducted under the guidance of an instructor according to the developed programme (Figure 4). When performing the programme, the muscles of various parts of the head, neck, and chest area were affected. Self-massage training took place 2 times a week. The instructor conducted 20 classes of 90 minutes each. As massage movements, warming up, kneading, softening, rubbing, stretching techniques were used.

**Figure 4.** Training in self-massage of the face and neck by the method of Revitonica

The complexes studied together with the instructor were repeated daily by the patient as homework, which were performed daily for 15-30 minutes 6 times a week (Figure 5).

**Figure 5.** Self-massage of the face and neck using the method of Revitonica

**3. Results and discussion**

**3.1. Initial indicators of clinical and functional diagnostics parameters**

Evaluating the initial indicators of the subjective assessment of the severity of depression on the Beck scale (Giannakopoulos et al., 2010), a conclusion can be drawn that the patient had

pronounced depressive symptoms. When assessing the psychological status, attention was drawn to pronounced fatigue ("I cannot do anything because of fatigue"), as well as the internalisation of negative emotions and the inability to feel them ("I used to be able to cry, but now I cannot, even if I want to"). The patient had ideas of self-blame ("most of the time I feel guilty", "I blame myself for my actions all the time"), a decrease in the level of social and labour activity ("I hardly force myself to do anything"). Of particular importance was dissatisfaction with the appearance and the realisation that there were negative changes in it ("there were significant changes in my appearance that make me unattractive"). Other problems, such as concern for health, interest in sexual activity, sleep disorders, and satisfaction with life were not dominant.

When evaluating the results of the survey, the patient had a high level of state anxiety. The patient noted that she almost always lacks self-confidence, she "feels defenseless", is not sure of her strengths and abilities: she assessed herself as "a failure", wanted to be "as lucky as others". Furthermore, emotional vulnerability and sensitivity were identified, as well as prolonged experience of negative emotions: "I am very worried about troubles, I cannot forget about them", "I take everything to heart". The pronounced level of anxiety was manifested in a low mood ("rarely in high spirits") and an unstable background ("often irritable"). During the survey, the patient was also found to have a high level of trait anxiety. The following features of the patient's personality were noted: she is extremely sensitive to external circumstances and worries for insignificant reasons: "I worry about nothing", "I am worried about possible difficulties", "I feel constant anxiety, I think about errands and troubles" (Table 1).

**Table 1.** Initial indices of psychological status (points)

| Indices of psychological status | Points |
|---|---|
| Subjective severity of depression | 21 |
| State anxiety | 42 |
| Trait anxiety | 59 |

According to the initial data of the electromyographic study, patient K. was found to have a significant excess of the standard indicators of bioelectric activity of all facial muscles (Table 2). Thus, in the initial state, the tonus of *m. corrugator supercilii* on the right was 31.4 mkV, on the left – 25.2 mkV; the tonus of *m. masseter* on the right – 27.3 mkV, on the left – 6 mkV; the tonus of *m. depressor anguli oris* on the right – 57.0 mkV, on the left – 50.3 mkV. In addition, there was a significant excess of the tonus of the masticatory muscle on the right in relation to the tonus of the masticatory muscle on the left. The results of the electromyography of the masticatory and facial muscles are presented in Table 2.

**Table 2.** Initial indices of facial muscle electromyography, test at rest (mkV)

| Facial muscles | Indices of electromyography (mkV) | |
|---|---|---|
| | On the right | On the left |
| *m. corrugator supercilii* | 31.4 | 25.2 |
| *m. masseter* | 27.3 | 6 |
| *m. depressor anguli oris* | 57.0 | 50.3 |

The initial evaluation of electromyographic data for the maximum voltage samples for each muscle showed that the bioelectric activity of the masticatory muscle (*m. masseter*) was 11.35 mkV on the right and 2.25 mkV on the left ($\Delta = 11.37\%$). In the initial state, the tonus of *m. corrugator supercilii* on the right was 251 mkV, on the left – 151.5 mkV; the tonus of *m. masseter* on the right – 509.5 mkV, on the left – 147 mkV; the tonus of *m.depressor anguli oris* on the right – 853.5 mkV, on the left – 245 mkV (Table 3).

