Bogomolets National Medical University
Prosthetic Dentistry Department

"**Approved**"
at the Methodist Council
of the Prosthetic Dentistry Department
"__" _____2024, protocol № _____

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Study Guide

Subject	**Prosthetic dentistry**
Lesson topic	Interdisciplinary approach in preliminary treatment before prosthetic rehabilitation. Treatment planning.
Course	Course V (term IX)
Faculty	Stomatological

Kyiv – 2024

1. Topic Relevance.

A thorough diagnosis must be based on the patient's dental condition, considering both hard and soft tissues. This must be correlated with the individual's overall physical health and psychological needs. Using the gathered diagnostic information, it is then possible to develop a treatment plan based upon the patient's dental needs.

II. Study Objective:

1.Students should know and have conception about:

Main principles of diagnostics in dentistry.

2. *Students should know (α =I):*

The basic methods of diagnostics of all organs of the chewing apparatus, classifications.

3. *Students should be able (α =II):*

To examine patient with use of all modern methods of diagnostics.

4. *Students should master the following practical skills (α =III):*

The gathering of the anamnesis, examination of an oral cavity, examination of teeth, chewing muscles, temporo-mandibular joint and other components.

III. Educational Objective:

1. To teach the students to understand the importance of carrying out of complete diagnostic status of chewing apparatus for planning adequate treatment.

2. To develop at students the understanding of deontological principles of work with patients during diagnostic procedures and treatment.

IV. Interdisciplinary integration:

Subject and proper chair:	To know:	To be able to:
Anatomy	Anatomical structure of organs of the chewing apparatus	To examine the organs of the chewing apparatus

V. Lesson topic contens.

Without a diagnosis, any invasive therapy is hazardous. Finding the causes of functional disorders requires systematic methods that can be adapted to the demands of the individual. The decision for therapy must be based on the foundation formed by a diagnosis.

The diagnosis is the written conclusion about present illness, expressed with the use of medical terms which designate the name of illness and includes etiological, functional and anatomical parts.

The following topics determine the course of the conversation:

1. The patient's main concern - chief complaint
2. The complete medical anamnesis
3. The dental anamnesis
4. The pain anamnesis in cases of chronic pain.

Chief complaint is obligatory to first inquire about the actual reason for the patient's visit to the dentist and must be documented.

As with all of the "topics of conversation", this must be carried out and recorded personally by the dentist. Conversation with patient is especially important, because it builds up a relationship of mutual confidence, which will be very useful later during

therapy. Standard questionnaire forms, which are available in most practices, should only serve as guidelines during the personal conversation, and should be the starting point of a deeper discussion.

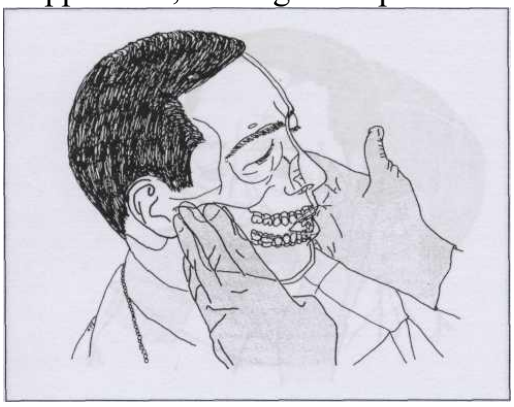
The pain anamnesis is of central importance in diagnostics. Should the patient report prolonged, persistent pain in the masticatory organ, a standardized pain anamnesis should be compiled. This concerns pain in the region of the head, neck and shoulders. It is advantageous to make the entries graphically with the aid of the supplied sketches. Standardized details can be included at a later time. The patient is offered a selection of various expressions to describe chronic pain. In cases of chronic pain in the craniofacial region, an additional pain analysis is routinely carried out, relative to the entire body, and is also documented graphically and orally.

Clinical methods of diagnostics.

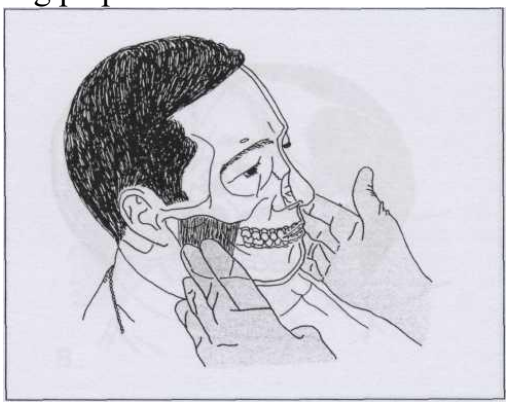
Clinical functional analysis results in an objective, organ-related criterion of the patient's functional state. It encompasses the following sections and must be carried out methodically and in all cases:

The main methods of clinical examinations are: visual examination of face and oral cavity (mucous, teeth, dental arches, tongue, kind of bite and ets.), palpation, percussion, probing.Tooth status, vitality status, fillings and testorations, abrasion facets, others particularities.

Additional methods: Palpation of the muscles and temporo-mandibular joint is carried out on the patient, while sitting freely and symmetrically, with weight distributed evenly. The patient indicates differences between the muscles of the right and left sides and, if applicable, the degree of pain in the areas being palpated.



The joints are palpated as the patient opens and closes to detect signs of dysfunction.



Masseter muscle can be palpated extraorally by placing your fingers over the lateral surfaces of the ramus of the mandible.

The movements of jows to be examined here are mediotrusion, laterotrusion, protrusion, retrusion, opening and closing. The movements are initially performed actively by the patient, and then carried out by the examiner on the passive patient.

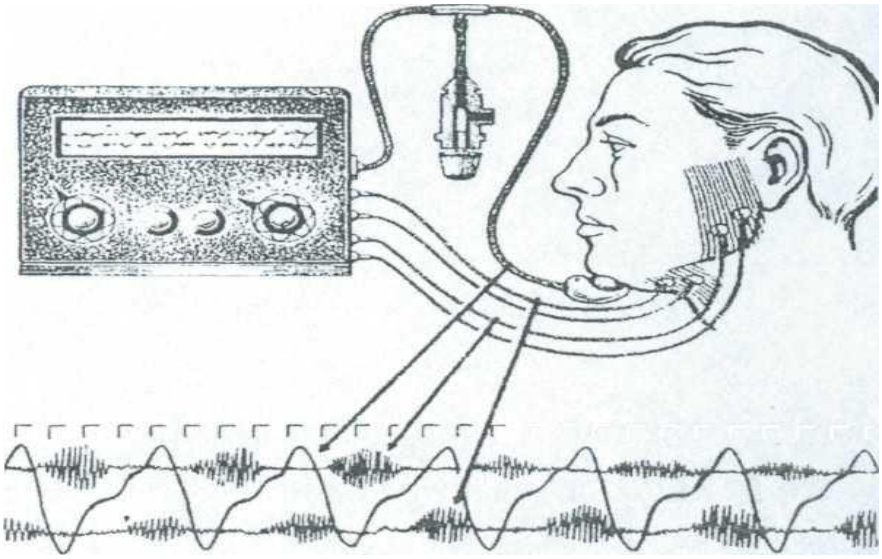
The occlusogram: retral pre-contact, protrusive guidance, laterotrusive guidance, retrusive guidance and etc.

Periodontal findings is an important requirement for the overall diagnosis and for provisional and definitive therapeutic planning. It encompasses the current plaque findings, the measurement of mobility, findings obtained from probing, and the results of a thorough intraoral X-ray status.

