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## COMPLETE REHABILITATION OF ORTHODONTIC PATIENTS AND PREVENTION OF RECURRENCES

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**Abstract.** Emotional instability of children leads to the development of oral habits or adaptive type of swallowing. They are ways of adaptation to existing chronic stress. Oral habits play an important role in the appearance of number of orthodontic anomalies of the occlusion or worsen the conditions of treatment of such a patient.

**The purpose of the study.** Improving the effectiveness of the complex treatment of maxillomandibular anomalies among the patients with pathological occlusion, with primary swallowing and oral habits is important. Only an etiological approach to such clinical cases gives the desired result.

**Materials and methods.** The article is based on a clinical and laboratory study conducted among patients aged 12-15 years who have oral habits (sucking fingers or other objects, breathing through the mouth, resting the head on the hands, sleeping in an uncomfortable position, having a primary swallowing). 15 people of the comparison group without maxillomandibular anomalies, oral habits, with normal swallowing and 60 patients with acquired maxillomandibular anomalies were examined. An important point of the clinical examination was the external oral examination with determination of the way of swallowing and breathing, determination of the condition of the TMJ. The patients were given the STAI testify, a secret questionnaire in order to identify stress factors that affect the body, and the relationship between the presence of a stress factor and the appearance of changes in the maxillofacial area was studied. We studied and analyzed the data of computed tomograms of 60 patients with acquired maxillomandibular anomalies, deformities, 15 tomograms of persons of the norm group. X-ray methods included examination of the patient on a spiral computed tomography scan TOSHIBA Aquilion PRIME 160-slices MODEL TSX-302A / 1C. The scan was performed according to a specially developed protocol. The results of the cephalometric study before and after the treatment were evaluated, and they were compared with the results of the clinical examination.

**Results.** The obtained results of the STAI testify to the state of chronic tension of patients, a feeling of emotional relief during the period of using an oral habit. The results of the examination and photo report confirm pronounced changes in the symmetry and proportionality of the face, where there is an oral habit. Patients had complex treatment with non-removable Appliance (Hyrex, MARPE), braces systems in combination with myogymnastics.

If there was a primary swallowing or hidden mouth breathing, the treatment began with labial therapy with FroggyMouth Appliance (France). The results of a cephalometric study confirm the presence of an acquired rather than a congenital deformation of the facial skeleton. Adaptive changes on the part of the maxillomandibular and the muscular system indicate the long-term effect of oral habits on the maxillofacial area and confirm the existence of a functional facial matrix.

**Conclusions.** Constant systematic struggle with oral habits and atypical swallowing in the complex treatment of patients with maxillomandibular anomalies is an important and necessary stage. Only elimination effect of the etiological factor can prevent a relapse of a disease. The long-term results of the treatment indicate that after the treatment, the clinical and cephalometric characteristics of the maxillomandibular bones and the muscular apparatus normalize in patients.

**Keywords:** Oral Habits, Cephalometry, Myofunctional Appliance, Labiotherapy, Stress.

**Introduction.** Children live in the conditions of war in Ukraine amid air alarms, constant fear and insecurity. Orthodontists work with such children in modern conditions. Often these are children who had to leave their usual way of life, their home. They had to change the clinic where orthodontic treatment was begun. Everything was changed in one day. Patients usually find it difficult to adapt to new conditions. And some of our patients were forced to leave Ukraine because of the war in the country. Most of them finish treatment in clinics of other countries

according to our treatment plan. I am sincerely grateful to the doctors. I am also grateful to those orthodontists who stayed to work close to the front line and help our patients who defend Ukraine in the ranks of the Armed Forces of Ukraine. However, even the ideal cooperation of clinics and orthodontists did not allow young patients to stay away from social stress. There is no doubt that life, which is filled with a large number of acute and chronic stressors, affects both the quality of life of patients [22, 23, 25], as well as the effectiveness of orthodontic treatment. A

number of studies suggest that there is a complex systemic relationship between stress and the development of pathological conditions in the human body [6, 15]. Emotional instability of children leads to the development of oral habits [8, 21] or adaptive type of swallowing [3]. The orthodontist needs to study in detail the patient's life history, the presence of conditions that will prevent the effective full rehabilitation of the orthodontic patient [11] and help minimize their impact on the quality of treatment in order to prevent relapses.

