

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

Approved
at the meeting of orthodontics department
«____»_____20____y.
protocol №____ by _____
Head of department_____ L.V. Smaglyuk

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 № 10	Methods of investigation of mastication function.
Course	III
Faculty	Preparation of foreign students

1. The relevance of the topic. The dental system as an integral part of the maxillofacial area consists of separate functional elements of different complexity. Dento-facial system functional element has teeth, their function mechanical processing of food through chewing.

2. Specific objectives:

To know the facial muscles and their function.

To know the function of each tooth and dividing them into groups.

To know the anatomical and physiological characteristics that contribute to chewing act.

To know the phases of chewing.

To know methods of research of function of mastication.

To know the definition of chewing force.

To know the definition of chewing efficiency.

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 state of the facial bones, teeth, muscles; to determine the pathological changes of hard tissues of teeth and periodontal tissues.
2. Prosthodontics	to navigate the materials used in the clinic of prosthodontics.

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. Mastication dynamometry	The physiological method of determining the strength of chewing.
2. Myotonometry	Consider the tone of the masticatory muscles under different conditions.
3. Electromyography	Recording of biopotentials of muscles, in order to study their physiological activity.
4. Arthrotomography	The method of auscultation of TMJ to identify in them the noise of the crunch and clatter, as well as

	differential diagnostics of functional and morphological disorders.
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4.2. Theoretical questions to the lesson:

1. Gnathodynamometry by Black and Tissenbaum.
2. Electrotensodynamometry by Tril, Vozniuk.
3. Electrotensodynamometry by Koniushko.
4. Peculiarities of conducting mastication tests by Chrisitiansen and Helman, their drawbacks.
5. Mastication test technique by Rubinov.
6. Masticatiography, its technique.
7. Myotonometry, the aim of conducting it, its technique.
8. Electromyography as a method of investigating the condition of the mastication apparatus, the peculiarities of conducting it.
9. To what values does mastication effectiveness equal by Oksman?
10. What teeth are to be taken into account to detect the mastication effectiveness by Ahapov and what does it equal?
11. What is the scheme of detecting the mastication effectiveness by Kurliandskyi based on?
12. What values are to be used to detect the state of teeth when preparing an odonto- parodontogram?
13. What is the reserve strength of tooth, methods of detecting it for odontopa- rodontogram?
14. Odontoparodontogram analysis, the ways of using its data.

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

- to determine chewing efficiency by Oxman;
- to determine chewing efficiency by Kurliandsky;
- to hold masticatiography, myotonometry;
- to decode the electromyography results.

The content of the topic:

Gnathodynamometry. A constructed mechanical gnathodynamometer with long beaks is pressed by the examined patient with his teeth. The force of pressing is detected in kilograms for every pair of opposing teeth. D.P. Koniushko charted a table of parodontium endurance to loads depending on the type of teeth. Except for mechanical gnathodynamometers, there have been offered a hydraulic one (A.T. Busyhin, M.R. Miller, 1958), an electronic (L.M. Perzashkevych, 1960), an electronic parodontodynamometer (D.P. Koniushko, 1950), a universal electronic dynamometer (V.Y. Kurliandskyi, 1970).

Valuable mastication function depends on many factors: dental arches integrity, occlusion character, parodontium condition, the degree of formation, resorption of roots, neuromuscular apparatus training, and also on the mental state of the patient.

Functional capacity of some teeth is detected depending on the form and size of their mastication surface, anatomical integrity, the number and height of tubercles, the number and size of roots, the structure of alveolar walls, the condition of the parodontium tissues, location of teeth in the dental arch and organism reactivity. The teeth of children of the same age have a certain physiologically individual limit of endurance. The physiological limit is not stable and changes depending on the condition of the parodontium tissues, and also of the whole organism.

To detect the degrees of functional disorders in children with dental arches defects there was studied parodontium endurance to the vertical loads of milk teeth in the process of root formation and resorption, and also of permanent teeth in the period of their functional formation in norm. S.I. Tril worked out a device, which allows, in contrast to others, measuring parodontium endurance of every single tooth.

