

THE MINISTRY OF HEALTH OF UKRAINE
THE HIGHER STATE EDUCATIONAL INSTITUTION OF UKRAINE
"UKRAINIAN MEDICAL STOMATOLOGICAL ACADEMY"

Approved
at the meeting of orthodontics department
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protocol №____ by _____
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METHODICAL RECOMMENDATION
for independent work of students during the preparation
to practical lessons and on the lessons

Academic discipline	Orthodontics
Module № 1	Orthodontia. Diagnostic of dentognathic anomalies and deformations.
The theme of the lesson № 9	Research methods of speech function. Palatography methods: direct and indirect. Features of articulation zones in normal and abnormal occlusion. Especially types of swallowing, their characteristics.
Course	III
Faculty	Preparation of foreign students

1. The relevance of the topic. Knowledge of the functional state of denta-jaw area - one of the components of a stable outcome of orthodontic treatment. Removing of swallowing and speech functional disorders is a long and complicated process. Thus, knowledge of the diagnosis of these functions is essential for successful orthodontic treatment.

2. Specific objectives:

To be able to characterize the speech and swallowing function.

To know methods of studying the speech and swallowing function state.

To know method of speech and swallowing function examination in patients with malocclusion.

To know the features of articulation zones in normal and abnormal occlusion.

3. Basic knowledge's, abilities, skills necessary for studying the topic (interdisciplinary integration)

Name of previous disciplines	Skills
1. Anatomy	to determine the deviation from the normal structure and function of the facial bones and muscles; to determine the pathological changes of hard tissues of teeth and periodontal tissues.
2. Normal physiology	to know physiological essence of speech and swallowing, the development of speech, the second signal system, forms of speech activity; to know the physiological bases of speech and swallowing.

4. Tasks for independent work during preparation to the lesson and on the lesson

4.1. A list of the main terms, parameters, characteristics that need to learn by the student during the preparation to the lesson:

Terms	Definition
1. Infantile type	Characterized by paving the tongue between the toothless jaws (as far as the lip) at the time of swallowing.
2. Somatic type	Appears from 2-3 years, the tongue apex rests against the hard palate.
3. Palatography	A record of the movement of the tongue in the articulation of sounds, or during the swallowing.
4. Lingvodinamometry	Definition of oral muscular pressure of the tongue on the dentition with the help of special instruments.
5. Dyslalia	Is a violation of sound reproduction in normal hearing and a preserved innervation of the articulatory apparatus.

4.2. Theoretical questions to the lesson:

1. The infantile type of swallowing. The reasons for this pathology.
2. The somatic type of swallowing, the physiological age of its formation.
3. The phases of the act of swallowing, conditions of their violation.
4. The aim of electromyography as an auxiliary method of investigating the act of swallowing.
5. Frankel's functional test, its technique.
6. Lingvodynamometry, its technique.
7. From what age is the somatic type of swallowing established?
8. On what conditions is the functional swallowing test based?
9. Palatography, methods of conducting it, results evaluation.
10. Comparative analysis of conducting direct and indirect palatography.
11. Palatogram types and their interrelation with dentognathic apparatus anomalies.
12. Peculiarities of pronouncing separate sounds connected with the anomalies of the attachment of the soft tissues of the oral cavity.
13. When does speech formation take place in children?
14. At what diseases does the speech violation in the form of rhinolalia take place?
15. The technique of conducting photopalatography.
16. Peculiarities of conducting phonography.
17. How to conduct the estimation of palatogram results by direct method?
18. How to conduct the estimation of palatogram results by indirect method?
19. Indicate the reasons for irregular pronunciation of vowels.

4.3. Practical works (task) which are executed at the lesson:

- to conduct the palatography, EMG for patient with speech and swallowing disorders;
- to decode the palatograms and EMG results of patient with speech and swallowing disorders at different types of malocclusion.

The content of the topic:

Methods of investigating the swallowing function.

The infantile type of swallowing is observed from birth till 2–3 years. In this period a child does not chew, but sucks, therefore during swallowing the tongue pushes off from the closed lips. With age the act of swallowing improves.

The somatic type of swallowing normally appears at the age of 2.5–3 years, that is after the establishment of milk teeth in occlusion. In this period a child switches from sucking to chewing, so during swallowing the tongue pushes off from the closed dental arches and palatine vault. Swallowing provides transfer of the bolus from the oral cavity through the esophagus to the stomach.