**Research rationale.** Stress and an increased level of anxiety is becoming an increasingly global problem, especially among children, because it negatively affects their lives and health, the progression of the development of oral habits and the development of relapses [13, 18]. Scientists believe that oral habits are an element of adaptation to existing chronic stress [12, 14, 20]. Oral habits play an important role in the appearance of number of orthodontic anomalies of the occlusion or worsen the conditions of treatment of such a patient. Parents often neglect this and do not notice oral habits and do not seek timely help.

According to the classification of P.V.Okushko oral habits that cause maxillomandibular anomalies are divided into 3 groups:

I. Sucking habits (recorded motor reactions). There are habits of sucking fingers; habits of sucking and biting lips, cheeks, objects; habits of sucking and biting the tongue.

II. Anomalies of functions (improper functioning of functions recorded). There are violation of chewing function; improper swallowing and the habit of pressing the tongue on the teeth; mouth breathing; incorrect language articulation.

III. Recorded extratonic reflexes, which determine the incorrect position of body parts at rest. There are incorrect body posture and posture disorders; incorrect position of the lower jaw and tongue at rest [12]. Oral habits (mouth breathing) negatively affects the formation of the facial skeleton and the formation of the bite in children, is the main reason for the formation of an open bite and clockwise rotation of the lower jaw [7], is considered a potential cause of growth retardation in the face of children [2] and the appearance of cardiovascular pathology at an early age [17]. Often, this oral habit is reflected in the condition of the lips in children [3, 13]. It indicates a violation on the part of the circular muscle of the mouth and the predominance of the facial nerve, not the trigeminal nerve, in swallowing. Unfortunately, we increasingly diagnose an atypical act of swallowing (primary swallowing) in patients older than 4 years. This indicates the formation of a number of pathologies. We believe that the psycho-emotional state of our patients prevents the formation of a normal swallowing. We are to remember that most of our skills and knowledge are acquired [9]. This is the result of the activity of the nervous system [10]. It is in the long-term memory that our skills are stored [1]. Synaptic connections are important for the formation of new skills. A person develops them during life or at certain stages of it. According to a number of studies, the synapse is the point of contact between 2 neurons. It has the ability to dynamically change functional efficiency and connectivity in response to spatially and temporally specific patterns of neuronal activity. This plasticity of the synapse is indispensable for the function of learning and memory. Several lines

of evidence indicate that postsynaptic regulation of AMPA-type glutamate receptors (AMPA-R) is critical for synaptic plasticity. Synaptic plasticity can be long-lasting if local synaptic modifications interact with activity-dependent newly synthesized plasticity-related molecules in the neuronal cell body [19]. The magnitude of synaptic transmission is a reflection of the strength of these synaptic connections, which in turn can be modified by the frequency with which synapses are fired, by the arrival of stimuli from other neurons in the appropriate time window, and by neurotrophic factors and neuromodulators. The ability of synapses to undergo long-lasting biochemical and morphological changes in response to these types of stimuli and neuromodulators is known as synaptic plasticity. There is the relationship between any form of synaptic plasticity and a particular type of memory. RNA metabolism, particularly the control of translation at or near the synapse, is one of the processes that controls long-term synaptic plasticity and, consequently, several types of memory formation and consolidation [17]. French scientists used these processes to switch the action of the facial nerve to the action of the trigeminal nerve in the act of swallowing and set up a new synaptic connection. FroggyMouth Appliance developed by Fellus Patrick is a revolutionary Appliance that affects the changes in nerve impulses and the reorganization of the activity of the nervous system and the normalization of swallowing [4]. In orthodontic practice, there are various appliances for working with such oral habits as sucking fingers, lips, cheeks, and objects. Among them, the individual vestibular plate (shield) according to Schoncher, Kerbitz; the vestibular plate with an opening according to Betelman, the vestibulo-oral plate according to Kraus. They are used to eliminate tongue sucking or primary swallowing. The apparatus with Rudolph loops is used to eliminate the oral habit of sucking or sticking the tongue between the dental raw and primary swallowing. The lip balancer is used to train the orbicularis oculi muscle. The Friel's disk and the Dass's activator also are used to train the orbicularis oculi muscle. All of the listed devices are designed to eliminate bad habits and rebuild impaired functions. The normalization of the bite occurs, if there were no drastic changes, in the jaws, muscles of this area and in the TMJ [12]. However, the listed appliances are bulky and children do not want to use them. FroggyMouth Appliance is very different. It is small in size, requires the child to use it actively for 15 minutes a day, often parents turn this time into a game while watching some video [3].