Paraclinical methods:

1. Target X-ray of teeth, orthopanthomografy, thomografy, 3D thomograthy, X-ray of temporo-mandibular joint.
2. Electromyography (EMG) is a technique for evaluating and recording the

electrical activity produced by skeletal muscles. EMG is performed using an instrument called an electromyograph, to produce a record called an electromyogram. An electromyograph detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, recruitment order or to analyze the biomechanics of movement.



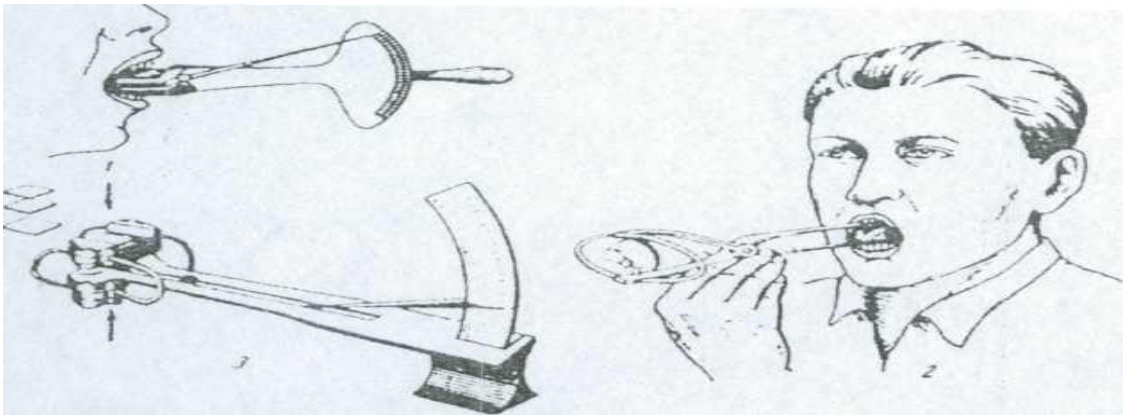
3. Axiography - electronic or mechanical registration of any positional relationship of the mandible in reference to the maxillae. These records may be any of the many vertical, horizontal, or orientation relations. (Jablonski, Illustrated Dictionary of Dentistry)

4. The analysis of diagnostic casts at the articulator.

5. Galvanometry – dimenthion of electric activity in patients saliva wich coused by (metal) prothetis with different metals.

6. Mastication test (мастикациография) is analising of lower jaw movements. Diagram of examination include 4 parts (phases). 1st phase – physiological rest. 2Nd – introduction of food (as usual used hazelnut). 3Rd – start of mastication. 4Th – phase of main (basic) mastication. 5Th – bolus shaping.

7. Gnathodynamometry - use gnathodynamometer is an instrument for measuring the force exerted in closing the mouth. A bimeter gnathodynamometer is one with an adjustable central-bearing point. Also this instrument detect power of mastication muscles.



8. Determination of mastication efficiency. Static method use numerical coefficients of teeth.

Static method by Agapov – all efficiency is 100 % every tooth except 18 28 38 48 have numeral coefficient.

Tooth	1	2	3	4	5	6	7	8	In all
Coefficient	2	1	3	4	4	6	5	-	25

Static method by Oxman use all teeth.

Jaw	Tooth								In all
	1	2	3	4	5	6	7	8	
upper	9	1	9	3	3	6	5	3	25
lower	1	1	2	3	4	6	5	4	25

Functional method by Rubinov. Rubinov modified the test of mastication approximating it to normal natural stimulation. In his test Rubinov used a single nut kernel instead of 5 grammes of almond, which allowed evaluation of the functional state of individual tooth groups (the data obtained from chewing the kernel were treated by Gelman's technique).

The tests suggested by Gelman and Rubinov are used not only to determine the functional condition of the maxillodental system and to apply dental prostheses for facilitating gastrointestinal activity, but also to estimate the efficacy of orthopedic treatment and prosthetic management.

9. Occlusal contacts analysis. With help wax plate, occlusion foil or paper, special devices as T-scan.

Examination and analysis of the occlusion

In most cases it is enough to examine the occlusion clinically, but in more extensive occlusal reconstructions or where there specific complaints of patient are present, study casts should be mounted in articulatore for detailed study. The clinician understands what he is looking for, there is no need to articulate study casts for the majority of individual crowns and small bridges at this stage.

Clinical examination of the occlusion

Clinician should examine occlusion if patient complaints on temporomandibular joint pain, muscle spasm or unexplained chronic dental or head pain, progressive teeth wear, teeth mobility, have difficulty of jaw excursions or fills occlusal interferences (for example after restoration).

Clinacally occlusion can be examined with help of articulating paper or foil, thin wax plate, registration silicones, plastic strips.

Articulating paper or foil

Flexible articulating paper or plastic foil of different colours may be used to mark occlusal contacts in different excursions. For example, the ICP may be recorded in one colour and the RCP in a second colour.

Articulating paper is rather difficult to use (Fig.1), having a tendency to mark the tips of cusps whether or not they are in occlusion, and often it does not register contacts on polished gold and glazed porcelain. The thickness of the paper will have an influence on the degree of marking that occurs and ideally it should be as thin as possible.

Fig.1. On left picture – articulating paper in patients mouth; on right picture – marked occlusal contacts on upper teeth.

Wax occlusography.

Thin, fairly soft wax with an adhesive on one side is marketed as a material for registering occlusal contacts (Fig.2). This is useful but rather expensive. A better alternative is to use 0.5 mm thick, darkcoloured sheet wax. It has the advantage that it can be removed from the teeth and placed over the study casts for the occlusal contacts to be studied more closely. It can also be used in full arch-sized pieces. Areas of contact in the mouth may be marked through the perforations with a chinagraph pencil.

Fig. 2. Occlusal contacts on wax plates.

Occlusal registration with silicone.

Fast setting silicone rubber materials can be syringed between teeth and the occlusal contacts are recorded. These materials are soft initially so offer no resistance to the closure of the mandible, which can be a problem with more viscous materials such as wax if it is not softened properly. The resistance felt on biting into a more viscous material and can guide the mandible into a different position. Once set the silicone material is flexible but sufficiently rigid to be used as an accurate interocclusal record to articulate casts. It can be placed on the model to show, by means of the perforations, which parts of the occlusal surface are making contact. Because it can be replaced onto the model or the patient's teeth without damage it is a better material than wax.

Plastic strips

Plastic strips may be used to test whether teeth are making contact in various excursions. The thinnest of these materials (shimstock) is opaque and silver-coloured and is only 8 micrometres (μm) thick. The strip is placed between opposing teeth and pulled aside once occlusal contact has been made. Often two pieces are used on opposite sides of the jaw to test the symmetry of the occlusion, or between the crowned tooth and its opponent, and the adjacent tooth and its opponent to test that the crown is in contact but is not 'high'. Less accurate (40 μm thick) but more manageable mylar matrix strips, used for composite restorations, are sometimes an acceptable alternative.

Surface electromyography (SEMG) is a standard method for evaluating and recording the electrical activity produced by skeletal muscles from the skin surface. EMG is performed using an instrument called an electromyograph, to produce a record called an electromyogram. An electromyograph detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, symmetry, synergy, recruitment order or to analyze the biomechanics of movement.

SEMG gains information concerning both the resting and the functional activity of the musculature (Fig.3).

The EMG signal directly reflects the recruitment and firing characteristics of the detected motor units within the measured depolarization zone. Raw SEMG can range between +/- 5000 microvolt and typically the frequency contents ranges between 6 and 500 Hz, showing most frequency power between 20 and 150 Hz.