**Table 3.** Initial indices of electromyography of masticatory and facial muscles, test at a maximum tension (mkV)

| Facial muscles | Indices of electromyography (mkV) | |
|---|---|---|
| | On the right | On the left |
| *m. corrugator supercilii* | 251 | 130 |
| *m. masseter* | 509.5 | 207.8 |
| *m. depressor anguli oris* | 853.5 | 131.5 |

Notably, patient K. demonstrated increased activity of the muscles of the right side of the face compared to the left side, which can be explained by various reasons, in particular, the habit of chewing or grinding teeth on the right side of the jaw or increased tension of the skeletal muscles on the right side of the body due to prolonged statokinetic loads during the working day.

When performing functional diagnostics, the patient had an initial high level of pain sensitivity on all the examined areas of the face during palpation (8-10 points). The obtained data on high pain sensitivity are consistent with neuromyographic indices, since prolonged myofascial hypertonia leads to an increase in the severity of pain, and pain sensitivity is a marker of the presence of muscle tension (Table 4).

**Table 4.** Initial indices of muscle pain sensitivity in various areas of face and neck (points)

| Palpable areas | Pain sensitivity level |
|---|---|
| Parotideomasseteric area | 8 |
| Postaural area | 10 |
| Submandibular area | 9 |
| Superciliary ridge area | 9 |
| Occipital set of muscles | 10 |
| Trapezius muscles | 10 |
| Pain in the lower part of the face (intraoral) | 9 |
| Sternocleidomastoid muscle | 10 |

Caliperometry. During caliperometry (assessment of the thickness of the skin-muscular folds on the head and neck using a caliper), the thickness of the folds in various areas of the face and neck was measured – parotideomasseteric, submandibular, buccal areas, the upper section of the sternocleidomastoid muscle. The measurements were made twice, after which the average value of the obtained data was calculated. Caliperometry data are evaluated in dynamics, comparing the results before and after neuromuscular relaxation procedures (Table 5).

**Table 5.** Initial caliperometry indices for various areas of the face and neck (mm)

| Measured areas | On the right | On the left |
|---|---|---|
| The volume of the skin fold in the parotideomasseteric area | 38 | 30 |
| The volume of the skin-muscular fold in the buccal area | 30 | 30 |
| Volume of the skin-muscular fold under the chin | 24 | |
| The volume of the skin fold above the upper section of the sternocleidomastoid muscle | 20 | 26 |

Thus, in the patient K., who applied for cosmetology services, against the background of pronounced depressive symptoms of varying severity and high trait anxiety, high indices of bioelectric activity and pain sensitivity of the facial and cervical muscles were observed.

### 3.2. Results of the influence of neuromuscular relaxation procedures on initial indices

When analysing the dynamics of the subjective assessment of the severity of depression on the Beck scale (Giannakopoulos et al., 2010), there was a transition from a pronounced degree of depression (21 points) to its almost complete absence (4 points), which indicated the high

effectiveness of myofascial massage in correcting disorders of the psychoemotional state. When assessing the psychological status of the patient, significant positive changes were observed: the mood has increased – "I do not feel upset", "I get as much satisfaction from life, as before", "I am not crying more than usual", the mood became more steady – "now I am irritable not more than usual", confidence has increased – "I do not feel like a loser", "I am not disappointed in myself", ideas of self-accusation and guilt have disappeared – "I am not disappointed in myself", "I do not feel that I can be punished for something", "I do not feel guilty". The patient's state of somatic health did not cause anxiety – "I do not worry about my health any more than usual". Sleep, appetite, and interest in sex also did not inspire the patient with fears. The most important change that occurred in the psychological status of the patient is satisfaction with her appearance, which occured after the end of the procedures – "I do not feel that I look worse than usual".

When analysing the dynamics of state anxiety, a significant effect of the correction was also noted: the level of state anxiety decreased from a moderate level (42 points) to a low level (29 points). A very important positive change was almost complete absence of a sense of external threat – "nothing threatens me". The patient also notes positive changes in her emotional background: she "does not feel constrained, tense", "feels peace of mind", notes that she "became happy".