**The purpose of the study:** improvement of complex treatment of patients with maxillomandibular anomalies against the background of oral habits and prevention of relapses after the active stage of treatment.

**Materials and methods.** The clinical and laboratory study was conducted among patients aged 12-15 years who have oral habits (sucking fingers or other objects, breathing through the mouth, resting the head on the hands, sleeping in an uncomfortable position, having a primary swallowing). 15 people of the comparison group without maxillomandibular anomalies, oral habits, with normal swallowing and 60 patients with acquired maxillomandibular anomalies were examined. An important point of the clinical examination was the external oral examination with determination of the way of swallowing and breathing, determination of the condition of the TMJ. To

detect primary swallowing in orthodontic patients, a clinical examination was performed, proposed by the team of Prof. P. Fellick [4].

Scheme of diagnosis of swallowing type:

1. the patient swallows saliva in the usual position as usual;

2. then we ask him to put his little finger in the area of the corner of the mouth between the teeth and the inner surface of the cheek in order to slightly pull back the corner of the mouth without excessive force and ask the patient to swallow saliva again.

The second swallow will be more natural for the patient. If the patient swallows without contraction of the muscles in the labial-mental area, there are no disturbances in speech and swallowing. Dysfunction will be quickly detected at the first exercise by contraction of the labio-mental muscles. In the second exercise, we will see the movement of the patient's finger after the contraction of the m.buccinator.

The criteria for determining atypical swallowing are detected lip and chin muscle tension, determination of the position of the arches and the presence of speech dysfunction. There are 3 life stages of such patients:

0 stage - a patient who has not undergone rehabilitation;

Stage 1 - the patient has programmed secondary swallowing, but has not yet automated it;

Stage 2 - the patient programmed and automated secondary swallowing.

It should be remembered that primary swallowing is the norm until the 4 years of the child. A patient with such dysfunction that is over the age of 4 years needs to undergo rehabilitation.

All patients were tested for nasal breathing (functional breathing test), since nasal breathing is necessary for the formation of the volume of the maxilla.

We studied and analyzed the data of computed tomograms of 60 patients with acquired maxillomandibular anomalies, deformities, 15 tomograms of persons of the norm group. X-ray methods included examination of the patient on a spiral computed tomography scan TOSHIBA Aquilion PRIME 160-slices MODEL TSX-302A / 1C. The scan was performed according to a specially developed protocol. During the scan, the position of the jaws in the bite and the head remains stable in order to reduce the risk of artifacts. The reconstruction algorithm at the time of the study was set as "bone" or "high resolution". The matrix extension was 512x512. The scan range included the facial and cerebral skulls. The thickness of the slice during the scan was 3-5 mm, the step in the reconstruction of the slice was 1 mm. All sections matched the anatomical area, had the same proportions and sizes and were scanned at the same table height. The scan was performed in one direction. After the study, archival data were stored in Dikom format.

The main method of examination is stereotopometric analysis (three-dimensional cephalometry), which studies the relationship of the structures of the head and face relative to three mutually perpendicular planes. Three-dimensional cephalometric analysis was performed on computer reconstructions in SimPlant Pro 11.04 software. We used a modified method of cephalometric and stereotopometric analysis for research [16].

Statistical processing of the results was performed using a personal computer using the software package Statistica 12.0. Data distribution was assessed using the Kolmogorov-Smirnov test of normality. Mean values and standard errors were calculated for continuous variables. Correlation between parameters was analyzed using Spearman's correlation coefficient and tested for significance. Significance was set at  $p < 0.05$ .

The patients were given a STAI (State-Trait-Anxiety-Inventory) test that shows that shows the level of an anxiety state secret questionnaire in order to identify stress factors that affect the body, and the relationship between the presence of a stress factor and the appearance of changes in the maxillofacial area was studied.