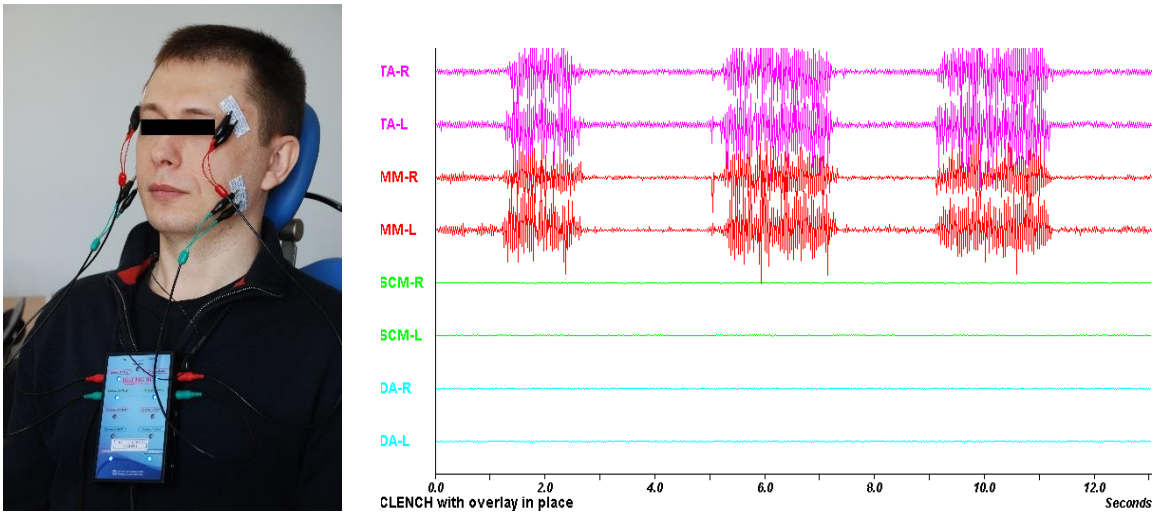


Fig.3. BioEMG III Electromioraphy.

Indications: TMD, force orthodontic treatment, complete prosthetic reabilitation, bruxizm, pathological wearing of teeth, chronic pain in maxillo-facial region.

This method is a not invasive and very informative. SEMG information is invaluable to the clinician who hopes to create beautiful dentistry that works with the patients physiology for optimum results.

Joint Vibration Analysis (JVA) – the electronic recording and computer-enchanced examination and interpretation of solid-borne joint vibration (tissue pressure waves).

Fig.4. BioJVA device

Ultrasound examination (US).

At diagnostic process ultrasound high frequency sound waves are transmitted in to the body by a transducer and echoes from tissue interface being detected and displayed on a screen. The transducers are designed to produce longitudinal waves hence only those waves can pass through tissues and get reflected, Audiofrequency of a sound wave is 20 KHz (20,000 hertz). Anything below this is called infrasonic and above is Ultrasound. Medical Ultrasound uses the frequency of 1-15 MHz (2.5, 3.5, 7.5 and 10 MHz). The transducer has a special property called piezoelectric effect i.e. they can convert sound waves in to electrical waves and vice versa.

Fig. 5. Ultrasound system.

Medical sonography (**ultrasonography**) is an ultrasound-based diagnostic medical imaging technique used to visualize muscles, tendons, and many internal organs, to capture their size, structure and any pathological lesions with real time tomographic images. Ultrasound has been used by radiologists and sonographers to image the human body for at least 50 years and has become a widely used diagnostic tool. The technology is relatively inexpensive and portable, especially when compared with other techniques, such as magnetic resonance imaging (MRI) and computed tomography (CT).

Ultrasonic echography has been used as an instant, non-invasive method for the observation of relatively deep areas. Recently, however high frequency echography has been developed that can provide detailed investigation of more superficial regions.

Ultrasound in dentistry is used for detection of fractures of the Maxillo facial region i.e Nasal bone fractures, Orbital rim fractures, Maxillary fractures, 3 Mandibular fractures, Zygomatic arch fractures and for locating the position of Mandibular condyles. And Post operative view can be done instantly to view the reduction and healing of fractures.

Ultrasound can be used to detect parotid lesions, where solid and cystic lesions are reliably differentiated and diffuse enlargement of the parotid gland (or) focal disease is readily shown by Ultrasound. Sonographically, benign lesions usually look well defined, homogeneous and hypoechoic, while Malignant lesions tend to be poorly defined and hypoechoic with heterogeneous internal architecture and enlarged cervical lymph node may be visible and reactive intra parotid lymph nodes may also be readily assessed.

The value of Ultrasonography is well recognized in inflammatory soft tissue conditions of the head and neck region and superficial tissue disorders of the maxillofacial region. Ultra sound can provide the content of the lesion before any surgical procedure, both solid and cystic contents could be identified by ultrasound. The mixed lesions should be considered as neoplastic and should be biopsied before surgical procedure.

Ultrasound with aid of high resolution transducer, can demonstrate the internal Muscle structures more clearly than CT. hyper echoic bands, which correspond to the internal fascia are usually observed on US Image of normal Muscles and are sometimes referred to as septa. These bands diminish or disappear with inflammation; hence this is an important structural Index of Masseteric Infection. Ultrasound is also an accurate Modality for measuring the thickness of Muscles, data regarding thickness may provide information useful in diagnosis and treatment especially in follow up examination.

Reserve periodontal forces of a single tooth and of the whole row

Under physiological conditions the supporting apparatus of each tooth of an intact maxillodental system utilizes only half of its force of resistance to the pressure of mastication when the food undergoes treatment in the mouth. The other half is its reserve which is mobilized during strong unusual stimulation which thus does not cause the development of pathological conditions.

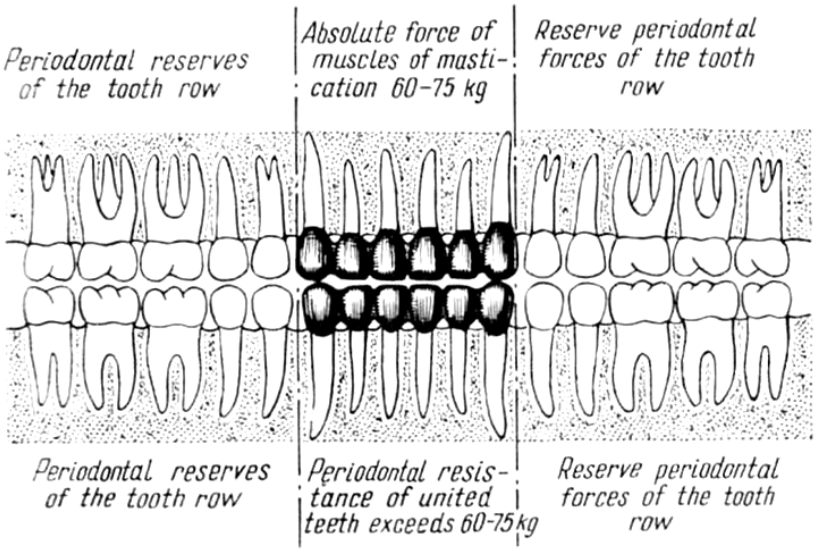


Fig.6. Reserve periodontal forces of the tooth row with the anterior teeth joined in a single unit.

For therapeutic purposes it is recommended to utilize the reserve forces of the periodontium (of a single tooth, group of teeth, or the whole row) in pathological conditions for the supporting tissues of a single tooth or a group of teeth.

