BASICS OF ORTHODONTICS

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КАФЕДРА ОРТОДОНТИИ

ОСНОВЫ ОРТОДОНТИИ

BASICS OF ORTHODONTICS

Учебно-методическое пособие

Репозиторий БГМУ

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Представлена современная классификация оттискных материалов. Рассмотрены основные вопросы клинических и лабораторных методов диагностики зубочелюстных аномалий. Приведены принципы изготовления съемных и несъемных ортодонтических конструкций. Даны общие понятия об ортодонтических аппаратах и изменениях в зубочелюстной системе при их применении.

Предназначено для студентов медицинского факультета иностранных учащихся, обучающихся на английском языке по специальности «Стоматология».

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INTRODUCTION

The educational guidance presents the basic and additional methods of diagnosis and treatment of dentoalveolar anomalies. It reflects the modern classification of impression materials, the basic principles of manufacturing removable and fixed orthodontic appliances. General concepts about orthodontic appliances and changes in the dentoalveolar system through the orthodontic treatment are presented. Basic principles of diagnostics and treatment of dentoalveolar anomalies are presented. The basic methods of orthodontic treatment and rehabilitation of children with congenital clefts in the maxillofacial area are described. Specific features of manufacturing of crowns and dentures in children are described. Presentations are given about the control and management of the space in the dental arch in children.

PRACTICAL SESSION 1

TOPIC: Orthodontics as a branch of dentistry: objectives, tasks. History and directions of specialty development. Organization of orthodontic care in the Republic of Belarus. Orthodontic office equipment, orthodontic tools.

Total time of session: 6 academic hours.

Topic description. Orthodontics is an independent and fast developing branch of dentistry. Purposes of orthodontics play an important practical role for health care. Solution of these problems, finding out and developing new directions of specialty that are related with adjacent disciplines are actual questions of contemporary dentistry. Therefore knowledge of subject and ability of its applying in practice are integral requirement for dentist of any specialty.

Aims and objectives of the lesson. Students should know:

1) definition of Orthodontics as a subject, its interrelation with other dental disciplines;
2) aims and missions of Orthodontics in medical aspect;
3) equipment and work organization of orthodontic office;

Requirements for the initial level of knowledge. Student should recollect in the Course of General Dentistry, Orthopedic Dentistry and Municipal Dentistry:

1) sanitary and hygienic norms of work organization in dental office;
2) exploitation rules for electric equipment in dental office, requirement of asepsis and antisepsis while using inventory and instruments in dental office;
3) material equipment of orthopedic office;

Practical questions of related disciplines:

1. What is the minimal square of the office for working with dental unit and dental chair?
2. What is the scheme of planned quarz disinfection of dental office during working day?

3. What are the main rules of electric equipment exploitation needed to work with dental unit?

4. What kind of material tools and devices is orthopedic office completed with?

Practical questions:

1. Orthodontic as a branch of dentistry. Definition of the subject, aims, missions and directions of development.

2. Work organization and material equipment of the orthodontic office. Differences in equipment between orthodontic and orthopedic offices.

Educational grants. Orthodontics is an independent branch of dentistry concerned with studying etiology and pathogenesis of malocclusion, creating and working out the methods of diagnostics, prevention and treatment of anomalies of the tooth position, dental arch form and occlusion, managing the jaw growth, correcting the functions of dentoskeletal system, improving esthetics, affecting the development of adjacent organs and the whole human body.

Both in our country and abroad the rapid development of Orthodontics was reported in the second half of the 20th century. The significant success was achieved in research of new approaches for management of malocclusion. Insufficient acquaintance with progress in orthodontics leads to using the outdated ineffective methods in daily practice, incorrect producing of new orthodontic appliances and results in clinical mistakes.

Irrespective of increasing volume of scientific and practical information on Orthodontics that is reflected in the special literature there are some questions studied not good enough. Poor attention is payed to the planning orthodontic treatment of children with caries, periodontal diseases and bad level of oral hygiene. There are different data about correlation between timing and completeness of treatment and severity of both morphological and functional disorders and patient-doctor interaction. There are also lack of information about providing prosthetic help for children with dentoskeletal abnormalities caused by traumas or congenital anomalies of dentofacial system. Providing orthodontic treatment remains rather actual problem in the regard to high prevalence of dentoskeletal abnormalities. Taking into account the conception of correlation between malocclusion and disorders in adjacent major organ systems of the human body the new approach is needed in organization of orthodontic treatment in our country. Nowadays taking into account patient's age, completeness and specifies of treatment six main directions in orthodontics are determined:

1. Preventive orthodontics in kindergartens and schools. To realize the goal of providing orthodontic help it is necessary to detect the children needed in orthodontic treatment while carrying out planned oral cavity sanitation in kindergartens and schools. It is reasonable both to detect children with orthodontic problems and to carry out preventive measures according to the patient's age and causative factors of disorders. The main preventive measures include:

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1) carrying out myotherapy as an independent treatment method for correction functions of dentofacial system;

2) artificial reduction of unworn cusps and cutting edges of primary teeth to prevent development of malocclusion in sagittal, vertical and transversal planes at early age;

3) subscribing massage of tongue, upper and lower lips frenums, alveolar processes and single teeth to provide teeth alignment in dental arch.

2. Specialized treatment for children and adolescences in integrated orthodontic departments. It includes management of teeth, dental arches and occlusion disorders in periods of primary, mixed and permanent dentition.

3. Orthodontic treatment for adults. It is carried out as preparatory stage before prosthetic treatment.

4. Orthodontic rehabilitation of patients with congenital malformations of dentofacial system as a part of complex treatment. Timely detection, taking under regular medical checkup and carrying out treatment in dental clinics and hospitals are important measures in realizing this direction. Orthodontic treatment of children is known to be a part of complex rehabilitation of patients with such kind of pathology. Surgical approach at early age is applied rarely. Therefore orthodontic treatment is an alternative way to recover function disorders, speech first of all. Orthodontic treatment prevents the development of both mental disorders, wrong articulation skills and atrophy of palatopharyngeal apparatus and also provides good environment for speech organs training, that in turn contributes to the achievement of functional result after surgery.

5. Orthodontic treatment in hospital as previous and final stage of surgical correction of malocclusion.

6. Orthopedic treatment for children and adolescents is conducted in different periods of dentition. Timely replacement of defects in the crowns of primary teeth and dentition by prosthetics for the correct formation of occlusion and functions of the dentoalveolar system plays an important role. This contributes to prevention of secondary deformations in the dentition and disorders of the position of individual teeth.

Orthodontic office organization. Orthodontic office is supplied with equipment, tools and other personal items for one physician’s position, as well as equipment, tools and products for collective use. The doctor's workplace must take into account ergonomics, i.e. such a system of doctor’s movement in the office at which the expenditure of physical forces and time is minimal.