**Research results and their discussion.** The STAI (State-Trait-Anxiety-Inventory) showed that all children have an anxiety state of more than 45 points. It indicates a high level of anxiety. The results of the examination showed that 59 children (98.3%) live in a state of chronic stress; 51 people (85.0%) believe that they are constantly in a state of social stress for more than 1 year, which is caused by new living conditions during the war in Ukraine, the fear of staying without home and family; 29 patients (48.3%) indicate psychological problems in the family and forced change of residence, frequent changes between periods of live communication and distance learning conditions.

96.6% of the examined (58 people) have oral habits: supporting the head with hands - 33 people (55.0%); sitting behind the monitor with an open mouth - 3 patients (5.0%); 5 interviewees (8.3%) – biting the lip more than 5 times a day; holding fingers, pencils in the oral cavity - 4 people (6.6%), 13 people (21.7%) putting hands under the head during sleep and/or not sleeping on orthopedic pillows.

On the patient's words the patients attributed the progression of the habit to constant quarantine, martial law and online training. We believe that the presence of chronic social stress stimulates the development of oral habits, and their use causes the patient to feel relief and peace.

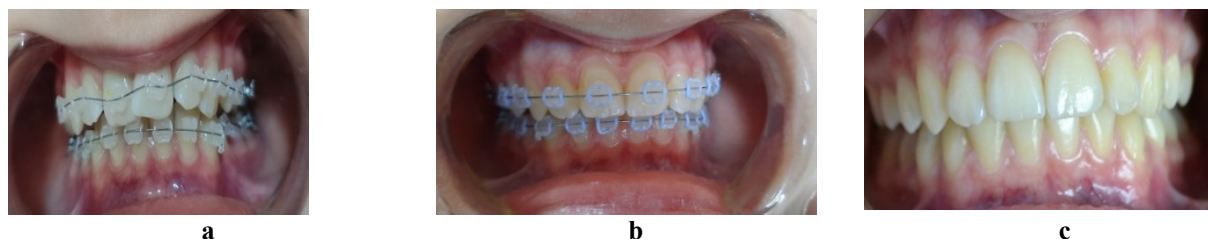
During the functional breathing test, 22 children (36.7%) had nasal breathing disorders and were referred for consultation to the otolaryngologist. According to the results of the clinical examination, an atypical swallowing (primary swallowing) was detected in 29 patients (48.3%). 26 patients (53.3%) were diagnosed with muscle hypertonus of musculus obicularis oris. In patients with hypertension, the tooth rows were narrowed and shortened.

Such a pathological condition is one of the etiological factors in the development of maxillomandibular anomalies, in particular, crowding of teeth in the frontal area of the jaws. Hypotonia of the circular muscle of the mouth was diagnosed in 3 people (5.0%). Hypotension is one of the etiological factors in the development of medial occlusion. Myogymnastics and myofunctional appliances are recommended to correct the pathological condition in this category of patients. All patients had cephalometric examination in order to establish the type of deformity and to confirm that the deformity is an acquired and not a congenital pathology [16]. All patients showed no changes in the base of the skull, which indicates the presence of an acquired deformity. The results of our research are confirmed by other scientific works [17].