Loosening of a tooth is a reparable process if the periodontium, and alveoli remain intact. The stability of a tooth can be restored by treatment of an inflammatory process responsible for the loosening or by relieving the tooth from an abnormally large load which is a frequent causative factor. Determination atrophy degree of alveolar bone. A record of periodontal affection is extremely important in orthopaedic practice and its extent must be established since dental prostheses exert an additional load on the periodontium. Its involvement
in a disease process is characterised by the degree of atrophy of the alveolus. Since atrophy of alveolar bone is an irreparable process all decisions with respect to orthopaedic treatment are made only on the basis of the intactness of the periodontium. The degree of atrophy of a tooth alveolus is determined by clinical

and X-ray findings. The combination of both examinations is necessary because X-ray cannot show the true condition of the atrophic process. Usual X-ray film gives an image of one plane, whereas atrophic processes usually develop irregularly around a tooth. The degree of the process is determined from the area of maximum atrophy; clinically it is established with the help of a probe. A straight or angulate graduated probe is used for the purpose, its end is either blunt or has a knob soldered to it which protects the floor of the pocket from injury.

Four degrees of alveolar atrophy are distinguished: I degree - root length; III degree - exposure of three-quarter root length; IV degree - full exposure of root.

Recording and deciphering information on the condition of the supporting apparatus of each tooth by a comparison of the clinical and X-ray data are quite simple. But analysis and synthesis of information on the condition of the supporting apparatus of all the preserved teeth are extremely difficult. Study of the record will not solve problems of management on it's own and will give no idea of the therapeutic effect.

ODONTOPARODONTOGRAM

An odontoparodontogram gives a clear picture of the condition of the dental rows and their antagonistic relations and the supporting apparatus of the remaining teeth, the functional state of the maxillodental system, and the course of the process (on comparison of dynamic records). It is obtained by recording information on each tooth and it's supporting apparatus in a special chart. Each tooth is shown on the diagram. Data concerning the supporting apparatus of the upper teeth are recorded in the two rows above the dental formula, while that concerning the supporting apparatus of the lower teeth in the two rows below the formula.

Information concerning the condition of the tooth and its supporting apparatus is recorded in the chart by means of conventional symbols. Data on the dental tissues are shown in the rows immediately above or below the formula, while data on the supporting apparatus, in the next rows.

Conventional symbols:

N—no pathological changes;
0—absent tooth;
1/4—I degree atrophy;
1/2—II degree atrophy;
Ca—caries;
P—pulpitis;
Pr—periodontitis;
3/4—III degree atrophy;
over 3/4—IV degree atrophy;
—the tooth or root must be extracted.

The odontoparodontogram is recorded in the patient's presence in a definite order: from the right mandibular wisdom tooth to the left mandibular wisdom tooth, then from the left maxillary wisdom tooth to the right maxillary wisdom tooth.

Repeated odontoparodontogram provides a follow-up of the process.

Date "_____" _____ 20__ year
The name of the patient _____
Age of the patient _____
Diagnosis _____

ODONTOPARODONTOGRAM

		11,5						7,5						11,5			
The degree of atrophy	More than ¾	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	TOTAL
	¾ - 75%																
	½ - 50%																
	¼ - 25%																
	N	2,0	3,0	3,0	1,75	1,75	1,5	1,0	1,25	1,25	1,0	1,5	1,75	1,75	3,0	3,0	2,0
		8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
The degree of atrophy	N	2,0	3,0	3,0	1,75	1,75	1,5	1,0	1,25	1,25	1,0	1,5	1,75	1,75	3,0	3,0	2,0	TOTAL
	¼ - 25%																
	½ - 50%																
	¾ - 75%																
	More than ¾	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		11,5						7,5						11,5			

Fig.7. Not filled odontoparodontogram map.

Changes in the resistance of the tooth supporting apparatus in various degrees of alveolar atrophy.

The resistance of the supporting apparatus to pressure is measured with a gnathodynamometer.

It decreases with a higher degree of alveolar atrophy. The atrophic processes in the alveolus of the tooth are usually attended with considerable changes in the periodontal receptor apparatus, which together with the tooth loosening developing due to atrophy makes measurement of the actual periodontal resistance to pressure impossible. That is why the periodontal resistance to load in atrophy is expressed by means of conventional coefficients based on the proportional ratios of the resistance of a healthy periodontium of different teeth to load, determined by means of a gnathodynamometer (Table 1).

TABLE 1. Periodontal Resistance to Load under Normal Conditions

Teeth	Upper first incisors (11, 21)	Upper second incisors and lower incisors (12,22,32, 31,41,42)	Canines	Premolars	Molars	Wisdom teeth
Coefficient	1.25	1.0	1.5	1.75	3.0	2.0

The coefficient of periodontal resistance to load decreases correspondingly with different degrees of alveolar atrophy in different teeth (Table 2).

TABLE 2. Changes in Periodontal Resistance in Different Degrees of Alveolar Atrophy

Teeth Degree of atrophy	Upper first incisors (11, 21)	Upper second incisors and lower incisors (12, 22, 32, 31, 41, 42)	Canines	Premolars	Molars	Wisdom teeth
Normal (initial) values	1.25	1.0	1.5	1.75	3.0	2.0
I (1/4)	0.9	0.75	1.1	1.3	5.25	1.5
II (1/2)	0.6	0.5	0.75	0.9	1.51	1.0
III (3/4)	0.3	0.25	0.4	0.45	0.75	0.5

In IV degree atrophy the periodontium has no resistance to load (and the tooth should be extracted). It is accepted in practice that the periodontium of a tooth can resist a load double that experienced during food breakdown.

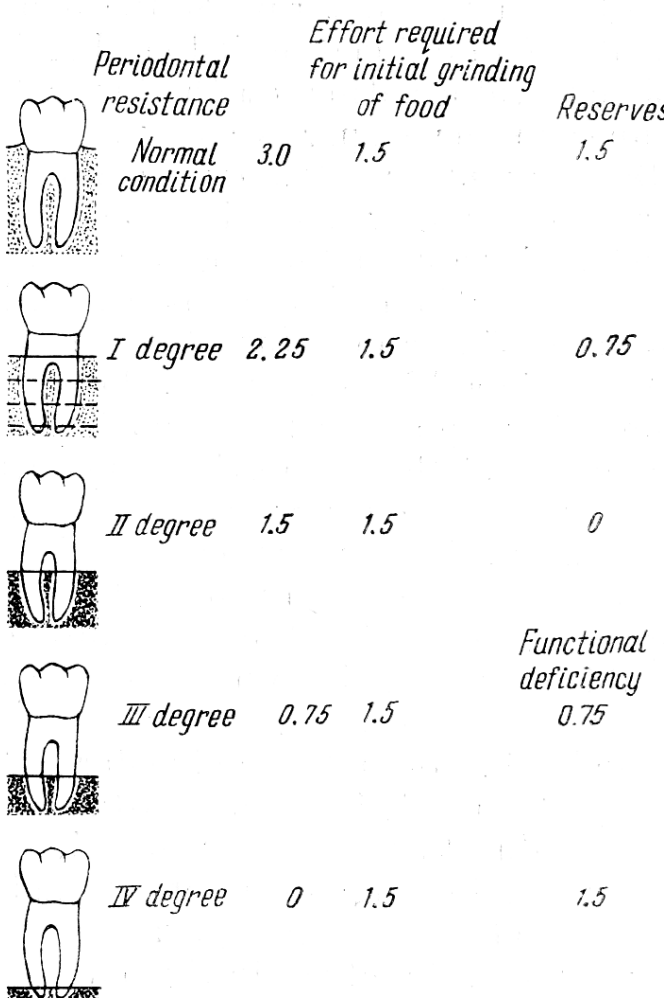


Fig.8. schematical representation of changes in the reserve forces of the periodontium with different degrees of atrophy and development of functional deficiency.