To work as an orthodontist, you need the following material equipment of the office:

1) stationary dental unit;

2) dental chair compatible with a stationary unit;

3) mobile soft chair with a back;

4) doctor's working table with medicines and instruments;

5) a desk for documentation;

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6) chairs for patients and nurses;

7) washbasin with mirror;

8) a table with a set of sterile tools and dressing material;

9) a case for storing diagnostic models;

10) a medical case for storing medicines to provide emergency and bandage materials;

11) a table for storage, mixing gypsum and pouring impressions with gypsum;

12) case with a set of special orthodontic tools (a set of forceps for working with multibonding systems, scissors for metal, round pliers, crooked forceps, anvil, dental hammer, etc.). Instruments for Orthodontist's work are presented in Figures 1–18.

Fig. 1. Tungsten Carbide Cutters

Fig. 2. Aderer Pliers (3-prong pliers) for working with transpalatal elements

Fig. 3. Arch-bending pliers – Tweed

Fig. 4. Begg light wire pliers

Fig.5. Angle pliers

Fig. 6. Separating pliers

Fig. 7. Scissors for metal

Fig. 8. Wire cutters

Fig. 9. Distal end cutters

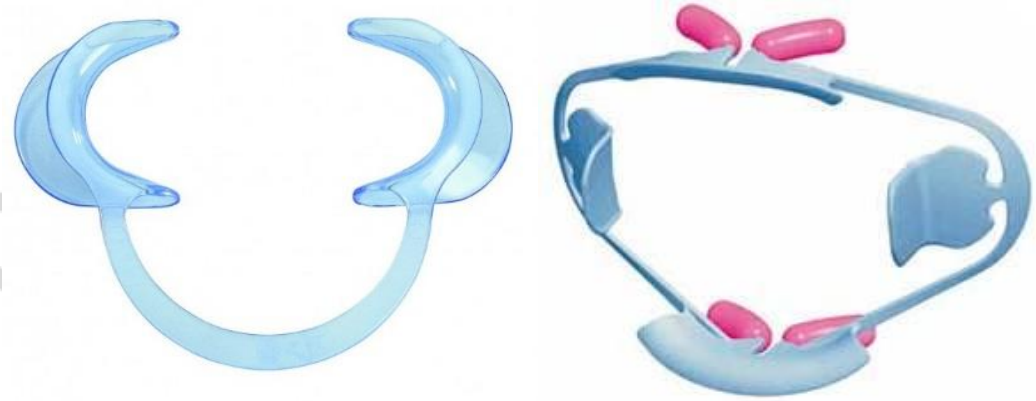

Fig. 10. Cheek retractors

Fig. 11. Band biter

Fig. 12. Posterior band remover

Fig. 13. Boone bracket position gauge

Fig.14. Self-locking bracket tweezer

Fig. 15. Ligature director

Fig. 16. Mathieu needle holder

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Fig. 17. Direct bond removing pliers

Fig. 18. Hemostat forceps

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TASKS FOR INDEPENDENT WORK OF STUDENTS

1. Orthodontics as a (specialty):

a) a section of maxillofacial surgery;
b) an independent section of dentistry;
c) a section of paedodontics.

2. An instrument for determining the position of the bracket on the tooth crown:

a) a mirror; c) tweezer; e) clasp.
b) a positioner; d) a retractor;

3. The main orthodontic preventive measures in kindergartens and schools:

a) carrying out myotherapy;
b) artificial reduction of unworn cusps and cutting edges of primary teeth to prevent development of malocclusion in sagittal, vertical and transversal planes at early age;
c) using functional orthodontic appliances.

PRACTICAL SESSION 2

TOPIC: Impressions, impression materials used in orthodontics. Classification and general characteristics of the modern impression material properties.

Total time of session: 6 academic hours.

Topic description. It is known that the qualitative final result of the doctor's work depends not only on his experience and training, in many ways it is determined by the quality of materials offered for his work by modern science and industry. Getting quality prints and the technique of using impression materials is an important work of a specialist of any dental specialty. Each qualified physician should possess a modern level of knowledge and skills in the issue.

Aims and objectives of the lesson:

Students should know the classification of impression materials used in dentistry. Have an idea of the physical and chemical properties of impression materials. Master the features of obtaining impressions in the clinic children and adolescents with elastic impression materials by means of standard impression trays. Master the skills of manufacturing working and diagnostic dental casts.

Requirements for the initial level of knowledge. Student should repeat from the course of general and orthopedic dentistry:

1. Classification of impression materials at the development stages of technology of their production.
2. Physical and chemical properties of impression materials used in dentistry.
3. Anatomical structure of the oral cavity, its features in children.
4. Age features of the formation of functions of the maxillofacial complex.

Practical questions of related disciplines:

1. Classification of impression materials by A.I. Doinikov, V.D. Sinitsyn. What principle is the basis of this classification?
2. What is the composition and properties of medical gypsum?
3. Name the boundaries and natural anatomical formations in the area of the vestibule of the oral cavity and the mouth.
4. Define the concept of the prosthetic bed, which anatomical structures include the boundaries of the prosthetic bed on the upper and lower jaws?
5. What are the age periods of the reorganization of the sucking function, swallowing, chewing and speech.

Practical questions:

1. Types of impression materials. Choice and components of the standard impression tray.
2. Name the basic requirements for impression materials. Technique and features of obtaining impressions in children.
3. Irreversible rigid impression materials. Medical gypsum, its positive and negative properties as impression material.

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4. Zincoxide-eugenol impression materials. Name them representatives, field of application. Advantages and disadvantages.

5. Reversible rigid impression materials (compounds). Name it representatives. The technique of their application. Advantages and disadvantages. Reversible agar-agar hydrocoloids. Their application in dentistry.

6. Irreversible elastic impression materials. Alginate hydrocolloids, anhydrous elastomers. Name representatives, field of application, advantages and disadvantages.

Educational grants. Orthodontic devices are manufactured in the dental laboratory on working models of jaws. Working models, in turn, are made of a model material, more often medical plaster (gypsum, supergypsum), of impressions obtained by special auxiliary impression materials from the tissues of the prosthetic area. The boundaries of the prosthetic area are those tissues and anatomical structures that have direct contact with the prosthesis or apparatus. Impression in dentistry is called reverse (negative) mapping of the relief of hard and soft tissues of the prosthetic area and adjacent anatomical structures.

The classification of the impressions is based on the following principles:

1. The first principle takes into account the number of simultaneously displayed dental arches, when getting impressions. In accordance with this, there are two-jaw and single-jaw impressions. Two-jaw imprints are obtained with the help of special impression trays with simultaneous recording (fixation) of the central occlusion. One-jaw impressions are obtained on one of the jaws.

2. The extent of the displayed parts of the dentition of one or both jaws determine the selection of partial impressions, displaying individual teeth, groups of teeth or half of the dentition, and full — reproducing the entire dentition of the jaw or dentition of both jaws.

3. The number of layers of impression material. On this basis, there are two-layer and one-layer prints. Two-layer impressions, depending on the methods of their preparation, can be single-phase and two-phase. Single-phase impressions are obtained with simultaneous mixing and application on the prosthetic area of two layers of material (basic and corrective). Two-phase impressions are provided for the alternate preparation of materials and the preparation of a basic and corrective layers.