The act of swallowing may be divided into three phases:

- 1) involuntary and conscious, when food is brought to the fauces;

2) weakly conscious, in which it is possible to return the bolus to the oral cavity;

3) involuntary, when food goes through the upper part of the esophagus and is directed to the stomach.

If the infantile type of swallowing is preserved, as a result of the irregular position of the tongue and lips the dentoalveolar arches are deformed and occlusion formation is violated. The position of the tongue, lips, cheeks, hyoid bone is studied in different phases of swallowing. The basic method of static evaluation is the lateral teleroentgenography of head, which shows hypertrophic adenoids and palatine tonsils, which promote the front position of the tongue, faulty articulation of its tip with surrounding tissues and organs, which causes the violation of swallowing function.

Morphologic abnormalities in the structure and location of hard and soft tissues of the craniofacial area allow judging about functional disorders of the perioral and intraoral muscles, located in the oral cavity.

At the teleroentgenocinematographic study of tongue position during swallowing its back is covered with a contrast substance. When viewing the film, using the freeze frame, on the lateral teleroentgenogram of head the distance between different parts of the tongue and hard palate in different physiological states (rest, swallowing) is measured. Seven measurements are conducted by graphic methods offered by T. Rakosi in 1964. A graph of tongue position is drawn on the basis of the obtained results.

The functional swallowing test is based on the studying of the patient's ability to swallow a bolus or liquid during a certain period of time involuntarily or at command. At normal swallowing the lips and teeth are closed, the facial muscles are not tense, sublingual muscles peristalsis is observed. Normal swallowing takes 0.2–0.5 seconds (fluid food – 0.2 s, solid food – 0.5 s). During irregular swallowing the teeth are not closed, the tongue contacts with the lips and cheeks. It can be seen by means of shoving the lips quickly with the help of fingers. At hindered swallowing there arises mimic muscles compensatory tension in the region of the mouth angles and chin, sometimes the eyelids shiver and close, the neck straightens up. Characteristic tension of the mimic muscles is noticeable – small recesses on skin in the region of muscle angles and chin (thimble symptom), suction of the lips, cheeks, not infrequently a push of the apex of tongue and further protruding of the lips can be seen.

The clinical functional test of Frankel is intended for detecting the violation of the back of tongue position and the changes of its location in the process of orthodontic treatment and at checking the acquired and remote results. The test is conducted with specially cambered loops. They are made of wire, burnt over blowpipe fire, 0.8 mm in diameter. To set the back of tongue in the front part of the palate a smaller loop is made, in the back part – a bigger one.

Wire loops are cambered and attached to the model of the upper jaw. When making a smaller loop its round part is located along the middle part of the palate at the level of the 1st premolars, the bigger loop - at the level of the 1st molars. The

ends of the wire are twisted, and the twisted wire is placed repeating the contour of the alveolar process clivus. Then it is taken out into the vestibule of mouth between the 1st premolar and the canine tooth. The device is tried on in the oral cavity, the end is taken out of the mouth in the area of its angle, a handle is bent parallel to the occlusive surface of dental arches in such a way that its anterior end is half as long as the posterior one. After introducing the finished wire loop into the oral cavity the patient is asked to sit still and attend to the handle not touching the soft tissues of the face; its position is registered before and after swallowing saliva. The change of handle position allows judging about the degree of the back of tongue touching the hard palate, or the absence of skills of lifting it. The success of orthodontic treatment and achieving of its stable results considerably depend on the normalization of the position of the back of tongue.

The experiments conducted by F. Falk in 1975 prove the necessity of multiple carrying out of such clinical tests in the process of treating full-blown dentognathic anomalies. The data testifying to the state of the tongue serve an indicator of the time of possible treatment ending with the hope for the durability of the obtained results.

Lingvodynamometry is the detection of tongue muscle pressure inside the oral cavity on dental arches with the help of special devices. During swallowing the force of tongue pressure on dental arches according to Winders is variable: on the frontal teeth – 41-709 gr/cm², on the hard palate – 37-240 gr/cm², on the 1st molars – 264 gr/cm². Tongue pressure on the surrounding tissues at command is twice as much as at voluntary swallowing. The form of the palatine vault depends on the distribution of tongue pressure on it.