A molar with a coefficient of 3 units resistance under normal conditions is given as an example. If it is assumed that under normal physiological conditions half of the periodontal resistance (1.5 units) is exerted during food grinding, then,

consequently, a reserve of1.5 units is maintained in the supporting apparatus, which is partially or fully mobilized in response to above-average load. With development of atrophic phenomena the resistance of the periodontium decreases and its reserves reduce. From the assumption that periodontal resistance decreases in arithmetical progression with different degrees of atrophy, it stems that in I degree atrophy the total resistance is 2.25 units, and the reserve is 0.75 unit. With II degree atrophy the effort spent on grinding food (1.5 units) is equal to the minimum resistance of the periodontium (1.5 units). In this case there are no reserve forces and the periodontium is therefore incapable of an adequate response to above average stimuli produced during the grinding of food. With III degree atrophy there is marked functional periodontal deficiency. Clinical observations show that if the reserve forces are maintained the pathological processes in the periodontium (marked by its dystrophy) do not produce any symptoms, but as soon as the reserves disappear they take an extremely acute course.

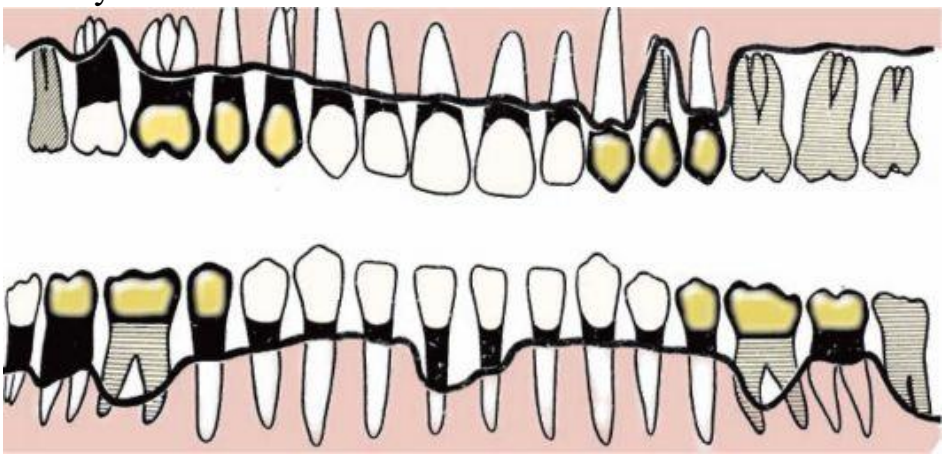


Fig. 9. Levels of alveolar bone atrophy.

Methods of mastication efficiency definition

Static methods of mastication efficiency definition

Some authors claimed that the functional importance" of each tooth could be indicated by conventional symbols (coefficient) the sum of which would show the total functional ability of the maxillodental system. With loss of some teeth the degree of impairment of the masticatory apparatus could be determined by subtracting the sum of their coefficients.

Different authors suggested different coefficients. The tests commonly accepted were: the size of the cutting or masticating surface, the thickness and length of roots, number of roots, number of cusps, distance from the tooth to the site of attachment of the main muscles of mastication (influence of the lever arm length).

Agapov suggested that the functional capacity of the masticatory apparatus should be taken as 100 per cent on the basis of the anatomo-physiological properties of the dental system (relation of the tooth and jaw, number and strength of the roots of individual teeth, size of the incisal edge and masticating surface of the teeth, and position of the tooth in the set) so that each tooth would have an appropriate coefficient expressed as a percentage:

Static method by Agapov – all efficiency is 100 % every tooth except 18 28 38 48 have numeral coefficient.

Tooth	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	Total
Coefficient	2	1	3	4	4	6	5	-	**25**

The coefficient of wisdom teeth with antagonists was taken as equal to the area of their masticatory surface (molar-molar, premolar-premolar). In that case the dental system amounts more than 100 per cent. Agapov's simplified method found wide application in dental practice in the Soviet Union. The degree of impairment is estimated by subtracting the sum of coefficients of the missing teeth and their antagonists from the total.

For example, the following teeth are missing:
6 ! 567
754~ !~5 the sum of their coefficients adds up to 36 per cent. The sum of the coefficients of the antagonist teeth, 36 percent, is added to it. The total impairment will constitute 72 per cent.

If in a dental system 14 teeth remain but there is not one pair of antagonists, the masticatory value of the rows is zero.

7050321 1004007
0604000 0230560

Static method by Oxman use the same scheme of calculation, but with winsdom teeth.

Jaw	Tooth								In all
	1	2	3	4	5	6	7	8	
upper	9	1	9	3	3	6	5	3	25
lower	1	1	2	3	4	6	5	4	25

Functional methods of mastication efficiency definition

The static method is of a relative character because it does not make allowances for the adaptation of a human being to mastication following the loss of teeth. The factor is determined more fully by various masticating tests which help to estimate more or less correctly the actual functional state of the dental system. The first attempt to give an objective evaluation of the functional state of the maxillodental system was made by Christiansen who proposed a test of the masticating ability by giving to the subject food of a definite weight and consistency and then examining how well it was chewed. For this purpose he gave the subject a wild nut and after it was chewed he determined the degree of its grinding and in this manner established the efficacy of mastication.

Rubinov's test of mastication.—Rubinov modified the test of mastication approximating it to normal natural stimulation. He suggested that foodstuffs differing in physical properties should be used (nuts, crusts, fresh bread, etc.) and

their treatment in the mouth is combined with reflexes arising in the oral cavity, which was determined by means of masticatiography. Rubinov revealed from studies that with a more impaired dental system the time needed for chewing hard food (nut) before it was swallowed is increased, but nonetheless food particles swallowed were relatively large. For instance, an adult with a normal masticatory apparatus took 14 seconds on the average to chew a single nut kernel before swallowing it, and no residue was left on the seive. In the absence of two or three teeth the chewing lasted 23 seconds, part of the kernel being inadequately ground. The time needed for chewing soft food with intact dentition differed but little from that needed with an impaired dental system, which stresses the importance of external adaptations of the human being (choice of soft food, abundant moistening in liquids) to the loss of teeth. In his test Rubinov used a single nut kernel instead of 5 grammes of almond, which allowed evaluation of the functional state of individual tooth groups (the data obtained from chewing the kernel were treated by Gelman's technique). The tests suggested by Gelman and Rubinov are used not only to determine the functional condition of the maxillodental system and to apply dental prostheses for facilitating gastrointestinal activity, but also to estimate the efficacy of orthopaedic treatment and prosthetic management.

The problems discussed concerning the value of dental prostheses as a method of normalizing gastrointestinal function and the indications for their application are obviously of great importance. But as it was already noted, this is not the main aim. Orthopaedic treatment is applied for wider purposes and is based on the normalization of the maxillodental system itself. Lesions of the maxillodental system can even develop from the embryonal period.

The following orthopaedic diseases are distinguished: developmental malformations of the teeth, developmental malformations of the jaws, lesions of the tissues of the tooth, and lesions of the periodontium and rows.