4. The fourth principle, which is the basis for the most well-known classifications of impressions, takes into account the methods of obtaining them. There are imprints of anatomical, functional and occlusion recorders. Anatomical impressions are obtained by standard tray without taking into account the pressure of the impression material on the soft tissues of the prosthetic area. To obtain functional impressions individual impression tray is used. The method of obtaining them involves dosing pressure on the mucous membrane and designing the edges with functional tests. The occlusion registrators are prepared by superimposing material between the dental arches without using the impression tray. With its help, the models are compared in the position of the central occlusion.

5. Depending on the purpose, prints are subdivided into working, auxiliary and diagnostic. Working Impression is designed to reproduce a dental cast on which a prosthesis or apparatus will be manufactured. A subsidiary is the negative display of the antagonist teeth, the reproduction of which on the model will be used for auxiliary purposes. So, for example, when manufacturing a prosthesis (denture) on the lower jaw, the impression of the lower jaw will be working, and the impression of the upper jaw will be an auxiliary one. Diagnostic impressions produce dental casts that allow studying the relationships of dentition, alveolar processes and other features that are important for diagnosing, planning treatment and evaluating its results.

Impression trays. Impression procedure is carried out by using impression trays. There are standard (stock) and individual (custom) trays. Standard trays are manufactured by the industrial method, and individual ones — in dental laboratories. Materials for making standard tray are most often stainless steel and plastics.

Custom trays are made of self-hardening and light-curing plastics (acryl) and compounds. Standard trays have different shapes and sizes. The widest application in the clinic of dentistry is the metal complete standard single-jaw tray for the upper and lower jaws with preserved dentition. In the tray there is a handle, an area for teeth and alveolar processes, sides, a palatal arch (in trays for the upper jaw) and a cutout (fissure) for the tongue (in trays for the lower jaw)

Orthodontic practice uses standard trays No. 1, 2, as well as individual trays, more often in patients with congenital disorders (cleft palate), after trauma, radical surgical interventions of maxillofacial area (fig. 19, 20).

Fig. 19. Standart plastic trays

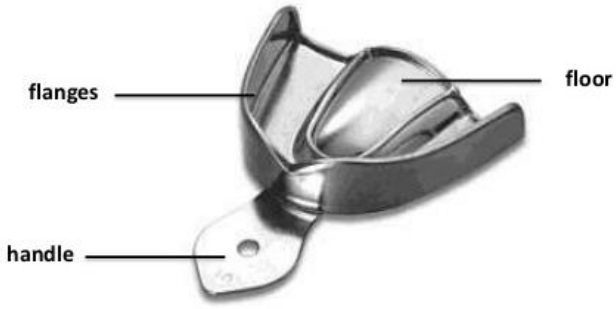

Fig. 20. Parts of impression tray

The technique of obtaining impressions in children corresponds to the general principles of the course of orthopedic and general dentistry, but at the same time there are a number of **special rules**:

1. When receiving an impression, it is necessary to take into account the psycho-emotional state of the child. In the absence of contact with the patient, it is better to postpone the procedure time to a more favorable moment.

2. Selection of an impression tray should be carried out especially carefully so as not to frighten and not to injure the child in full compliance with rules of aseptic and antiseptic.

3. The choice of impression material should be given to materials from the group of elastic, comfortable having a pleasant taste, color and consistency when working with children.

4. Removal of the tray from the oral cavity after curing the impression material should not be rude.

5. Receiving an impression, the child is obliged to have direct medical control and, if necessary, measures to prevent aspiration of fragments of the impression in the respiratory tract.

Modern industry offers a large number of names of impression materials obtained on the basis of the latest achievements of science and the latest technologies, but on a par with them today in dentistry there are materials proposed in the last century: gypsum, masses containing wax, various resins, oils, oxide zinc. The search of optimal impression materials continues today, since the available manifold of impression materials has in its majority both advantages and disadvantages.

Highlights of the **basic requirements**, which must have impression materials used in dentistry:

1. Should give an accurate imprint of the relief of the mucous membrane of the mouth and teeth.

2. Preserve the constancy of the size after removal of the impression from the oral cavity and shrinkage should not exceed 0.1%.

3. The material should be easily applied to prosthetic tissues and easily removed from the mouth after hardening.

4. Do not disintegrate when interacting with the environment of the oral cavity.

5. As a result of the thermal and chemical processes occurring in the material, they should not have a harmful effect on the tissues of the oral cavity and the body on the whole.

6. Do not cure too quickly or slowly, allowing the doctor to perform functional tests.

7. Do not connect with the model material.

8. Do not have smell and taste or have a pleasant smell and taste.

9. Must have a light antiseptic effect.

10. Easy to be packaged and dosed, convenient for storage, transportation and relatively cheap.

11. The prepared impression material should be homogeneous, do not have grains.

12. Must be disinfected.

Classification of impression materials. According to the chemical composition, physical properties and conditions of use, the impression materials are combined into appropriate groups.

The most complete classification of modern impression materials, reflecting the curing regime, physical state and chemical composition of materials,

should be recognized as the ISO classification (G. Staegemann, 1990; R. Phillips, 1991) (tabl. 1).

Table 1

Classification of impression materials ISO (TC 106)

	Irreversible (Hardening as a result of chemical reactions)	**Reversible (Hardening as a result of temperature changes)**
Rigid	1. Gypsum (ß-hemihydrate) 2. Zync-oxid-eugenol paste (ZOE) 3. Non-eugenol paste (ZONE)	1. The wax 2. Thermoplastic composites (compounds)
Elastic	1. Alginate hydrocolloids 2. Elastomeric: – Polysulfide; – Polyether; – Silicone (C-type, A-type)	Agar hydrocolloid

In the characteristics of the principles of curing materials they are isolated: irreversible materials, hardening as a result of chemical reactions and reversible materials — hardening under the influence of temperature changes.

The physical state of the impression material after its curing is characterized as rigid or elastic.

Rigid, irreversible impression materials. *Gypsum. Zincoxide-eugenol paste.*

Gypsum is a widely used auxiliary material used in dentistry for performing various medical and dental work. Gypsum-calcium sulfate has long been the main material for impressions. This is due to its availability and cheapness. In addition, it gives a clear imprint of the surface of the tissues of the prosthetic area, it is harmless, does not have unpleasant taste and smell, practically does not shrink, does not dissolve in saliva, does not swell when wetted with water and easily separates from the model when using simple separation agents (water, soap solution).

Along with the positive qualities gypsum has a number of shortcomings, as a result of which in recent years it has been replaced by other materials.

Gypsum is fragile, often leads to breakage of the impression when removing it from the mouth, its small parts, filling the space between the teeth, are often lost.

Zincoxide-eugenol impression materials — mixtures containing zinc oxide and eugenol (guaiacol), are widely used in dental practice as impression fillings. In some cases, zincoxide-eugenol (ZOE) materials are used for temporarily fix provisional prostheses.

The material consists of two pastes, which include zinc oxide, eugenol, plastificators, catalysts, fragrances and dyes. Produce ZOE pastes in the form of sets consisting of two tubes, with differencies in composition and color components.

To obtain the impression, the required amount of both pastes is mixed on water-resistant paper in equal amounts using a metal spatula for cement.