The analysis of trait anxiety showed a fairly stable condition. The dynamics remained at a high level – over 46 points. Notably, trait anxiety explains the persistency of the individual's property of perceiving certain external factors and actions as threatening and experiencing anxiety in response to such situations. A slight decrease in this metric after neuromuscular relaxation may indicate the individual characteristics of the patient's mental organisation. The patient who took part in the study was recommended to see a psychologist to eliminate psychoemotional discomfort and correct anxiety disorders in the future. Figure 6 presents the dynamics of indices of psychological status.

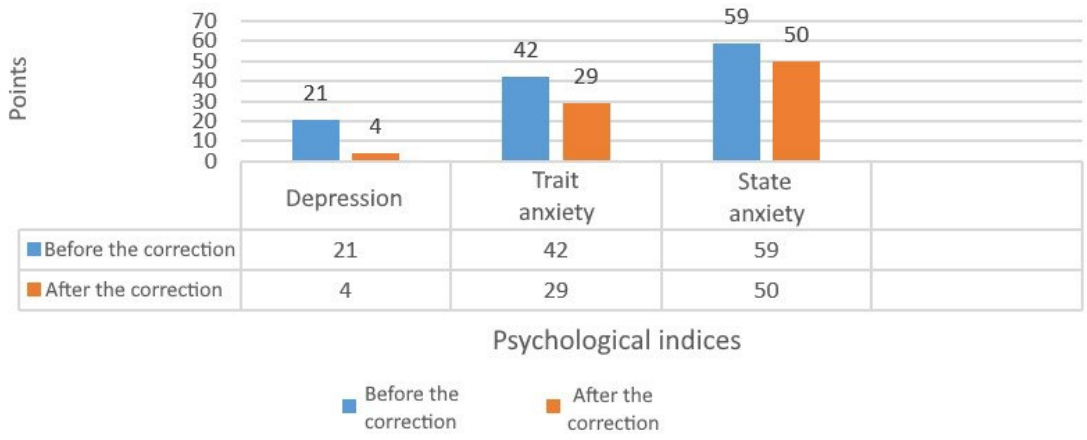


**Figure 6.** The dynamics of indices of the patient's psychological status

Improvement of psychological indices during neuromuscular relaxation procedures was accompanied by positive dynamics of quality-of-life indices (Table 6). Thus, the resting electromyography indices were normalised, and the muscle tonus on both sides was also normalised. This indicates the effectiveness of the method.

**Table 6.** The dynamics of electromyographic indices of facial muscles, test at rest (mkV)

| Muscles under study | Electromyographic indicators (mkV) | | | |
|---|---|---|---|---|
| | On the right | | On the left | |
| | Before | After | Before | After |
| *m. corrugator supercilii* | 31.4 | 2.1 | 25.2 | 2.0 |
| *m. masseter* | 27.3 | 3.0 | 6 | 2.5 |
| *m. depressor anguli oris* | 57.0 | 2.5 | 50.3 | 2.2 |

When analysing the data of the electromyographic study of the facial muscles in maximum tension in patient K., a positive trend was established (Table 7).

**Table 7.** The dynamics of electromyographic indices of facial muscles, test at maximum tension (MV)

| Muscles under study | Electromyographic indicators (mkV) | | | |
|---|---|---|---|---|
| | On the right | | On the left | |
| | Before | After | Before | After |
| *m. corrugator supercilii* | 251 | 130 | 151.5 | 120.5 |
| *m. masseter* | 509.5 | 207.8 | 147 | 95.45 |
| *m. depressor anguli oris* | 853.5 | 131.5 | 245 | 140 |

There was a decrease in the parafunctional activity of all the studied facial muscles on the left and right sides. In addition, after applying neuromuscular relaxation procedures, there was a more symmetrical muscle contraction on both sides of the face. Thus, the use of neuromuscular relaxation procedures has become an effective tool in correcting muscle tension in the facial and cervical muscles. Evaluating the indices of caliperometry (Table 8), the authors of the study recorded a noticeable decrease in the thickness of the skin fold after neuromuscular relaxation procedures (in the parotideomasseteric and buccal areas on the right – by 52.6%, and on the left in the parotideomasseteric area by 33.3%, in the buccal area – by 52.6%, in the upper section of the sternocleidomastoid muscle by 23%). The volume of the skin-muscular fold in the submandibular area decreased by 41%. A pronounced asymmetry can be noted: on the right side, the thickness of the skin-muscular fold was more pronounced than on the left side.