Absolute force of the muscles of mastication

The muscles of mastication are muscles of force, i.e. they are mainly concerned with the force of movements, in distinction to other muscles that are mainly responsible for the quickness of movements. Muscular work depends on 'live muscular force'. The absolute force of muscles (is the stress exerted by a muscle on maximum contraction.) is determined by the number of fibres contained in the given muscle, i.e. the area of the physiological cross section. The more the number of fibres in a muscle, i.e. the greater the area of its physiological cross section, the greater the force produced by the given muscle. Weber claimed that with all other conditions being equal the force of a muscle varies in direct proportion to the area of its cross section. According to Weber, a muscle with a cross section of one square centimetre exerts a force of ten kilograms. Muscles elevating the lower jaw have the following cross sections: m. temporalis 8 cm^2, m. masseter 7.5 cm^2, m. Pterygoideus interims 4 cm^2. Proceeding from these values of the cross section it is established that the absolute force of m. temporalis is 80 kg (41.03 per cent), of m. masseter 75 kg (38.46 per cent), m. pterygoideus interims 40 kg (20.51 per cent), that is, the total absolute force of muscles of one side is 195 kg (100 per cent). The total absolute force of the muscles of mastication of the right and left sides is 390 kg (195 X 2). The contribution of mm. pterygoideus internus, masseter et temporalis to the masticatory

pressure, taking into account the different directions of the individual bundles and the muscle layer (mm. pterygoideus internus et masseter contribute fully but m. temporalis only partially because of its marked rear deviation and insertion close to the joint) can be expressed, says Weber, in a ratio of 1 : 2 and 1 : 1.6. On the basis of the different direction of the fibres and insertion Weber claimed that the vertical effective force of the muscles varied and was 80 kg for m. temporalis, 70 kg for m. masseter, and 30 kg for m. pterygoideus, i.e. the absolute vertical force raising the lower jaw was 360 kg (180 X 2). Later the absolute force of the vertical pressure exerted by the muscles of mastication was estimated without taking into consi deration their bundles which moved the mandible forward or contributed to its horizontal movements.

Tolusch are came to the conclusion that the value of the absolute force of muscles of mastication was considerably overestimated. He believed that the breakdown of food in the mouth did not need such great force, the more so since the food here was not only compressed but also ground, which made the work easier. He suggested that estimation of the force of the muscles of mastication should proceed from the assumption that one square centimetre of physiological cross section accounts for a force of 2 to 2.5 kg. Thus, in his opinion, the absolute force of the muscles of mastication was 80 to 100 kg. The absolute force of muscles established theoretically by finding the sum of values of the physiological cross sections of muscles that elevate the lower jaw and multiplying it by the potential force of every square centimetre of cross section of the muscle naturally does not conform to the actual value. Working jointly the muscles of mastication cannot exert a force of 390 or 360 kg vertical efficiency, and the corrections made by Tolusch are also hardly reliable.

Determined experimentally the absolute force of the muscles of mastication by increasing the resistance of the periodontium of a set of teeth to the pressure is exerted by them. A unit of teeth was formed by capping a group of functionally orientated antagonists, the maxillary and mandibular anterior teeth or the masticating teeth on the right or left side of the jaw. Joining the teeth in a single unit greatly increased the periodontal resistance to pressure: the individual under test could strain his musculature to the utmost without feeling any pain in the periodontium.

The variations in the absolute force of muscles can be attributed to the individual extent of the masticatory muscles development.

Gnathodynamometry uses gnathodynamometer is an instrument for measuring the force exerted in closing the mouth. A bimeter gnathodynamometer goes with an adjustable central-bearing point. Also this instrument detects power of masticatory muscles.

Gnathodynamometric studies (Fig.10) also do not give any accurate results. The truly maximum force of masticatory muscles cannot be determined because of the low resistance of the periodontium of some teeth. The pain arising here is arrested by further reflex exertion of pressure before all muscle force is exhausted. Attempts to remove the pain reflex with the help of anaesthesia were unsuccessfull because the high masticatory pressure, still not exerted to the limit of muscular endurance, caused injury to the dental enamel.

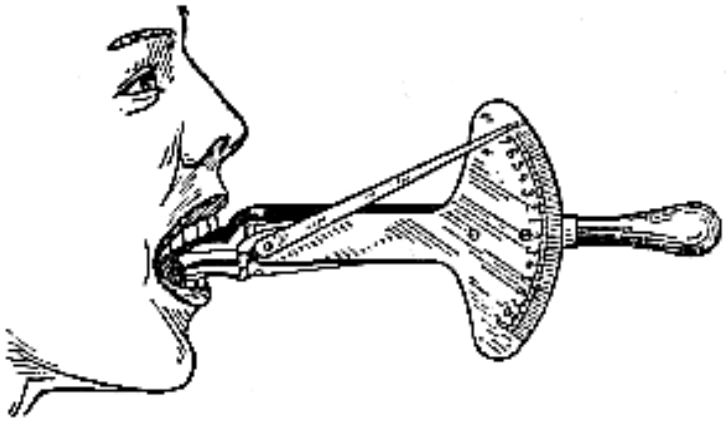


Fig.10. Gnathodynamometery

According to Blacks gnathodynamometric studies the feasible pressure (determined by the reflex sensitivity of the periodontium) in the region of the masticating teeth was 47.2 kg. According to other authors, the pressure produced in females in the region of the incisors was 20 to 30 kg, and in the region of the molars 40 kg; the respective values for males were 20 to 40 kg and 60 to 80 kg. We proved experimentally the absolute force of the masticatory muscles by increasing the resistance of the periodontium of a set of teeth to the pressure exerted by them. A unit of teeth was formed by capping a group of functionally orientated antagonists, the maxillary and mandibular anterior teeth or the masticating teeth on the right or left side of the jaw. Joining of the teeth in a single unit increased the greatly periodontal resistance to pressure: the individual under test could strain his musculature to the utmost without feeling any pain in the periodontium. The experiments showed that the absolute force of the masticatory muscles that raised the lower jaw was 90 to 150 kg (with the gnathodynamometer applied in the region of the masticating teeth) and 60 to 75 kg (with the instrument applied in the region of the anterior teeth). The variations in the absolute force of muscles (from 90 to 150 kg and from 60 to 75 kg) can be attributed to the individual extent of development of the masticatory muscles.

Mastication test (masticatiography) is a graphical method for detection of reflex lower jaw motion activity during chewing. The apparate for mastication test is mastikaciograph (1954, Rubinov S.I.).

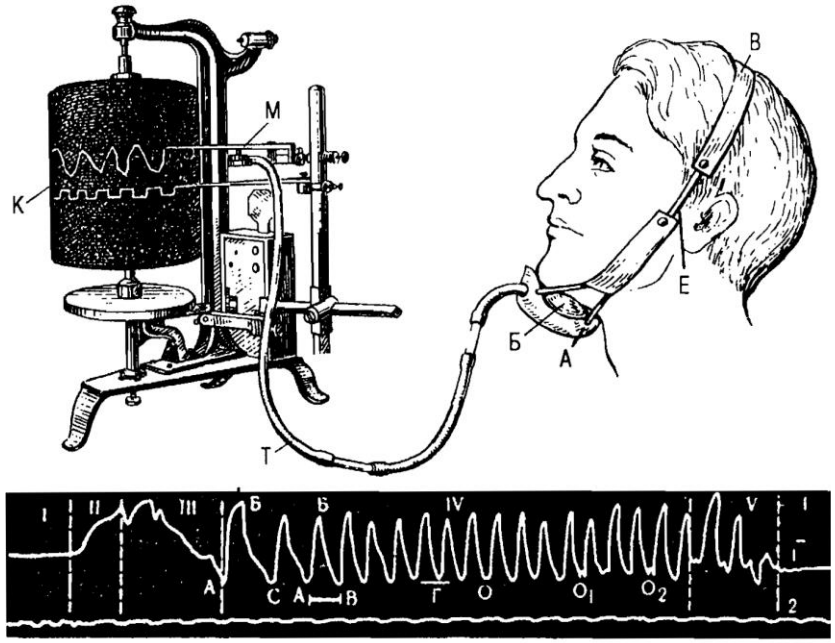


Fig.11. Masticatiography.