The study of parodontium endurance to vertical loads was conducted with the help of the gnathotensodynamometer, which consists of a measuring tensogirder with two steel branches, located parallel to one another with a certain space and firmly connected with one another. The tips of steel branches end with a biting plane on one end and a biting gum shield on the other. Two strain gages, built up into a tensoscheme, are glued to each branch. For the convenience of biting the platforms are covered with changeable food rubber.

When loads are applied to the tensogirder mechanical deformation appears, which causes linear change of current in the resistive-strain sensors, glued to the tensogirder, i.e. the transformation of the mechanical deformation of the tensogirder is directly proportional to the current change in the measuring scheme of the resistive- strain sensor. As the obtained signal's value is very small (0–20 MV), it should be amplified. Transducer amplifier (ID-1) amplifies the obtained signal of the scheme to 2 volts, and it gets to the computer. Besides, there is a numerical scale in the device, which allows observing the obtained load in kilograms. The value of load in kilograms and time are registered on the chart strip. The computer allows registering, storing, deciphering, and outputting information in the form of graphs and calculation results. It is conducted in the following way. The resistive-strain sensor's branch is placed with its semicircle biting gum shield onto the jaw opposite the examined tooth, and the other branch with the biting working platform is brought to the occlusive surface; the patient is told to press the teeth to the sense of minor painfulness in the examined tooth. Then, moving the branches, other teeth are examined. Measurements are conducted right-to-left on the upper, and then on the lower jaw. The recording of findings is conducted with the help of the electronic digital and recording device. After this, electroodontograms are studied; the functional condition of the parodontium is

estimated by means of comparing the obtained data with the norm, i.e. the evidence obtained in children of the same age with intact teeth and dental arches.

In the endurance of the milk incisors parodontium there are two well-defined periods: the 1st period of functional rise and the 2nd period of its gradual decrease. The decrease of teeth endurance begins from the age of 8 years, making up till the age of 12 years 6.37 ± 0.42 kg.

It should be noted that in the whole frontal group of teeth during the first 2-3 years after eruption parodontium endurance is preserved almost at the same level, then during 3-4 years its rise happens, and again comes a period of stabilization. The increase of incisors parodontium endurance to vertical loads at the age of 10-13 years, and of canine teeth – at the age of 12-15 years we connect, first of all, with the end of the period of their roots formation and parodontium tissues adaptation to mastication loads.

The dynamics of age changes of permanent teeth endurance is conditioned by the subsequent formation of the root system, parodontium tissues differentiation, and perfect function of the mastication muscles in the process of dentognathic apparatus formation at all stages of its development. It should be noted that the functional endurance of the lower permanent teeth is slightly bigger than of the upper ones – by 1.5-2 kg on average. Besides, the difference between endurance indices of opposite teeth of one jaw has been detected. Still, this difference is not big: 3–6 %. Probably it is conditioned by one-sided type of mastication.

The given data concerning the endurance of parodontium of intact milk and permanent teeth to vertical loads at physiological occlusion may be considered the indices of age norm.

Still, it is inconvenient to use the data in kilograms for the diagnostics of functional disorders of dentitions in children. In this connection calculations have been performed and the percentage of each tooth participation in the act of mastication has been detected. Calculation was made by the formula

$$f \times 100 / F,$$

where f – functional endurance of one tooth in kg, F – total functional endurance of all teeth in this age period in kg.

Mastication endurance of the dentognathic apparatus is estimated on the basis of topographic-anatomical and functional peculiarities of individual teeth and dental arches. Assessment criterion is the findings of gnathotensodynamometric experiments. On their basis the coefficients of mastication effectiveness in milk, transitional dentition, and permanent occlusion in children and teenagers have been derived.

The loss of mastication effectiveness was calculated taking into account opposing teeth. If a tooth was absent on one jaw, its similar antagonist was excluded from mastication effectiveness for convenience in work.

Our investigation of mastication effectiveness is based on the anatomico-functional principles of every tooth separately and the whole dentognathic apparatus in age aspect.