Stirring is carried out for 1–1.5 minutes until a uniform color is obtained. The working time is 3–4 minutes, and the setting time is 7–10 minutes. The ZOE impression materials have acceptable shrinkage. Reducing the size of the material during hardening does not exceed 0.1 %.

The scope of ZOE, as an impression material, is primarily related to functional imprints. For these purposes, the material is suitable due to its ability to print with distinct images of parts, its consistency of volume and ability to harden in a moist environment. The correct consistency of the paste excludes the possibility of forceful compression of soft tissues and allows you to get imprint irreproachably according to the individual characteristics of the patient. Unlike gypsum, ZOE materials allow the specification of a functional impression (relocation) or additional compression of the mucous membrane in the area of the glandular zone. A new portion of pasta, layering on the previous layer, is well connected with it. ZOE imprinting materials are — Dentol-M, Bite Registration, Cavitec, Coltex, ZOE Impression Paste.

Hard reversible impression materials (compounds). Compounds belong to the group of reversible impression materials because of the ability of the mass to acquire good plasticity under the influence of a certain temperature and return to the original (hard) state after reduction temperature.

Impressive compounds (type I) are used for obtaining impressions from individual teeth with the help of tooth bands, preliminary (anatomical) impressions from toothless jaws and recording occlusion. The second type — the basic compound — is used to produce the first layer of double impressions, the production of individual trays, the correction of the edges of individual trays, and the laboratory relocation of removable dentures. Compounds are a composition of substances with thermoplastic properties. They include plastificators (paraffin, ceresin, stearin, beeswax, rosin, gutta-percha, etc.) and fillers that change the strength of the material, thermoplasticity and correcting temperature conditions. In addition, the composition of compounds includes dyes and fragrances that impart a corresponding color and flavor to the mass. They include the mass of Stens, proposed in 1856, as well as: acrodent-02, dentafol, MST-01-02-03, orthocor, stance-02, stomoplast. The main drawbacks of the compounds are the stiffness of the material, which manifests itself even at the temperature of the oral cavity and irreversible deformation of the impression when it is removed from the oral cavity. This is especially true in the presence of undercuts and convergent teeth, when it is not possible to remove the impression without distortion. Long-term storage of impressions is not recommended, because external temperature effects can lead to softening of the material and distortion of the display. Thermoplastic compounds do not have the ability to display small details of the relief and are connected with the model material.

Elastic, irreversible impression materials (alginate hydrocolloids). This group of impression materials includes materials based on the sodium or potassium salt of alginic acid. They represent powders which, when mixed with water, form a sol, which turns in the result of chemical reactions into a gel. To give the gel physical properties that allow it to be used as an impression material, it is necessary to increase its elasticity and rigidity, to reduce the stickiness. This is achieved by the insertion of gypsum into it, as well as fillers (white soot, barium sulfate, sodium carbonate, etc.). Representatives of this group of materials are: Stomalgin, Aelastic, Ypeen, Hydrogum, Algosan, and others.

To mix components of alginate impression materials, a rubber bulb, a plastic or metal spatula are used. Tools should be clean without remnants of other materials.

It is advisable to have separate mixing bowls (flasks) for gypsum and alginate masses. When two-component «powder-water» system is used, the powdery composition is mixed with water. Dosage of powder and water is carried out with the help of special measuring devices included in the kit. To obtain a partial impression, measure 1 powder meter and 1 water meter. To obtain a full impression from the lower jaw, two powder measures and two water measures are usually taken. For a full impression from the upper jaw, three measures of both powder and water are used. In all cases, the individual sizes of the jaws are taken into account. A disadvantage of alginate impression materials is a change in their linear dimensions after removal of the impression from the oral cavity and its improper storage. The reason for the instability of dimensions is the ability of hydrocolloids to lose or absorb water. Pouring alginate prints with gypsum should be carried out immediately, while the dental cast is easily separated from the alginate impression and reproduces the microrelief to 0.05 mm.

Elastic, irreversible impression materials (anhydrous elastomers). In addition to hydrocolloid irreversible gels, there is another group of irreversible elastic impression materials called anhydrous elastomers. Depending on the chemical composition, four groups of anhydrous elastomers are isolated: polysulfide, condensed silicone, A-silicone and polyester materials. Each group of anhydrous elastomers, in its turn, is classified with regard to consistency. Their representatives: polysulfide — Tiodent-M, Surflex and others; condensed — Alphasil, Coltex, Dentosil, etc.; filled silicone (A-type) — Aqasil, Bisico, Contrast, etc.; polyester - Impregum, Ramitec, etc.

Anhydrous elastomers are produced by various manufacturers in a wide range.

With the help of elastomeric materials one-layer and two-layer impressions are obtained. Depending on the technique of production, two-layer impressions are subdivided into single-phase and two-phase impressions. They have in their composition a basic paste, paste-catalyst, they also contain various types of fillers, plasticizer, dyes and other additives. The dosage of components and the preparation technique of the material are carried out strictly according to the in-

structions of the manufacturer. The drawbacks of anhydrous elastomers include: the complexity of using them in children (double-layered impressions), a relatively high cost, some pastes after mixing have an unpleasant taste and side-effects that are not indifferent to the child's body.

Elastic reversible impression materials (agar-agar hydrocolloids). If in irreversible hydrocolloidal materials the transition of the sol to the gel takes place by chemical reaction, then in the reversible hydrocolloid impression materials, the agar sol is converted to a gel at a temperature of 37 °C. The composition of reversible hydrocolloid impression materials includes the following ingredients: agar, borax, sulfates, wax, fillers, water. Agar is the most suitable base for reversible elastic hydrocolloid materials, since the gelling temperature corresponds to the temperature of the oral cavity. Agar hydrocolloids provide high accuracy of the relief display (from 0,075 to 0,02 mm) and are easily separated from the model material. At the same time, low strength of agar gel can promote deformation of the impression during its removal from the oral cavity. There are two methods of obtaining impressions using reversible hydrocolloids: single-layer and two-layer (single-phase). Obtaining single-layered impressions is difficult due to the long process of gelling (about 17 minutes). More acceptable is the method of applying reversible hydrocolloids to fabrics by means of an alginate impression material (technique for producing a two-layer single-phase impression). For the preparation of a reversible impression hydrocolloid mass, special equipment and tools are necessary. The materials are produced in special syringes for the convenience of adding mass to the formed cavity. Conversion of gel into sol is carried out by immersing the syringe in boiling water for 10 minutes. Then, the sol is cooled in a thermostat to a temperature of 65–68 °C, where it can be stored for a long time. The impression is removed, when the time of binding of the alginate material to the hydrocolloid is completed, the impression is removed from the oral cavity by a fast strong movement directed along the longitudinal axis of the teeth. Slow swinging movements, as well as minor efforts to remove the impression, contribute to its deformation. Casting a model to prevent surface porosity due to syneresis of the impression material, inhibitors of its crystallization reaction are used in the preparation of gypsum. The impression and model should be contacted for 60 minutes.