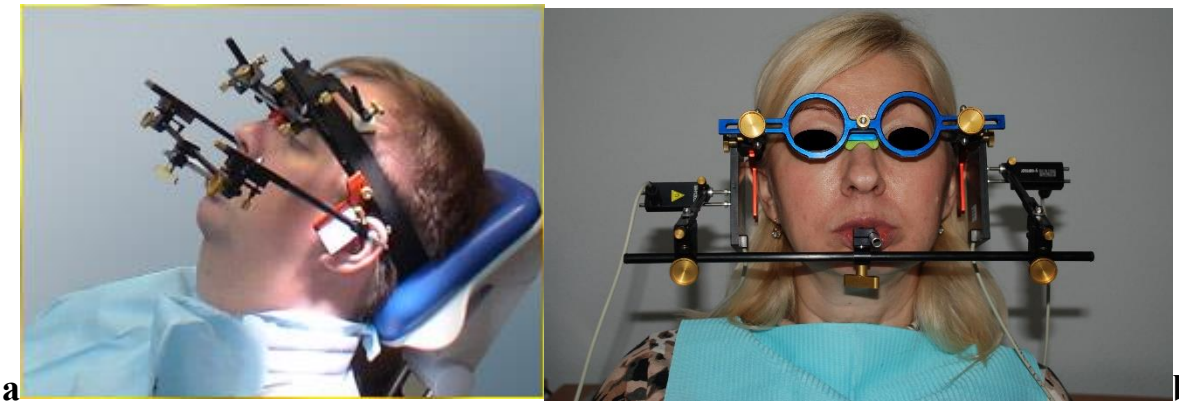
Mastication test is an analysis of lower jaw movements. Diagram of examination includes 4 parts (phases). 1st phase – physiological rest. 2Nd – introduction of food (as usual used hazelnut). 3Rd – start of mastication. 4Th – phase of main (basic) mastication. 5Th – bolus shaping.

Galvanometry – dimension of electric activity in patients saliva wich is caused by (metal) prosthetis with different metals ("burning mouth" symptoms).

Reography – method of blood vessels pulse investigation, based on graphic changes of tissues electrical resistance.

Condylography (Axiography) is electronic or mechanical device for recording of all mandibular movements (translations and rotations). These records can be any of numerous vertical, horizontal, or orientation relations. (Jablonski, Illustrated Dictionary of Dentistry). One major advantage of the computerized system is having the enlarged diagram of tracings on the computer screen. This means that small changes such as initial disk displacements can be diagnosed more readily than with the mechanical device.

These articulator measurement systems are commonly used by prosthodontics to reveal the maxillomandibular relationship for improved diagnosis and treatment planning.



a b

Fig.12. Patient with condylograph face bows during mechanic axiography (a), digital axiography (b).

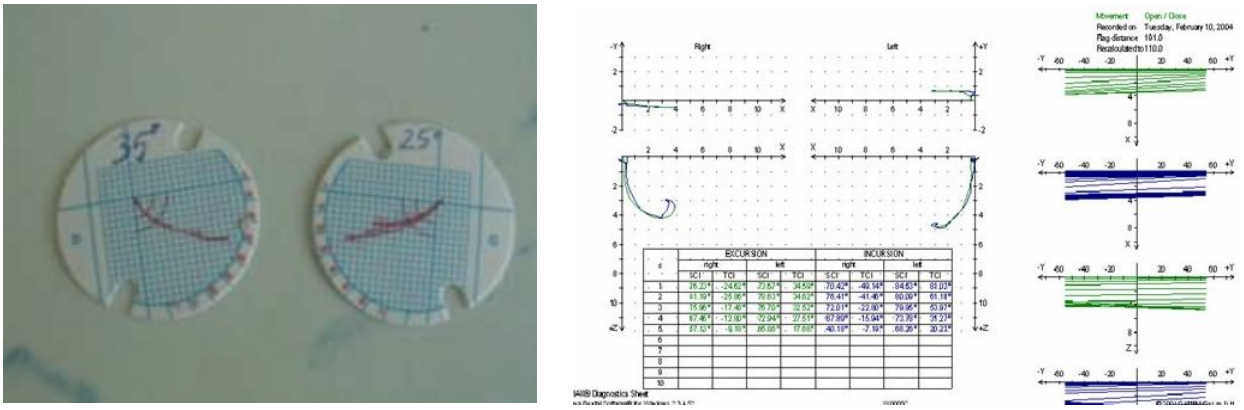


Fig.13. Tracks after mechanical (left) and digital (right) axiography.

Study casts

For further more detalised studies of the dental rows and jaws clinician can make the diagnostic models. Anatomical impression with stock tray must be taken from the lower and upper jaw as usual. With prepared impressions plaster models must be made in dental laboratory. Diagnostic models must be accurate, without "bubbles" on ocllusal surface. and gnathostatic models are cast to both impressions. To obtain a model the orbital bow is removed from the metal rod of the gnathostat and in its place a metal plate is fitted at the same distance from the impression; then the impression is cast in plaster. With this technique the base of the model will correspond to the auriculo-infraorbital plane because the plane of the metal plate is replaced to the orbital bow which was lying in this plane. The gnathostatic model of the lower jaw is cast to the impression by the routine techniques after which both models are fastened together in centric occlusion and a second plate is fitted to the gnathostat rod. A block in eight centimetres long is inserted between the plates, the models are placed on the lower plate, and plaster is added to the model of the lower jaw to fill up the space to the upper plate. After they are cast and the needed lines are traced on them, the gnathostatic models are examined in the symmetrograpli. In addition to the line of the frontal plane previously drawn with the pointer of the orbital bar the line of the sagittal plane is traced strictly along the suture of the hard palate. The frontal and sagittal lines are transferred to the model of the lower jaw; to do this both models are brought together in centric occlusion. The line tracings are continued on the outer surfaces of the models. The symmetric arrangement of the

rows of teeth from the midline is studied by means of sliding dividers. In asymmetries, malformations or deformities revealed graphic methods are employed, namely Howley-Herbst diagram.

Fig.14. Diagnostic casts mounted in SAM articulator.

Accurate diagnostic casts transferred to a semiadjustable articulator are essential in a planning of fixed prosthodontic treatment. This permits static and dynamic relationships of the teeth to be examined without interference from protective neuromuscular reflexes, and unencumbered views from all directions reveal aspects of the occlusion not always easily detectable intraorally (e.g., the relationship of the lingual cusps in the occluded position). If the maxillary cast has been transferred with a facebow, a **centric relation (CR)** interocclusal record has been used for articulation of the mandibular cast, and the condylar elements have been appropriately set (such as with protrusive and/or excursive interocclusal records), reproducing the patient's movements with reasonable accuracy is possible. If the casts have been articulated in CR, assessing both the CR and the MI position is possible, because any slide can then be reproduced. Another critical information is not immediately apparent during the clinical examination includes the occlusocervical dimension of edentulous spaces. On an articulator, these are readily assessed in the occluded position and throughout the entire range of mandibular movement. Relative alignment and angulation of proposed abutment teeth are easier to evaluate on casts than intraorally, as there are many other subtle changes in individual tooth position. Articulated diagnostic casts permit a detailed analysis of the occlusal plane and the occlusion, and diagnostic procedures can be performed for a better diagnosis and treatment plan; toothpreparations can be "rehearsed" on the casts, and **diagnostic waxing** procedures allow evaluation of the eventual outcome of proposed treatment.