Thus, in milk occlusion mastication effectiveness of all teeth makes 171.4 ± 0.51 kg, in transitional dentition – 143.95 ± 0.64 kg, and in permanent – 463.76 ± 0.24 kg.

To find the coefficients of mastication effectiveness it was taken completely in every age group as 100 %, and knowing the endurance of every tooth the percentage of each tooth participation in mastication function was calculated.

Estimation of the functional effectiveness of dental arches in children is the characteristic of the functional condition of every tooth separately and the dentognathic apparatus as a whole, which is very important and is the basis for calculating indications to prosthetics.

S.I. Tril studied the endurance of the parodontium tissues to vertical loads at dental arches defects taking into consideration the patient's age, extension and topography of the defect, and also the reasons for it.

Experiment results show that the functional endurance of the teeth, which were kept, has a tendency to decrease in comparison with such at intact dental arches. At small and medium defects the functional endurance of teeth, which limit them, reduces by 12-16 % on average. Besides, in such patients the decrease of parodontium tissues endurance is also marked on the opposite side, that is by 4-7 % with an intact dental arch. At big defects the endurance of remained teeth reduces by 30-36 % on the side of the defect, and by 12-14 % – on the opposite side of the jaw with an intact dental arch. Thus, the biggest decrease of parodontium tissues endurance is observed in teeth, which limit the defect. If dental arches defects are present in lateral regions on one side, the endurance of frontal teeth parodontium practically does not change, and if on both sides – its decrease is marked by approximately 6-8 %. And endurance decrease is directly proportional to defect prescription. The regularity is observed in all age groups.

The stated above testify to the fact that at dental arches defects in children and teenagers remaining teeth can not compensate for the lost mastication effectiveness, because the dentognathic apparatus is in the process of formation and its compensatory mechanisms are imperfect. These data confirm the necessity of timely substitution of dental arches defects in children and teenagers with fixed and removable dental prostheses.

Myoarthrography is a simultaneous registration of the contractions of the mastication muscles proper and the movements of the articular heads of the lower jaw in the TMJ with the help of the electronic myoarthrograph (V.Y. Kurliandskyi, S.D. Fedorov, 1973). Articular heads and muscles dislocation leads to the deformation of recording plates, which fit the face skin in the studied areas, and to indices changes in the strain gage. The changed electric impulse is increased and recorded onto a photographic film. Myoarthrography allows differentiating the waves of muscles contractions and the waves arising at lower jaw movements.

Arthrophonography is a method of auscultating the TMJ to detect murmur, crunch, and clicking in them, also used for differential diagnostics of functional and morphological violations.

Myotonometry takes into account the masticatory muscles tone in different states. The degree of muscle tension (thickness) is judged by the force with which the probe of the device (myotonometer) is immersed at predetermined depth. The pointers of the myotonometer's scaleplate indicate muscle tone in grams. Normally the tone of the quiescence of the mastication muscle proper most often reaches 40 gr, and the tone of the same muscle at dental arches pressure during central closure varies within 180-240 gr.

Myotonometry findings show that the masticatory apparatus tone falls under its own variations and changes in the process of orthopedic treatment.

Mastication dynamometry is a physiological method of detecting the force of mastication. This method is based on the following principles: detecting the force of mastication is carried out by means of applying natural food stimuli with simultaneous graphic registration of lower jaw movements. Beforehand, with the help of a special device – phagodynamometer – the force, needed for the grinding of this of that substance, is measured in kilograms.

Electromyography is the recording of muscles biopotential with the purpose of investigating their physiological activity. With the help of electromyographic investigation it is possible to detect the violation of the mastication and mimic muscles in the quiescence, tension, and lower jaw movements characteristic of different occlusion anomalies. The multichannel electromyograph "Diza" can be used. Electromyograms are recorded onto a perforated photographic film with the speed of rotation 5 mm/s, oscillograph photographic paper 10 cm wide with the speed of 20 mm/s.