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TASKS FOR INDEPENDENT WORK OF STUDENTS

1. Main requirements for impression materials:

a) Resistance to destruction in oral environment;
b) Absence of connection with modeling material;
c) Sufficient working time;
d) Shrinkage after polymerization less than 1 %.

2. Application impressions:

a) Only standard impression trays;
b) Only individual impression trays;
c) Standard and individual impression trays.

3. The aim of application impressions:

a) Functional; c) Diagnostic;
b) Monolayer; d) Working.

PRACTICAL SESSION 3

TOPIC: Anthropometric research method in orthodontics. Aesthetics face analysis. Face and head parameters analysis.

Total time of session: 6 academic hours.

Topic description. Correct diagnosis is the key point in the doctor's work. Without this it is impossible to understand the causes of the pathology, to determine the level of morphological disorders, and therefore, to develop an optimal plan of treatment. Information, which has been received during dental examination of the patient, in most cases is insufficient. Additional information can be received by conducting laboratory (additional) research methods. One of such methods in orthodontics is the anthropometric measurement of a patient's face photos. Each qualified specialist should not only be able to conduct such research, but also correctly interpret it.

Aims and objectives of the lesson. Students should know:

1) the purpose of anthropometric research;
2) mesial and lateral cephalometric points on the face and head.
3) linear and angular parameters of the face and head.
4) the morphological index according to Garson, profile types according to Khoroshilkina.
5) how to conduct and evaluate the results of anthropometric measurements of the face and head, as well as the criteria of the dental aesthetic index (DAI).

Requirements for the initial level of knowledge. Student should recollect in the from:

Course of Orthopedic Dentistry:

– Anthropometric research used in orthopedic dentistry.

Practical question of the related disciplines:

– Anthropometric research used in orthopedic dentistry.

Practical questions:

1) Dimensional planes, used during study of the head and jaws. Which anatomical structure do they cross and how do they interact with each other?

2) Anthropometric metrical points on the head and face, their localizations. Measuring the facial heights and horizontal parameters of the head and face.

3) Ricketts analysis of the facial profile. Evaluation of the facial form with the frontal perspective and evaluation and calculation of facial morphology index.

4) Criteria of the dental aesthetic index (DAI). Interpretation of the DAI.

Anthropometric methods of studying the aesthetics of the face. In studying aesthetics of a person three orienting planes are used: midsagittal, Frankfurt and frontal (tabl. 2, 3). All of them are mutually perpendicular to each other and conditionally cross the head through certain landmarks (fig. 21).

Concerning this or that plane, we study and describe regularities or deviations in the structure of the face (sagittal, vertical, transversal).

Linear dimensions of the face. Anthropometric characteristics of the face measurements are carried out on the skull, on the face, in photographs and cephalograms of the head, on the models of the jaws. Anthropometric parameters are determined by a number of vertical, horizontal and angular magnitudes.

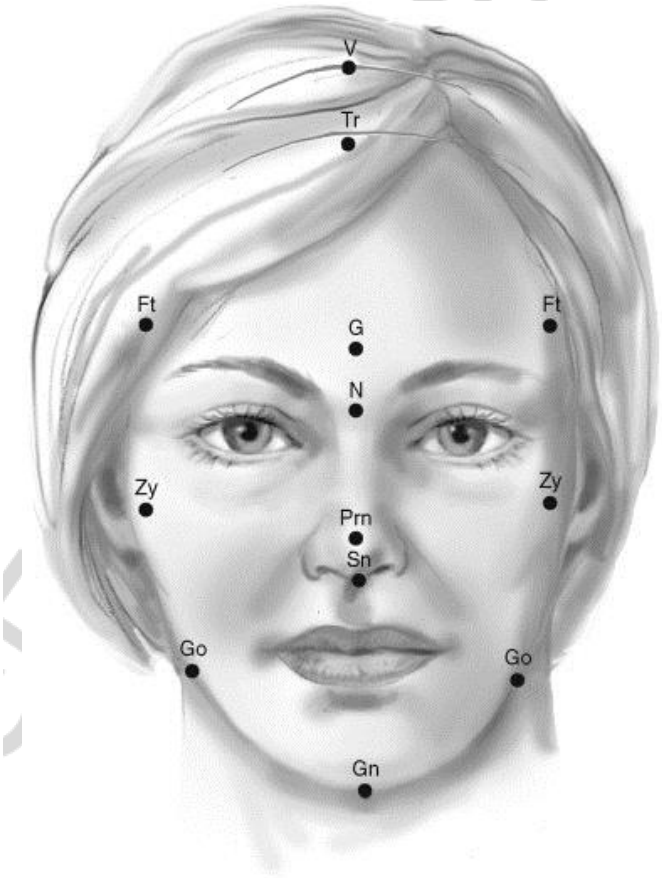

Fig. 21. Location of cephalometric measuring points on the head and the face is represented

Table 2

Approximate planes of the head and jaws

Conditional designations	Planes head	Conditional designations	Planes jaws
SS	Midsagittal the plane passes vertically front to the back through the middle of the nose between central incisors on the seam of the hard palate and divides the head into the right and left halves	**RM**	Mid palatal raphe plane — corresponds to the midsagittal plane. Passes on the seam of the hard palate
F	Frankfurt plane goes horizontally through the inferior margin of the orbit and upper edge of external auditory meatus perpendicular to the first plane and divides head into upper and lower divisions	**OC**	Occlusal plane passes through the cusps of premolars and mesial-buccal cusps of molars perpendicular to the first plane
Or	Orbital or frontal plane-crosses face from top to bottom through superior and inferior edges of the orbits perpendicular to two previous ones and divides the head into the front and back divisions	**Tb**	Tuberosity plane — passes behind Tuber maxillae perpendicular to two previous planes

Table 3

Cephalometric measuring points of the head

Conditional designations	Medial points	Conditional designations	Lateral points
Tri	Trichion-the point of intersection of the normal hairline and the middle line of the forehead	Eurion	The most lateral point on the head
Oph	Ophrion-the point of intersection of midsagittal plane and line above the orbits	Orbitale	The lowest point in the inferior margin of the orbit
N	Nasion-the point of intersection of the frontal bone and two nasal bones	Zygion	The most lateral point on the zygomatic arch
Prn	Pronasal-the most prominent point on the tip of the nose	Tragus	The point on the superior edge of the external auditory meatus
Sn	Subnasal-the point where the lower boarder of the nose meets the outer contour of the upper lip	Gonion	The most inferior and posterior point on the mandibular angle
Pg	Pogonion-the most anterior point of the chin	Ft	Fronto-temporale — the most anteri- or point of the temporal line on t he frontal bone
Gn	Gnathion-the most inferior point of the chin		

Vertical parameters. The face is distinguished by physiognomical (from the point tr — trichion to the point gn — gnathion) and morphological (from the point n — nazion to the point gn — gnathion) height. In assessing the harmony faces distinguish between the upper part — from the border of the scalp of the forehead (point — trichion to the point oph — ophrion), the average part — from the point oph (ophrion) to the point sn (subnazal) and the lower part which is located between the sn (subnazal) and gn (gnathion).