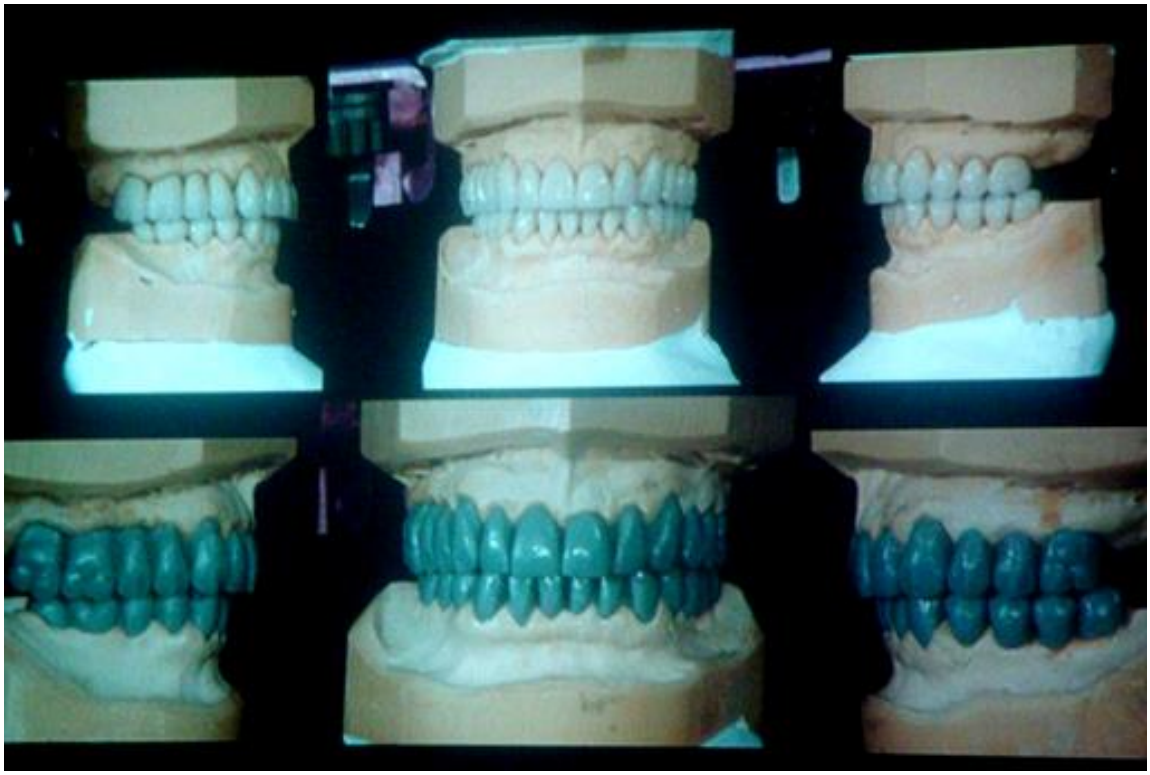


Fig.15. Diagnostic models with wax up.

Occlusal contacts analysis with T-Scan.

In 1987, Tekscan, Inc. (South Boston, MA) developed the T-Scan Occlusal Analysis System, a grid-based sensor technology for reliable measurements of occlusal biting forces and contacts placement. This system consists of a hand-held device with a flat, U-shaped pressure-measuring sensor, which is placed into the patient's mouth between dental rows and produces measurement at a consistent rate of 100Hz which are analyzed with software. This unit produces a frame-by-frame (equal to 0.01 seconds) T-Scan movie, which appears on PC screen. The screen displays the percentage of forces per tooth and a two-dimensional arch view that can be divided into quadrants. Also a three-dimentional force diagram on dental arch model and chart of forces appeare in time.

The T-Scan III has many applications in dentistry, including the occlusion balancing on implant supported dentures, fixed prosthetics occlusion equilibration, periodontics and orthodontic treatment occlusaltrauma checking and removing.

Digital analysis of occlusion with T-Scan has incontestable advantages before occlusal paper: where is no influence of saliva, possibility to analyse occlusal contacts timing.

Fig. 16. T-scan in working condition

Fig. 17. T-scan with sensor and fixator.

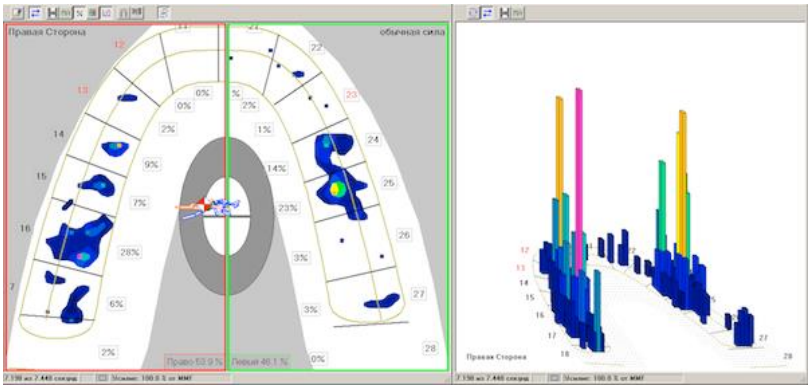


Fig. 18. 2D and 3D forces charts.

VI. Structure and Organization of the Lesson:

6.1. Duration of the lesson – 7,5 academic hours.

6.2. Lesson Stages (table)

№	Lesson stages and their contents	Study objectives and their mastering level	Training and control methods	Materials for the methodical supply	Time in min.
I	Prelimi-nary stage	Subjective methods of examination, interview with patients	Theoretical express questioning. Test control of preliminary le-vel. Written questioning. Solving typical tasks.	Test questions of the 1st level. Test questions of the 2 level. Models, tables, pictures, casts, video-movies	30 min.
II	Basic stage:	Detailed study of all organs of the masticatory system through the clinical and laboratory methods of inspection.	Practical training. 1.Investigation of models. 2.Analysis of pattern works.	Models, pattern works.	70 min.

III	Final stage	Verification of treatment of patients, forming of diagnosis, drafting of plan of inspection and treatment. Clinical analysis of complicated patient's, discussion of motion of manipulations. Decision of clinical tasks.	Individual control of practical skills and their results.	Analysis of results of X-ray films investigating, analysis pattern works and video-movies. Orientation scheme for individual training with literature.	20 min. 10 min. 2 min.

VII. Materials for the lesson methodical supply.

1. Methodical recommendation, diagrams , tables ,questions for the initial control of level of student s knowledge, situation tasks.
2. Students albums.
3. Diagnostic models.

Tasks for methodical supply of the main stage of the lesson:

1. A patient, 45 years, applied to the clinic with complaints about an esthetic defect. Objectively: the crown of the 1st tooth is injured by 2/3, as a result of trauma. What methods of examination must be performed for choice of construction properly?

2. At an objective examination of a patient pain in the area of temporo-mandibular joint during closing and wide opening of mouth. What methods must be used for diagnosis?

VIII. Materials for the methodical supply of the individual students' self-stady:

Sequence of actions	Methods of performance (acquiring skills)
1. Examination of patients 2. Investigation of X-ray 3. Other methods of diagnostic 4. Choose methods of prosthetic treatment	To analyze clinical situations, X-ray and diagnostic cast models. To acquaint with peculiarities of tooth preparation for crowns, fixing of the crowns

Questions for self-control.

1. What diagnosis is?
2. What parts does diagnosis consist of?
3. What parts does the examination of patient consist of?
4. What laboratory and special examination methods do you know?
5. What Electromyography is?