Electromyography allows finding the participation of the mimic and mastication muscles in the act of swallowing. Normally the amplitude of biopotentials waves at the contraction of the orbicular muscle of mouth is insignificant, and at the contraction of the mastication muscles proper – significant. At irregular swallowing a reverse picture is observed. There have been attempts of the electromyographic examination of the tongue during swallowing (M.P. Kozhokur, 1973). Masticatiography, myography, myotonometry and other methods are also used to study swallowing.

Methods of investigating the speech function

Speech establishes in the process of growth and formation of the child's organism. Dentognathic anomalies and deformations often lead to irregular articulation of the tongue, but sounds articulation is not always violated: almost 30 % of such children speak correctly (L.D. Subtelny, 1962). Speech violations – lispings, rhinolalia – are observed in children with congenital palate nonunion (cleft palate), and also with through uni- and bilateral nonunion of lip, alveolar process, and palate.

Palatography is the registration of the place of the tongue contacting the palate during pronunciation of different sounds. Palatography is conducted by direct and indirect methods. Using the direct method talc is placed on the tongue, thus its impressions are on the palate. Using the indirect method an artificial palate

is employed, which is made by the model of the upper jaw of different materials: plastic, wax, celluloid. The surface of the plate turned to the tongue is covered with black lacquer or dusted with indifferent powder (for example, with talc, but not with powdered sugar which might cause hypersalivation), inserted into the mouth cavity of the observed patient and pressed to the palate. The patient pronounces the offered sound, leaving imprints. Further, the plate is taken out of the mouth and imprints are studied.

A palatogram is a result of experimental phonetic work. A thin dark plate is made, which bears against the palate of the observed patient. The patient pronounces the sound, the articulation of which is examined; at that, the tongue touches corresponding areas of the palate. Then, the plate is carefully taken out of the mouth. Dark “licked off” areas on the plate indicate the areas of the tongue contacting the palate. The plate is photographed, articulation schemes (palatograms) are drawn from the photograph.

The palatography technique has been known for a long time. According to S.K. Buhlych, the first imperfect attempts belong to English doctor Okley-Cols (1871).

In 1887 N.V. Kingsley introduced an artificial palate made of caoutchouc for stomatological observation. Later different authors replaced the material of the artificial palate with copper, caoutchouc, plastic, celluloid; the principle of using it remained unchanged.

We used a celluloid plate to make an artificial palate.

Meanwhile it is known that the form of the so-called passive organ at normal speech production, and also at inserting artificial dentures, obturators, orthodontic appliances (also passive speech organs) changes, which influences the character of speech production. In some cases slight thickening or changes in the form of the dental arch (during prosthetics or because of deformation) sharply worsen the clearness of articulation.

Using available in the phonetic literature data of consonants palatograms, by means of palatography of patients with defective speech and dental arches deformations or defects it is easy to detect and eliminate the reason for the damage.

Photopalatography is getting photographs of the “artificial palate” from the obtained imprints of the tongue after palatography. For this purpose the “artificial palate” is placed on the model of the upper jaw. There is used the photostatic technique of shooting to reproduce identical images before the beginning of orthodontic treatment, in the process of it, after it finishes and after speech therapy. The scheme is copied onto the tracing paper on the negatoscope. Then, the schemes of identical palatograms are compared, and obtained results are analyzed.

In the reflex phase of digestion the nerve receptors, located in the craniofacial area, are very important. The work of the glandular apparatus of the mouth, stomach, and pancreas depends on alimentary substances and their influence on the nerve receptors of the oral cavity. The main function of the oral cavity is the act of mastication, which is one of the factors influencing the

processes of gastrointestinal digestion, providing its mechanical, chemical and reflex phases.

Speech violations in children may be caused by anatomico-physiological peculiarities of the organs of speech, hearing, the central nervous system, age deviations.

The dependence of articulation clearness on morphologic peculiarities and functional value of the dentognathic apparatus and palate form is not questioned.

Some authors believe that articulation system anomalies (occlusion deformations) is not an obstacle and speech can be corrected with the help of logopedics techniques only. This position is correct only concerning the role of the tongue in speech production, but, as N.A. Omelchenko denotes, “though the tongue is important in producing sounds it obviously does not play the leading role”.

Others suppose that the main role in producing sounds belongs to different parts of the oral cavity (the soft palate – West, Kennedy and others). Knobel denotes that in the etiology of the violated pronunciation of sibilants occlusion deformations and teeth position anomalies take a considerable place.