In this case, only the middle part of the face has a relatively stable dimensions, the lower one depends on the height of the occlusion, the upper one — on the severity hair on the head.

Horizontal parameters. The most often horizontal parameters:

a) the greatest width of the head (eu-eu);

b) frontal width of the face (ft-ft);

c) zygomatic width of the face (zy-zy);

d) bigonial face width (go-go).

The shape of the face. The shape and size of the face are determined by the ratio vertical and horizontal parameters.

Garson (1910) proposed to calculate the morphological index of the face — this is the percentage of the morphological height of the face to the largest zygomatic width:

$$\frac{n - gn}{zy - zy} \cdot 100\,\%.$$

The author singled out 5 types of faces:

1 — very broad face — the index value is less than 78,9 %;

2 — wide face — 79,0–83,9 %;

3 — the average face — 84,0–87,9 %;

4 — narrow face — 88–92,9 %;

5 — very narrow face — 93,0 % or more.

The shape of full face was established by studying the relationship of the morphological height of the face to its zygomatic width, taking into account the convergence of its lateral parts. Thus, four main forms of the face were identified:

1. Rectangular shape — when the morphological height of the face exceeds its zygomatic width, and the tangents to the lateral contour of the head (eu-go) are parallel to each other or converge slightly up to 30 %.

2. Square shape — with equal or less value morphological height in relation to the zygomatic width, with parallel to the tangential to the side contour of the head.

Triangular form — in which the tangent to the side contour head sharply converge downwards (angle of inclination is more than 30 %).

A rhomboid form — in which the tangents to the side contour head converge at the level of the zygomatic arches.

In order to study the facial aesthetics, a number of angular parameters are used. A. Schwarz (1936) recommended connecting points subnasal (sn) and pogonion (pg) and measure the profile angle (T) formed by this line and nose plane (Pn), to characterize the location of the subnasal and pogonion with respect to the nasal plane and the definition of the degree of convexity or concavity of the face (fig. 22).

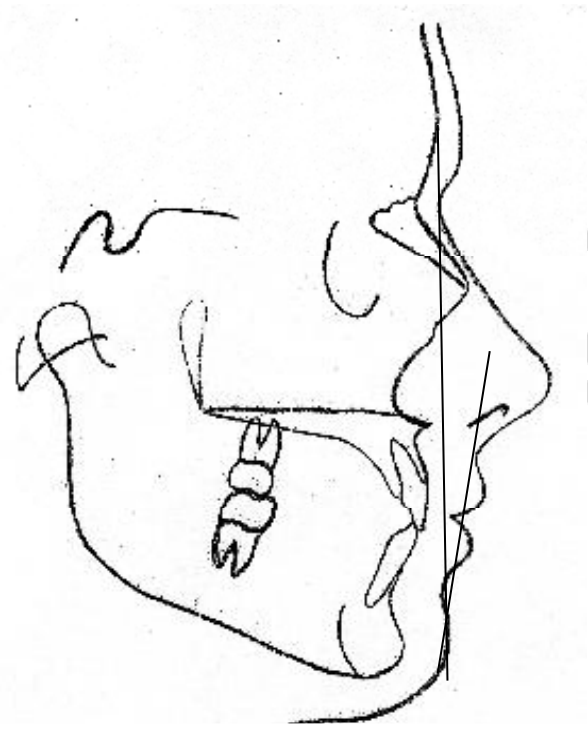

Fig. 22. Determination of the profile angle T by A. Schwarz (1936)

This angle is on the average 10 °. With an average angle, the shape profile of the person, in the opinion of the author, is ideally aesthetically pleased and it is called a «direct profile»; If the angle is greater than 10°, the profile is denoted as «beveled back», if it is less than 10°, then the profile is called «Oblique anterior». Increasing the angle gives the face an expression of tenderness, and a decrease of energy.

Khoroshilkina (1970), using the Ricketts method (1960) (fig. 23).

Depending on the location of the lips according to the aesthetic plane, which is conditionally carried through the points prn-gn, it can be identified four types of face profile:

1 type — the lips are located in front of the aesthetic plane:

a) at an equal distance;

b) one lip prevails — upper or lower.

2 type — the lips touch the aesthetic plane.

3 type — the lips are located behind the aesthetic plane:

a) at an equal distance;

b) one lip prevails — upper or lower.

4 type — different combinations of the above options.

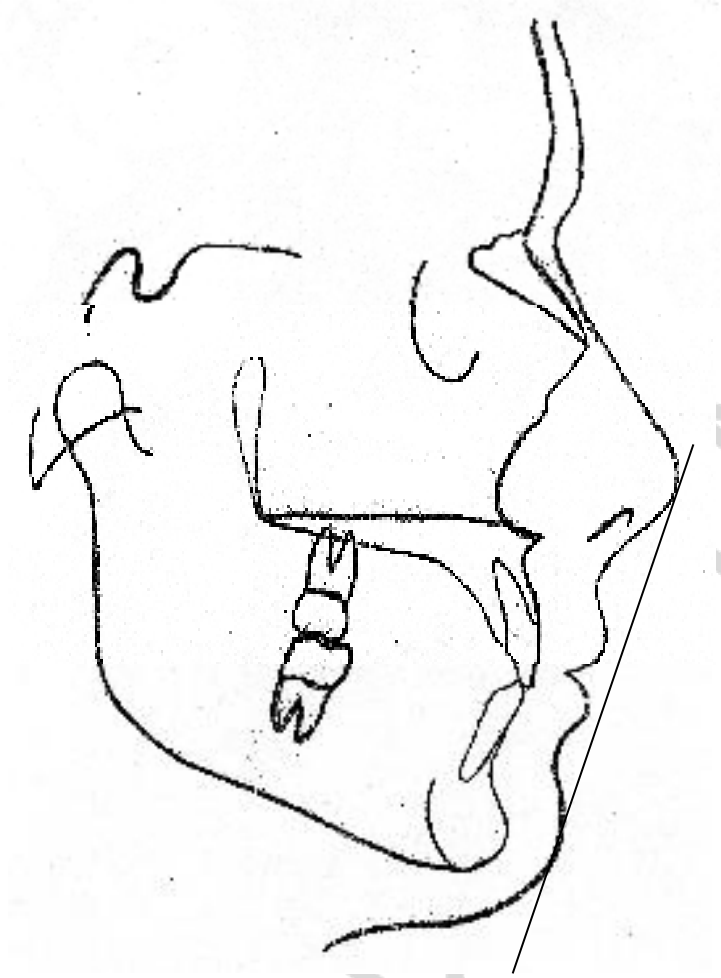

Fig. 23. Aesthetic plane by Ricketts

The Dental Aesthetic Index (DAI) (tabl. 4), developed in the United States of America and integrated into the International Collaboration Study of Oral Health Outcomes by the World Health Organization (WHO, 1989) as an international index, identifies occlusal traits and mathematically derives a single score. As dental auxiliaries can use the DAI to determine which patients apply to a specialist, this can reduce the number of initial consultations by dentists or orthodontists, and become an important advantage in public health programmes. DAI scores have also been found to be significantly associated with the perception of treatment needed by students and parents and these are good predictors of the acceptance of future fixed orthodontic therapy.