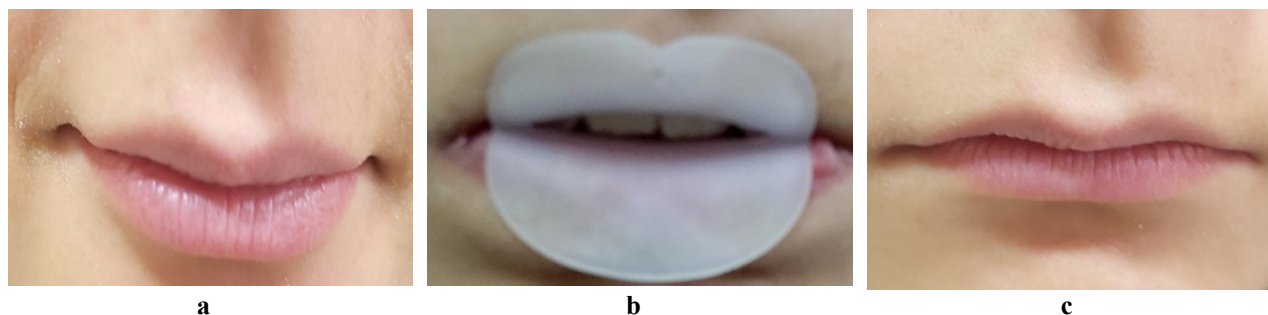


Patients with swallowing disorders and/or hidden mouth breathing underwent labial therapy for 10 weeks in complex treatment. Among them were 29 patients. After 5 weeks of active labial therapy, 62.1% (18/29) of patients remained at "stage 0". 31.0% (9/29) of patients achieved automated swallowing skills and passed to "stage 2", 6.9% (2/329) of patients passed to "stage 1". After 10 weeks, 17.2% (5/29) of patients were still in "stage 0"; 72.5% (21/29) - achieved automated swallowing skills and passed to "stage 2"; 10.3% (3/29) - moved to "stage 1". Only 17.2% (5/29) remained at "stage 0" after 10 weeks. The results obtained by us correlate with the results of other

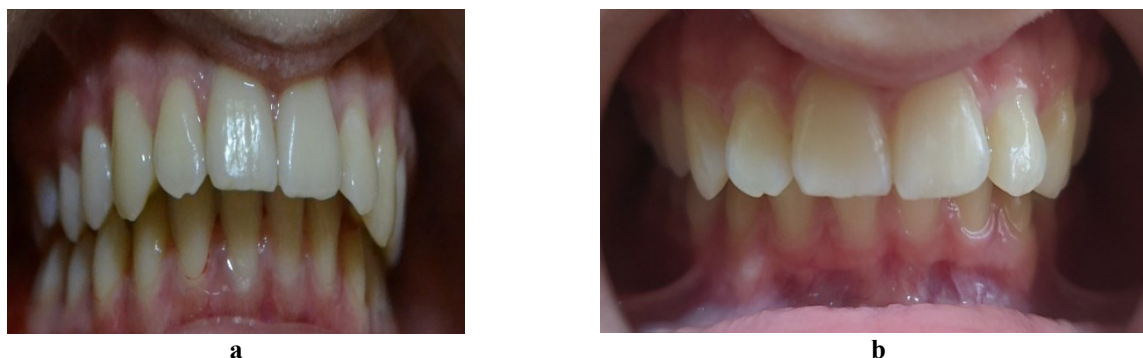
scientists [21]. According to a number of studies, relapses of the disease often occur in orthodontic practice. Little RM, Riedel RA, Artun J. indicate that relapses occur in 90.0% of cases [13]. Scientists emphasize that such problems arise precisely because of the failure to eliminate the etiological factor [2, 3, 4]. There were also relapses among our patients. They were found in cases where it was difficult to achieve a normal type of swallowing 6.9% (2/29). Such patients additionally underwent a course of breathing exercises and work with a psychologist. The desired result was achieved up to 6 months (Fig. 1-3).



**Fig. 1 Patient K. 12 years old with acquired maxillomandibular deformity against the background of oral habits (atypical swallowing). The patient failed to develop a normal swallowing:**  
a – before treatment; b – at the stage of active treatment; c- after treatment.



**Fig. 2. The condition of the lips during the act of swallowing:**  
a-before treatment (tension of the circular muscle of the mouth);  
b- with the FroggyMouth device superimposed;  
c- 6 months after the start of treatment (absence of circular mouth muscle activity during swallowing)



**Fig.3 Patient K., 14 years old with relapse acquired maxillomandibular deformity:**  
a- relapse of the disease 12 months after the removal of the brace system;  
b- after 6 months of working with FroggyMouth Appliance.

We associate relapses with the psycho-emotional state of patients living in Ukraine during the war. At the beginning of active treatment with the bracket system, patient K. underwent labial therapy with the FroggyMouth Appliance and reached "stage 1", but did not go to "stage 2", which did not develop a normal type of swallowing. We believe that this very moment is the reason for the relapse. We recommend that you definitely eliminate bad

habits of patients, because they are an obstacle to the effectiveness of orthodontic treatment. The results of our study correlate with the indicators of other scientists [2, 4]. The results of a cephalometric study confirm the presence of an acquired rather than a congenital deformation of the facial skeleton. Adaptive changes on the part of the jaw bones and the muscular system indicate the long-term

effect of oral habits on the maxillofacial area and confirm the existence of a functional matrix of the face [5, 16].