To analyze the state of muscles superficial and needle electrodes are used. Superficial electrodes are put in the centre of muscle contraction. The identity of electromyographic investigations is achieved by applying electrodes with equal distance between them. With this purpose electrodes are set into special devices made of elastic plastic or other material. They are applied onto the same areas of skin which provides the identity of biocurrent electrodes bent at repeated examinations in the process of treatment and the check of its late fate. After palpatory determination of the centre of muscle contraction the movement point is marked. The goniometer is applied to the angle of mouth and the location of the point, marked on the face, is detected in the vertical and horizontal direction on the goniometer's scale. The obtained coordinates are written down into the card of examination and are taken into account later on.

When examining the temporal muscles electrodes may be applied to their anterior, middle or posterior parts on the right and left; the orbicular muscle of mouth – on the middle parts of the upper and lower lips; the mental muscle – on the region of chin. Before electrodes application corresponding areas of skin are thoroughly wiped with alcohol and covered with special paste.

It is advisable to register the activity of pair muscles in the quiescent state, tension, including closed dental arches, different movements of the lower jaw. Investigation of the electric activity of indicated muscles at mastication, involuntary swallowing, and swallowing on the instructions is of big interest. In order to detect the degree of the participation of the orbicular muscle of mouth, mental, mastication muscles proper and others in these acts EMG is to be obtained through a couple of channels simultaneously.

At orthognathic occlusion the EMG of the mastication muscle, registered in the quiescent state, usually reflects feebly marked electric activity with the presence of low voltage oscillations. Such recording is almost a straight line.

The increase of the bioelectric activity of the orbicular muscle of mouth in the quiescence is more often registered in patients with occlusion anomalies, whose lips are not closed because of mouth breathing, bad habits, etc.

The increase of the bioelectric activity of the mental muscle in the quiescence is sometimes observed in patients with distal, mesial or open occlusion. The largest amplitude of biopotentials oscillations of the mental muscle in the quiescence is marked in the presence of a sagittal or vertical fissure between the frontal teeth. Constant pressure of the mental muscle on the region of the apical basis of dental arches promotes alveolar process retrusion, the change of the transversal cut of the chin. At such violation the variance in the location of skin (pg) and bone (Pg) points of the chin is marked, which is detected by the analysis of lateral teleroentgenograms of head.

The mastication muscles proper and bundles of temporal muscles at occlusion anomalies usually show low-grade electric activity in the quiescence. Bioelectric activity of the posterior bundles of temporal muscles in the quiescence may be increased in patients with posterior occlusion. EMG analysis and comparison of the obtained data with the results of the examination of diagnostic jaws models and lateral teleroentgenograms of head allow assuming that the tone tension of this or that muscle in the quiescence may arise as a result of the irregular position of teeth and also their closure at lower-jaw movements.

Investigation of the bioelectric activity of the muscles surrounding dental arches allows finding out their influence on the growth of jaws and occlusion formation. It is known that mastication muscles have relatively short fibers and big weight. As a result of these muscles' contraction the lower jaw moves up and forward. The temporal muscles mainly lift the lower jaw, though their posterior and anterior bundles have different direction, and biopotentials, derived from them, are also not infrequently unequal. The predominance of the function of one of these two pairs during mastication (maseterial or temporal type of mastication) to some extent defines the direction of lower jaw growth. If the function of the mastication muscle proper prevails, the lower jaw is usually well-developed. Predominance of the function of the mastication muscle proper is observed at mesial occlusion, of temporal muscles – at distal. The hypotonia of the elevator muscles of the lower jaw is usually combined with considerable disconnection of dental arches in the quiescent state (more than 3 mm), and at hypertonia it is

into it. Depending on the consistency of food the recording changes. If it is necessary to adjust to the destruction of the piece of food and smash its resistance on the curve, which characterizes lower jaw movements, a series of additional wavelike peaks appear. As soon as the necessary position is chosen for the mastication of food and its resistance is worn down, curve descending is marked, and then the main mastication phase (the 4th) takes place. At preserved teeth and their regular closure it is characterized by rhythmical mastication movements and their identical swing. The 5th phase is the phase of bolus formation and swallowing. Together with the recording of lower jaw mastication movements time is also counted on the kymograph film. It enables to calculate the time of any mastication phase.