The regression equation for calculating the DAI score is as follows: (absent teeth x 6) + (crowded) + (spacing) + (diastema*3) + (largest anterior irregularity on the maxilla) + (largest anterior irregularity on the mandible) + (anterior maxillary overjet x 2) + (anterior mandibular overjetx 4) + (vertical anterior open bite x 4) + (anteroposterior ratio of molars x 3) + 13. The levels of malocclusion in the population are classified according to the scale of the aesthetic index, as shown in Table 5.

Table 4

Dental aesthetic index components	Weights
No. of missing incisor, canine, or premolar teeth in maxillary and mandibular arches	6
Crowding in the incisal segments (no. of segments crowded)	1
Spacing in the incisal segments (no. of segments spaced)	1
Midline diastema in millimeters	3
Largest anterior irregularity on the maxilla in millimeters	1
Largest anterior irregularity on the mandible in millimeters	1
Anterior maxillary overjet in millimeters	2
Anterior mandibular overjet in millimeters	4
Vertical anterior open bite in millimeters	4
Antero-posterior molar relation; largest deviation from normal either left or right, 0 = normal, 1 = ½ cusp either mesial or distal, 2 = one full cusp or more either mesial or distal	3
Constant	13
Total	DAI Score

Table 5

DAI scores	Severity levels	Frequency/percent
<25	Minor or no anomaly (no or slight treatment need)	3
26–30	Definite malocclusion (treatment elective)	15
31–35	Severe malocclusion (treatment highly desirable)	27
≥36	Handicapping malocclusion (treatment mandatory)	55

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TASKS FOR INDEPENDENT WORK OF STUDENTS

1. The direction of FH plane (Frankfurt's horizontal):

a) goes vertically front through the middle of the nose between central incisors along the palatine raphe (suture);

b) goes horizontally from the right to the left through the lower edge of the orbit and the upper edge of the external acoustic meatus;

c) crosses the face downward through both edges of the orbits;

d) crosses the face downward through the external acoustic meatus.

2. Mid-sagittal plane conventionally divides the head into:

a) upper and lower divisions; c) anterior and posterior divisions;

b) left and right halves; d) facial and cranial departments.

3. The direction of the orbital plane:

a) goes vertically front through the middle of the nose between central incisors along the palatine raphe (suture);

b) goes horizontally from the right to the left through the lower edge of the orbit and the upper edge of the external acoustic meatus;

c) crosses the face downwards through the both edges of the orbit;

d) crosses the face downward through the external acoustic meatus.

PRACTICAL SESSION 4

TOPIC: Anthropometric research method in orthodontics. Diagnostic dental casts. Diagnostic dental casts analysis in the period of mixed dentition.

Total time of session: 6 academic hours.

Topic description. Correct diagnosis is the key point in the dentist's work. It is impossible to understand the causes of the pathology, to determine the level of morphological disorders, and therefore, to develop an optimal plan of treatment, without it. Information , which has been received during dental examination of the patient, is insufficient in most cases. Additional information can be received by carrying on work laboratory (additional) research methods. One of such methods in orthodontics is the study of diagnostic models of the jaws. Each qualified specialist should not only be able to conduct such research, but also interpret it correctly.

Purpose and objectives of the lesson. Students should:

1) know the requirements to diagnostic models of jaws
2) to be able to make diagnostic models;
3) know the methods of studying diagnostic models;
4) know how to assess the results of studying diagnostic models.

Requirements to the initial level of knowledge. Student should review material from:

Course of General Dentistry, Orthopedic Dentistry and Anatomy:

1. Technique of manufacturing of diagnostic casts.
2. Planes of the jaws: mid-sagittal, occlusal and tuberal.

3. Anatomical features of the structure of the primary and permanent teeth.

Practical questions from related disciplines:

1. Which anatomical formulations should be represented on the diagnostic casts?

2. Through which anatomical structures do the mid-sagittal, occlusal and tuberal planes conditionally pass?

3. Through what anatomical formations do a dental, alveolar and basal arches conditionally carry out?

4. At what level is the largest mesiodistal size of the crowns of the upper and lower incisors determined?

5. What can be called a contact point between the adjacent teeth of one jaw?

Practical questions:

1. Name the main differences in fabrication techniques, storage and aims of application of work and diagnostic plaster models.

2. Which instruments are used for diagnostic plaster models measurement? Methods for studying of crown sizes of deciduous and permanent teeth, evaluation of their results.

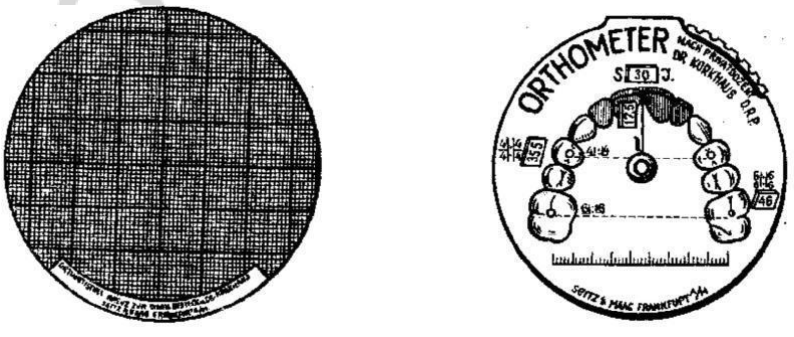
3. Which methods can detect space deficiency in frontal and lateral segments of the dental arch?

4. Methods of study by Johnson-Tanaka, Moyers (measurement protocol and interpretation).

5. Methods of study by Pont, Korkhaus (measurement protocol and interpretation).

Educational grants. During the first visit of the patient jaw impresses are obtained with the help of impress mass. This is done to see clearly the alveolar processes, apical bases, palate, sublingual region, frenula of tongue and lips. Models are cast in gypsum or supergypsum. Models bases can be shaped with the help of special devices, rubber moulds. The patient's name, surname and age, the date of obtaining impresses are marked on the models. Such models are called control or diagnostic.

To study the dimensions of teeth, dental arches, apical bases of jaws it is expedient to use a meter or a special slide gauge or different devices like orthocross, symmetroscope, orthometer (fig. 24).



a ***b***

Fig. 24. Measuring instruments to study the diagnostic models of jaws:
a — ortokrest on Korkhaus, *b* — ortometr on Korkhaus

Models study is conducted in three mutually perpendicular axes: sagittal, occlusal, frontal, and corresponding to them directions: sagittal, transversal, and vertical (fig. 25).