**Table 8.** Caliperometry indices on various areas of the face and neck (mm)

| Measured areas | On the right | | On the left | |
|---|---|---|---|---|
| | Before | After | Before | After |
| The volume of the skin fold in the parotideomasseteric area | 38 | 18 | 30 | 20 |
| The volume of the skin-muscular fold in the buccal area | 30 | 18 | 30 | 18 |
| The volume of the skin-muscular fold in the submandibular area | 24 | | 14 | |
| The volume of the skin fold above the upper section of the sternocleidomastoid muscle | 20 | 20 | 26 | 20 |

After neuromuscular relaxation procedures, the level of pain decreased to a mild degree of tension (in the parotideomasseteric area – by 87.5%, in the postaural – by 80%, in the submandibular area – by 89%, in the superciliary ridge area – by 77.8% and in the sternocleidomastoid muscle – by 70%) and moderate tension in the occipital muscles – by 60%, in the trapezius muscle – by 60%, and in the lower face (intraorally) – by 44% (Table 9).

**Table 9.** Indices of pain-related muscle sensitivity in various areas of the face and neck after neuromuscular relaxation procedures (points)

| Palpable areas | After |
|---|---|
| Parotideomasseteric area | 1 |
| Postaural area | 2 |
| Submandibular area | 1 |
| Superciliary ridge area | 2 |
| Occipital set of muscles | 4 |
| Trapezius muscles | 4 |
| Pain in the lower part of the face (intraoral) | 5 |
| Sternocleidomastoid muscle | 3 |

Consequently, during neuromuscular relaxation procedures, there is a decrease in the severity of hypertonia, the vicious circle "hypertonia – pain" is broken, which is accompanied by a decrease in muscle pain during palpation. Thus, a decrease in pain can be considered a reliable indicator of a decrease in muscle tension.

Long-term results of neuromuscular relaxation procedures were evaluated 4 months after the main study. During this period, the patient performed prophylactic self-massage of the face and neck exercises 2-3 times a week to maintain the result. As a result, patient K. maintained positive results in terms of the subjective severity of depression and state anxiety. There was no depression (3 points on the Beck scale) and a low level of state anxiety (33 points on the Spielberger-Khanin scale). The level of trait anxiety remained unchanged (54 points on the Spielberger-Khanin scale) (Giannakopoulos et al., 2010). The presented clinical case sets one thinking about several points:

Firstly, the high tonic activity of the facial muscles was confirmed in a somatically healthy woman who sought help with cosmetic procedures. This fact is consistent with the study conducted by C. Le Louarn and co-authors, who confirmed the presence of high levels of facial muscle tension in healthy individuals using magnetic resonance imaging. At the same time, muscle hypertonia remained hidden, did not significantly worsen the quality of life of the patient and became a diagnostic finding in the course of the study (Le Louarn et al., 2010).

Secondly, the patient was found to have a high level of depression symptoms during the study, and a special state anxiety against the background of increased muscle tonus of the facial muscles. This means that the link between emotional disturbances and facial muscle response has been confirmed by numerous predictions. For example, a systematic review of M. Wieckiewicz and co-authors say that from 2006 to 2016, almost 60 papers were published on the mental state of women complaining on pain in the masticatory muscles, of which 79% of studies were devoted to the relation of pain with depression, 42% – with anxiety, 21% – mood disorders (Wieckiewicz et al., 2017). Many publications are related to the study of the corrugator muscle (m. corrugator supercilii), and its connection with negative emotional states (fear, anger, sadness) (Heller et al., 2014). The correlation between the indices of technical activity of the facial muscles and the psychological state of a person was proved with the help of a study which involved 151 women (Dubinskaya et al., 2019).

Thirdly, this clinical case illustrates the pronounced positive effect of neuromuscular relaxation of the facial muscles on the psychological state of a healthy woman, and this particular case is confirmed by a study conducted on a large sample (Dubinskaya et al., 2020). A deep and differentiated method of working with the facial muscles with the help of myofascial massage provided not only the achievement of therapeutic, but also of psychological effect. A decrease in the tonic activity of the facial muscles led to a persistent improvement in the emotional state. The performed massage led to the disappearance of the increased electrical activity of the masticatory and facial muscles both at rest and at maximum tension, as well as to the almost complete disappearance of muscle parafunction. The most significantly pronounced muscle spasm decreased in the *m. masseter*, which is the most sensitive to the effects of emotional stress (the brightest trigger or "emotionally responsive" point). As a result of the correction, the patient's subjective severity of depression, state and trait anxiety decreased.