H.W. Jahn indicated that among 6-year-old children the habit of holding the tongue between the teeth is often observed – in approximately 10 % cases. In children, who have this bad habit, the pronunciation of palatine consonants suffers, the lips and tongue might thicken.

F. Libman names destroyed frontal teeth, diastems presence, occlusion anomalies, and also short or deformed with cicatricial bands upper lip among the reasons for incorrect sounds pronunciation.

A. Sakharov points that “not infrequently irregularities accompanying the formation of separate phonemes depend on hearing impairment caused by complications after suffering from infectious diseases in childhood”.

The oral cavity plays an important role, and the tongue, in its turn, is the principal organ in producing speech. There is a great difference between phonation and mastication: though mastication muscles take part in both processes, sounds production takes place without any pressure from them.

Incorrect pronunciation of vowels may be caused by irregular movements of the tongue, occlusion anomalies, short frenulum of tongue, hearing impairment, etc.

It is possible to detect the presence of sounds pronunciation violation by means of listening to the child, though for that the skills and knowledge of articulation peculiarities are needed as well as taking into account voice changes in the pubertal period in boys and girls etc.

Slight deviations in pronunciation may be inconspicuous in ordinary communication for one’s associates, but a specialist with trained hearing can easily detect them.

The reasons for violations may be both functional and organic disturbances. The purity of sibilants pronunciation depends on the state of teeth, their presence, occlusion anomalies, etc.

Sometimes irregular pronunciation may be caused by incorrect position of the tongue – the tip of the tongue is situated between the teeth.

Phonography is the recording of words and sounds on the oscillograph, although the pronunciation of one and the same sound by different persons, men and women, gives different images on the oscillograph.

	НПА	МЮП	ЛГБ	МІБ	ВАБ	КВП	МГБ	АБШ	АГБ
Т									
Т'									
С									
Ш									
Р									
Л									
З									
К									
К'									
Х									

Palatograms of Ukrainian consonant sounds with individual peculiarities

Materials for self-control:

A. Tasks for self-control (tables, diagrams, drawings, graphs):

- to draw the palatograms of some Ukrainian sounds in norm;

- to draw the palatograms of some Ukrainian sounds for patient with malocclusion.

B. Tasks for self-control:

1. Patient S., 11 years old held indirect palatography. By carrying out this research study impressions:
on the painted artificial palate
on the palate and tongue
on the artificial palate
on the tongue
on the palate

2. In the kinder garden identified a child with speech disorders in the twang form.

At what diseases there is speech violation can be:

palate cleft defect
the periodontal tissues disease
pain in the temporo-mandibular joint
the absence of teeth
ENT diseases

3. Etiological factor of interdental stigmatism can be:

open bite
deep bite
cross-bite
small tongue
upper lip frenulum low attachment

4. The patient P. 12 years old by a physician speech therapist assigned to record sounds and words. What method of research with this purpose used:

phonography
palatography
X-rays
electromyography
photometry

5. The patient S., 10 years assigned functional Frenkel test. What violations we can to detect by this study:

the tongue position
the lips position
the cheeks state
the soft palate position
the masseter muscles

6. After conducting of clinical functional tests with a drink of water for the 7 years old patient the "thimble" symptom was determined. What is the evidence:

- infantile swallowing
- somatic swallowing
- mouth breathing
- hypertone in the masticatory muscles
- hypertone temporalis muscle

7. What age does infantile type of swallowing should be transformed into somatic:

- 3 year
- 5 years
- 2 years
- 6 years
- 9 years

8. To define functional disorders of the 15 years old patient O., was appointed linguodinamometry. This method of study allows to determine:

- tongue pressure in the middle of the oral cavity
- participation in swallowing of facial muscles
- the tone of the circumoral muscle
- the tongue position in the oral cavity
- the patient's ability to swallow food lump