Constant systematic struggle with oral habits and atypical swallowing in the complex treatment of patients with maxillomandibular anomalies is an important and necessary stage. Only the elimination effect of the etiological factor can relapse be prevented [15, 20].

**Conclusions.** The STAI showed that all children have an anxiety state of more than 45 points. They had the state of chronic tension. Patients felt of emotional relief during the period of using an oral habit. 29 patients (48.3%). 26 patients (53.3%) were diagnosed with muscle hypertonus of musculus obicularis oris. The results of the examination and photo report confirm pronounced changes in the symmetry and proportionality of the face, where there is a bad habit. Patients had complex treatment with non-removable Appliance (Hyrex, MARPE), braces systems in combination with myogymnastics. If there was a primary swallowing or hidden mouth breathing, the treatment began with labial therapy with FroggyMouth Appliance (France). The results of clinical examination showed affectivity of FroggyMouth Appliance in complex treatment of patients maxillomandibular anomalies. The results of a cephalometric study confirm the presence of an acquired rather than a congenital deformation of the facial skeleton. Adaptive changes on the part of the maxillo-mandibular and the muscular system indicate the long-term effect of oral habits on the maxillofacial area and confirm the existence of a functional facial matrix. Constant systematic struggle with oral habits and atypical swallowing in the complex treatment of patients with maxillo-mandibular anomalies is an important and necessary stage. Only elimination effect of the etiological factor can prevent a relapse of a disease. The long-term results of the treatment indicate that after the treatment, the clinical and cephalometric characteristics of the maxillomandibular bones and the muscular apparatus normalize in patients.

**Prospects for further research.** Patients will be re-examined after the chronic stressor has been eliminated.

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**ПОВНА РЕАБІЛІТАЦІЯ ОРТОДОНТИЧНИХ ПАЦІЄНТІВ ТА ПОПЕРЕДЖЕННЯ РЕЦИДИВІВ**Н.П. Махлинець<sup>1</sup>, З.Р. Ожоган<sup>2</sup>, А.В.Пантус<sup>3</sup>,  
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**Резюме.** Емоційна нестабільність у дітей призводить до розвитку шкідливих звичок та адаптивного акту ковтання.

**Мета дослідження.** Підвищення ефективності комплексного лікування пацієнтів із зубощелепними аномаліями на фоні шкідливих звичок.

**Матеріали та методи.** Обстежено 15 осіб групи порівняння без зубощелепних аномалій, шкідливих звичок, нормальним способом ковтання та 60 пацієнтів із набутими зубощелепними аномаліями та шкідливими звичками віком 12-15 років. Визначали спосіб ковтання та дихання, стан

скронево-нижньощелепових суглобів. Проводили таємне анкетування з метою виявлення стресових чинників, вивчали залежність між наявністю стресового фактора та появою змін у щелепно-лицевій ділянці. Оцінювали результати цефалометричного дослідження до лікування та після проведеного лікування, порівнювали їх з результатами клінічного обстеження.

**Результати дослідження.** Результати таємного анкетування свідчать про стан хронічного напруження учнів, відчуття емоційного полегшення у період застосування шкідливої звички. Результати обстеження та фотопротоколу підтверджують виражені зміни в симетричності та пропорційності обличчя, де наявна шкідлива звичка. Пацієнтам проводили комплексне лікування незнімними піднебінними конструкціями, брекет-системами у поєднанні з міогімнастикою та лабіальною терапією. Результати цефалометричного дослідження підтверджують наявність набутої, а не вродженої деформації лицевого скелету. Адаптивні зміни зі сторони щелепових кісток та м'язової системи вказуються на тривалу дію шкідливих звичок на щелепно-лицеву ділянку та підтверджують існування функціональної матриці обличчя.

**Висновки.** Постійна систематична боротьба зі шкідливими звичками та атиповим актом ковтання у комплексному лікуванні пацієнтів із зубощелепними аномаліями є важливим і необхідним етапом, оскільки тільки усунувши дію етіологічного чинника вдається попередити рецидив. Після проведеного лікування у пацієнтів нормалізуються клінічні, цефалометричні характеристики щелепових кісток та м'язового апарату.

**Ключові слова:** шкідливі звички, цефалометрія, міофункціональні апарати, лабіотерапія, стрес.

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