Fourthly, the direct participation of the patient in the correction helped to increase the interest and commitment to the implementation of the recommendations, thereby ensuring the achievement of a better psychological effect. The authors of this study believe that the effectiveness of correction is associated with independent exercises that were conducted at a conscious level and with a high degree of responsibility. Perhaps, myofascial massage in combination with regular exercises aimed at reducing muscle tension (self-massage of face and neck), contributed to persistent muscle relaxation and breaking the vicious circle between the tonic activity of the facial muscles and the emotional centres of the brain, which, in turn, led to the stabilisation of the psychoemotional state. From this case, it follows that achieving stable positive dynamics of most indices of the psychological state against the background of improving the functional activity and tonus of the facial muscles when performing a set of neuromuscular relaxation procedures based on the facial feedback mechanism is effective.

## 5. Conclusions

The technique of neuromuscular relaxation provides a long-term positive effect of muscle relaxation and a reduction in the severity of somatic pain. The reduction of muscle hypertonia and the reduction of pain response contribute to the registration of a new, anatomically correct position of the myofiber and a physiologically adequate pattern of muscle activity by the motor centres of the brain, which, according to the principle of facial feedback, ensures the restoration of the psychoemotional status, normalises the mood background, reduces the severity of anxiety and depression, increases the indices of physical and psychological health. The results of the study indicate that the course of myofascial massage, aimed at reducing muscle tension, complemented by independent practice, allows developing a new dynamic stereotype, which is fixed and supported by independent practice of self-massage of face and gymnastics for neck, leading to the stabilisation of the emotional state.

The authors of this study believe that this clinical case is interesting because it illustrates the presence of hidden psychoemotional disorders that were discovered after visiting the clinic for the correction of aesthetic disorders of appearance. The severity of emotional disorders (the severity of depression, state and trait anxiety) correlated with the presence of pronounced spasm of the facial and masticatory muscles and muscle parafunction, which was confirmed by the data of electromyography and calyperometry. Emotional deviations were also combined with severe pain syndrome, which is a diagnostic indicator of muscle tension and hypertonia. It became possible to establish a clear correlation between the presence of severe depression and anxiety and increased electrical activity of the facial muscles, and the data obtained allow concluding that the use of neuromuscular relaxation techniques is an effective psychocorrective tool that breaks the connection between prolonged muscle tension and the negative emotional state of the patient, which positively affected her psychological status.

## References


1. Baumeister, J., Papa, G., Foroni, F. (2016). Deeper than skin-deep. The effect of botulinum toxin-A on emotion processing. *Toxicon*, 118, 86-90.
2. Clam, J.R. (1990). Clinical EMG for surface recordings. *Clinical Resources*, 2, 81-89.
3. Davis, J., Senghas, A., Brandt, F., Ochsner, K. (2010). The effects of botox injections on emotional experience. *Emotion*, 10, 433-440.
4. "Depression: let's talk" says WHO, as depression tops list of causes of ill health. (2018). https://www.who.int/news-room/headlines/30-03-2017--depression-let-s-talk-says-who-as-depression-tops-list-of-causes-of-ill-health.
5. Dimberg, U., Söderkvist, S. (2011). The voluntary facial action technique: a method to test the facial feedback hypothesis. *Journal of Nonverbal Behavior*, 35, 17-33.
6. Dong, H., Fan, S., Luo, Y., Peng, B. (2019). Botulinum toxin relieves anxiety and depression in patients with hemifacial spasm and blepharospasm. *Neuropsychiatric Disease and Treatment*, 15, 33-36.
7. Dubinskaya, A.D., Yurova, O.V., Kotelnikova, A.V., Gulaev, Ye.N. (2019). Myofascial facial massage as a possible method for correcting psychoemotional states. *Questions of Balneology, Physiotherapy and Exercise Therapy*, 96(6), 24-39.
8. Dubinskaya, A.D., Yurova, O.V., Kotelnikova, A.V., Tkachenko, G.A. (2020). The relationship between psychological status and tonic activity of the facial muscles in apparently healthy women. *Psychotherapy Questions*, 73(78), 110-126.
9. Finzi, E., Norman, E. (2016). Emotional proprioception: treatment of depression with afferent facial feedback. *Journal of Psychiatric Research*, 80, 93-96.
10. Finzi, E., Rosenthal, N. (2019). Botulinum toxin therapy of social anxiety disorder: a case series. *Journal of Clinical Psychopharmacology*, 39(4), 410-412.
11. Finzi, E., Rosenthalb, N. (2016). Botulinum toxin for depression. Emotional proprioception. *Journal of Psychiatric Research*, 80, 93-96.