The character of mastication waves, closure loops, characteristics of separate phases depend on the size of the bolus, food consistence, occlusion type, occlusive correlations of preserved teeth, the character of false teeth closure, dentures fixation, the state of the mastication muscles and TMJ, etc.

Materials for self-control:

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

- to write down the phases of mastication;
- to draw in albums the scheme of electromyography.

B. Tasks for self-control:

1. Define the following types of chewing:

temporal and masseterial
infantile and somatic
static, dynamic, graphic
morphological and physiognomic
correct and incorrect

2. The function of the incisors during the physiological chewing act in the permanent dentition period is:

the biting of food
the grinding of food
the milling of food
the bolus formation
taste food analysis

3. The function of the premolars during the physiological chewing act in the permanent dentition period is:

the grinding of food
the biting of food

the milling of food
the bolus formation
taste food analysis

4. The function of the molars during the physiological chewing act in the permanent dentition period is:

the milling of food
the grinding of food
the biting of food
the bolus formation
taste food analysis

5. In food biting take part the following muscles:

m. temporalis
m. masseter
m. risorius
m. pterigoideus medialis
m. pterigoideus lateralis

6. The mastication efficiency is determined by:

teeth number involved in chewing
the number of lateral chewing movements while grinding food
the amount of chewed food per unit time
the number of sagittal movements while grinding food
the number of vertical movements while grinding food

7. The volume and degree of food grinding is controlled by:

teeth
lips
receptors of the mucous membrane,
tonsils
hard palate

8. Static method of masticatory efficiency determining is based on:

the definition of each tooth coefficient participation in the chewing process
the tooth mobility determining
the alveolar processes mucous membrane state determining
the type of the bite determining
the supporting tissue endurance determining

9. Odontoparodontogram represents:

the table into which are entered data about each tooth and its supporting apparatus
the registration of mandible movements
a diagram of the teeth location in the dental arch

the registration of upper and lower jaws teeth occlusal contacts
the tooth mobility registration

10. Functional methods of chewing investigation can to determine:

the food grinding degree for a certain time
the degree of bolus formation for a certain time
the degree of swallowing reflex formation for a certain time
the jaws compression during mastication
the degree of food bolus moistening

11. Gnatodinamometry method defines:

the force on the teeth antagonists
the muscles biopotentials recording
the chewing force
the masticatory muscles tonus at the different conditions
the muscle constriction and movements of the articular heads

12. The graphical methods of chewing functions assessing include:

masticatiography
palatography
arthrography
spirography
reparodontography

13. The absolute power of masticatory muscles is seen when:

strong emotional arousal
static examination
rest state
clinical examination
during sleep

14. Chewing pressure is:

the force developed by the muscles which raise the lower jaw and acting on a certain area
the force developed by the muscles which move the lower jaw to the side and act on a certain area
the force developed by muscles that push the lower jaw forward and operate in a certain area
the force developed by the muscles that displace the lower jaw back and operate in a certain area
the force which develops circumoral, buccal, and mental muscles during the act of mastication

15. The maximum force of masticatory muscles constriction is:

390 kg
540 kg
250 kg
150 kg
936 kg

16. The effectiveness of chewing depends on:
the presence of malocclusion
day period
region of residence
level of prosperity
education

17. Functional methods of mastication function assessment include:
Rubinov method
Oksman method
Sbarga method
Kurlandsky method
Agapov method

18. Functional diagnostics method of chewing – myography - provides:
record the muscles contractility
simultaneous registration of the masticatory muscles contractions and movements of the mandible articular heads
record tone muscle
check movements of the mandible
recording of muscles biopotentials

19. Functional diagnostics method of chewing – myotonometry - provides:
record the masticatory and mimic muscles tone
recording the muscles contractility
simultaneous registration of the masticatory muscles contractions and movements of the mandible articular heads
check movements of the mandible
recording of muscles biopotentials

20. Functional diagnostics method of chewing – electromyography - provides:
recording of muscles biopotentials
recording the muscles contractility
simultaneous registration of the masticatory muscles contractions and movements of the mandible articular heads
check movements of the mandible
record the tone of masticatory and mimic muscles

21. Patient B., 39 years old with generalized periodontitis II degree conducts research of periodontal endurance by gnathodynamometry. What anatomical and functional data get with this method?