9. To what age the somatic type of swallowing is formed:

- 3 year
- 5 years
- 6 years
- 9 years
- 10 years

10. What method to record sounds and words is used:

- phonography
- palatography
- X-Rays
- electromyography
- photometry

11. At the infantile type of swallowing, the tongue pushes from:

- closed lips
- alveolar bone
- the hard palate
- the upper frontal teeth

the lower frontal teeth

12. Newborn at the same time can:

to suck, breathe, swallow

to swallow and say

to breath and swallow

to chew and swallow

to chew and breathe

13. Infantile type of swallowing is physiological for:

kids

adults

preschooler

student

elderly person

14. The transformation of infantile type of swallowing in somatic occurs during:

the eruption of milky incisors

erupting canines

the eruption of molars

the eruption of the premolars

the eruption of permanent incisors

15. The act of sucking consists of the following number of phases:

4

2

3

1

5

16. Sucking movements occur in:

II-III phases

phase II

phase III

I - II phases

phase IV

17. In 2 years of life the child has to say:

300-400 words

100-200 words

800-1000 words

8-50 words

50 - 100 words

18. The child has to make simple sentences at the age of:

2 years

1 year

3 years

4 years

5 years

19. The child has to make a long sentence at the age of:

3 years

1 year

2 years

4 years

5 years

20. Child needs to pronounce complex words and sentences at the age of:

5 years

1 year

2 years

4 years

3 years

21. Speech disorders are divided into:

functional and mechanical

impulsive, reflective

impressive, expressive

arbitrary, quick

unemotional, emotional

22. Speech disorders are accompanied by violation of processes in:

the speech areas of the brain or auditory perception

violations of the lips articulation

violation of the tongue articulation

violations of the soft palate

temporomandibular joint disorders

23. A mechanical speech disorders accompanied by violation of processes:

violation of the tongue articulation

auditory perception

speech areas of the brain

violations of social adaptation

mental defects

24. The period of active word creation is connected:

increase of vocabulary
number of erupted teeth
the phase of the height bite increasing
development of the tongue frenulum
development of the circumoral muscle

25. To determine the speech disorders needs to make:
speech tests
test with a drink of water
frenkel test
the test with the wool fibers
lip closing test

26. The speech tests is:
pronunciation of different sounds and sound combinations
test with a drink of water
test with a apex tongue control
test with a tongue control
lip closing test

27. The most active development of the speech notes:
from 2 to 5 years
from 1 to 2 years
from 5 to 6 years
from 6 to 7 years
from 7 to 8 years

28. Somatic type of swallowing is:
correct apex tongue position according to the frontal part of the hard palate
and palatal surfaces of the frontal teeth
correct TMG position
correct lower jaw position
correct and timely teeth eruption
tongue between the lateral teeth

29. Premature loss of the frontal milky teeth causes the next problem:
incorrect apex tongue position according to the frontal part of the hard palate
and palatal surfaces of the frontal teeth
TMG disorders
incorrect lower jaw position
mouth breathing
tongue between the lateral teeth

30. Premature loss of the frontal milky teeth causes the next problem:

incorrect apex tongue position according to the frontal part of the hard palate and palatal surfaces of the frontal teeth

TMG disorders

incorrect lower jaw position

mouth breathing

tongue between the lateral teeth

31. Infantile type of swallowing causes the next problem:

upper and lower frontal teeth protrusion

TMG disorders

incorrect lower jaw position

upper and lower frontal teeth protrusion

lateral teeth protrusion

32. Infantile type of swallowing causes the next problem:

open bite formation

deep bite formation

cross bite formation

deviation from the normal sizes of the teeth

lateral teeth deviation

33. One of the reason of the infantile type of swallowing formation can be:

shortened tongue frenum

shortened upper lip frenum

shortened lower lip frenum

shortened upper frontal teeth

shortened lower frontal teeth

34. One of the reason of the infantile type of swallowing formation can be:

Artificial feeding

TMG disorders

shortened lower lip frenum

shortened upper lateral teeth

shortened lower lateral teeth

35. One of the reason of the infantile type of swallowing formation can be:

tongue size disorders

TMG disorders

shortened lower lip frenum

shortened upper lateral teeth

shortened lower frontal teeth

Literature

Main:

1. Fleece P.S. "Orthodontics". - Kyiv, MEDICINE, 2008, - 139-147p.
2. Golovko N.V. et al. Orthodontics. Occlusion development, diagnostic of malocclusion, orthodontical diagnosis. Poltava,- 2008, - 95p.

Additional:

1. Pubmed. – Режим доступу: <http://www.ncbi.nlm.nih.gov/pubmed/>
2. Google Scholar – Режим доступу: <https://scholar.google.com.ua/>
3. BASE. – Режим доступу: <https://www.base-search.net/>
4. European Journal of Orthodontics. – Mode of access: <https://academic.oup.com/ejo>
5. Angle Orthodontist. – Mode of access: <http://www.angle.org/?code=angf-site>