12. Giannakopoulos, N.N., Keller, L., Rammelsberg, P., Kronmüller, K.T., Schmitter, M. (2010). Anxiety and depression in patients with chronic temporomandibular pain and in controls. *Journal of Dentistry*, 38(5), 369-376.
13. Hao, M., Liu, G., Gokhale, A., Xu, Y., Chen, R. (2019). Detecting happiness using hyperspectral imaging technology. *Comput Intell Neurosci*, 2019, article number 1965789.
14. Hawlik, A.E., Freudenmann, R.W., Pinkhardt, E.H., Schönfeldt-Lecuona, C.J., Gahr, M. (2014). Botulinum toxin for the treatment of major depressive disorder. *Fortschr. Neurol. Psychiatr*, 82(2), 93-99.
15. Heller, A.S., Lapate, R.C., Mayer, K.E., Davidson, R.J. (2014). The face of negative affect: trial-by-trial corrugator responses to negative pictures are positively associated with amygdala and negatively associated with ventromedial prefrontal cortex activity. *Journal of Cognitive Neuroscience*, 26(9), 2102-2110.
16. Jochum, H., Keel, P., Baumgartner-Gruber, A., Zeilhofer, H., Leiggener, C. (2019). Bruxism, myoarthropathy and psychosomatics. *Swiss Dent Journal*, 129(4), 287-292.
17. Kaewcum, N., Siripornpanich, V. (2018). The effects of unilateral Swedish massage on the neural activities measured by quantitative electroencephalography (EEG). *Journal of Health Research*, 32(1), 36-46.
18. Komiyama, O., Wang, K., Svensson, P., Arendt-Nielsen, L., Kawara, M., de Laat, A. (2008). The influence of psychological state on the masseteric exteroceptive suppression reflex and somatosensory function. *Clinical Neurophysiology,* 119(10), 2321-2328.
19. Le Louarn, C., Buthiau, D., Buis, J. (2007). Structural aging: the facial recurve concept. *Aesthetic Plastic Surgery*, 31(3), 213-218.
20. Lewis, M.B. (2012). Exploring the positive and negative implications of facial feedback. *Emotion*, 12(4), 852-859.
21. Luo, J. (2018). The neural basis of and a common neural circuitry in different types of pro-social behavior. *Frontiers in Psychology*, 9(JUN), article number 859.
22. Method of neuromuscular relaxation of facial muscles. (2019). https://patents.google.com/patent/RU2705237C1/en?oq=RU2705237C1
23. Neta, M., Norris, C.J., Whalen, P.J. (2009). Corrugator muscle responses are associated with individual differences in positivity-negativity bias. *Emotion*, 9(5), 640-648.
24. Oberman, L.M., Winklelman, P., Ramachandran, V.S. (2007). Face to face: blocking facial mimicry can selectively impair recognition of emotional expressions. *Social Neuroscience*, 2(3-4), 167-178.
25. Orlova, O.R., Mingazova, L.R., Morenkova, A.E., Wayne, A.M. (2002). The phenomenology of facial pain. *Bulletin of Practical Neurology*, 5, 21-22.
26. Sessle, B.J. (2014). *Neural basis of oral and facial function*. Amsterdam: Elsevier Inc.
27. Söderkvist, S., Ohlén, K., Dimberg, U. (2018). How the experience of emotion is modulated by facial feedback. *Journal of Nonverbal Behavior*, 42(1), 129-151.
28. Wieckiewicz, M., Zietek, M., Smardz, J., Zenczak-Wieckiewicz, D. (2017). Mental status as a common factor for masticatory muscle pain: a systematic review. *Frontiers in Psychology*, 8(May), article number 646.