- give periodontal
- the chewing force
- the chewing efficiency
- the chewing pressure
- the tone of the masticatory muscles

22. Define the concept of " Bennett movement":

- displacement of the head joint on the balancing side during lateral displacement of the mandible
- displacement of the head joint on the working side during lateral displacement of the mandible
- displacement of the head joint when mouth opening
- displacement of the head joint when mouth opening or closing
- displacement of the head joint when mouth closing

23. List the muscles which take part in the act of chewing:

- masseter, temporal, medial pterygoid and lateral
- masseter, temporal, upper and lower pterygoid, digastric, awl-hyoid, chin-hyoid, mylo-hyoid
- digastric, awl-hyoid, chin-hyoid, mylo-hyoid
- masseter, temporal, medial and lateral pterygoid, digastric, awl-hyoid, chin-hyoid, mylo-hyoid
- masseter, temporal, medial and lateral pterygoid, digastric, awl-hyoid, scapular - hyoid, mylo-hyoid

24. Which method applies to static definition of chewing efficiency?

- Agapov and Oksman method
- the study of diagnostic models
- Christensen method
- physiological masticatory test by Rubinov
- masticatiography

25. From the muscles located around the mouth slit, closes the threshold of the oral cavity during chewing:

- the circumoral muscle
- a large temporal muscle
- the muscle lifting the mouth corner
- the muscle, lowering the mouth corner
- chin

26. The sagittal Spee curve connects:

the points on the cutting edge of the lower central incisors and on the tops of the distal buccal tubercles of the lower first molars
the tops of the lower teeth tubercles (from canine to last molar), resulting in a concave downward line
the buccal and lingual tubercles of the same lateral lower teeth
the start and the end of the articular way
the tip of the nose and the tragus of the ear

27. Graphic method for the study of masticatory movements of the mandible is called: masticatiography

myography
myotonometry
arthrography
rheography

28. What method can be used to check occlusal contacts?

occlusiography
TMJ tomography
zonography
electromiography
masticatiography

29. Which of the masticatory muscles as one of its beams attached to articular disk and ensures synchronicity of movement with the lower jaw?

m. pterigoideus lateralis
m. pterigoideus medialis
m. masseter
m. digastricus
m. temporalis

30. Which of the upper jaw counterforts in the complex will have functional significance in the distribution of masticatory pressure?

fronto-nasal, zygomatic, pterigo-palatal
zygomatic, pterygoid, palatal
fronto-nasal, zygomatic, pterigo-palatal, palatal
fronto-nasal, zygomatic, palatal
fronto-nasal, pterygoid, palatal

31. Fibers of the lateral pterygoid muscle is oriented horizontally in the anteroposterior direction. During bilateral contraction of these muscles of the lower jaw is:

pushed forward
does not move
moving backwards

moving to the left
rises

32. "Canine way" is characterized by:
the same cusps contact on the working side and the opposite cusps contact on the balancing side
the presence multipoint and uniform contacts with both sides
the opposite cusps contact on the working side
the absence of cusps contact on both sides
the same cusps contact on the balancing side

33. What is the masticatory efficiency of the all dentition (by Agapov):
100%
50%
100 units
10 units
100 kg

34. Central occlusion is:
the dentition closure in the maximum number of teeth-antagonists contact
lateral movement of the lower jaw
movement of the lower jaw downward
lateral group of teeth closure
forward mandible displacement

35. To determine the chewing pressure there is:
gnatodinamometer
kymograph
occlusiometer
EMG-appliance
reoplatysmograf

Literature

Main:

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Additional:

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