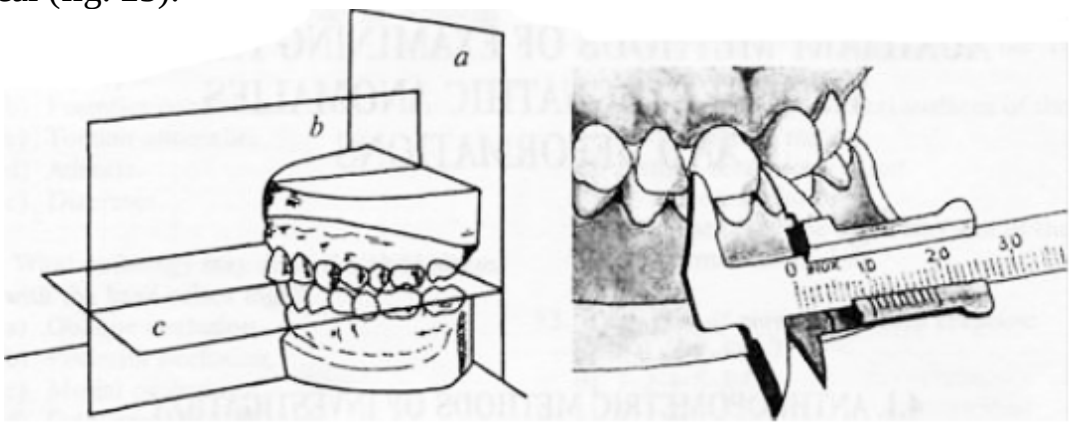


Fig. 25. Planes for the study of jaw models: *a* — tuberal; *b* — sagittal; *c* — occlusal

TEETH MEASURING

The width, height, and thickness of the coronal part of tooth are measured. The width is detected in the widest part of the tooth — in all teeth at the level of equator, and in lower incisors — at the level of the cutting edge (fig. 26). For the frontal group of teeth it is the mediolateral dimension of tooth, for lateral — mesiodistal; though in contemporary literature, both domestic and foreign, the width of the coronal part of all teeth is spoken of as the mesiodistal dimension.

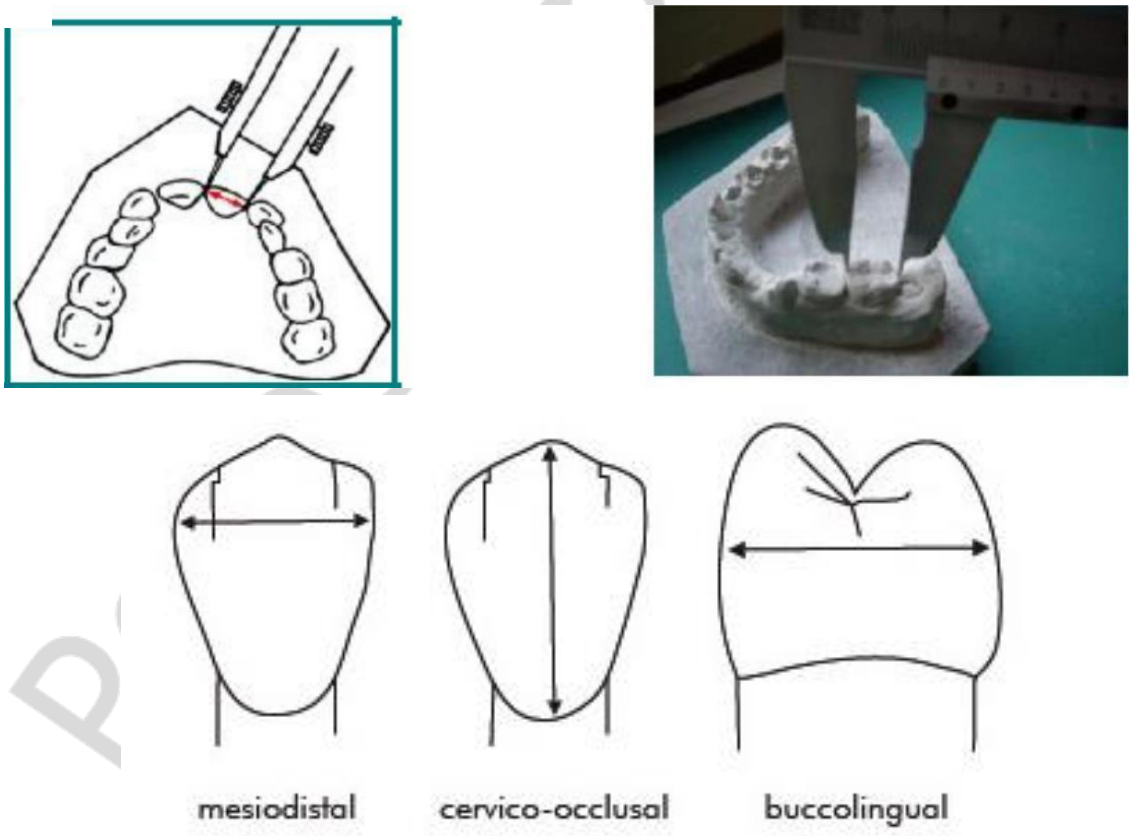


Fig. 26. Tooth width measuring with the help of the caliper

The height of the coronal part of permanent teeth is measured from the cutting edge of tooth to its border with the gingival margin: of the frontal teeth — along the middle of the vestibular surface, of the lateral ones — along the middle of the buccal cusps.

The thickness of the coronal part of tooth is its vestibular-oral dimension for the incisors and canine teeth and buccolingual dimension for the premolars and molars.

The data of average value of the coronal part of deciduous teeth is shown in the table by Wetzel, and permanent — in the table by V.D. Ustymenko (tabl. 6).

Table 6

Sizes of permanent crowns of teeth (mm) VD Ustymenko

Designation teeth	Width		Height	Thickness		
		average		average		average
	size					
1 | 1	8.5	8.0–9.0	8.9	8.2–9.7	7.2	7.7–7.7
2 | 2	6.5	6.0–7.1	7.8	7.1–8.5	6.3	5.7–6.7
3 | 3	7.6	7.1–8.1	8.9	8.0–9.6	8.2	7.7–8.7
4 | 4	6.7	6.2–7.2	7.3	6.6–8.0	9.0	8.5–9.5
5 | 5	6.4	6.0–7.0	6.1	5.3–6.9	9.2	8.6–9.9
6 | 6	9.4	8.7–10.0	5.2	4.5–5.9	10.9	10.4–11.2
7 | 7	9.4	8.7–10.0	5.2	4.5–5.9	10.9	10.4–11.2
1 | 1	5.3	4.9–5.6	7.8	7.8–8.6	6.1	5.6–6.6
2 | 2	6.0	5.6–4.6	7.9	7.2–8.7	6.3	5.8–6.8
3 | 3	6.7	6.3–7.2	9.4	8.5–10.2	7.5	7.0–8.0
4 | 4	6.8	6.4–7.3	7.8	7.2–8.5	7.6	7.1–8.1
5 | 5	7.0	6.5–7.4	6.7	6.0–7.3	8.1	7.6–8.6
6 | 6	10.0	10.3–11.7	5.5	4.4–6.1	10.3	8.7–9.7
7 | 7	10.2	9.6–10.8	5.2	4.5–5.9	10.1	9.6–10.6

MEASUREMENT OF DENTITIONS

L. R. Merrifield and Little methods used for analyses of the space in anterior segment of lower jaw.

L. MERRIFIELD METHOD

By L. Merrifield (fig. 27) measure mesiodistal size of each incisors and canines of the lower jaw (first dimension). Then, using a soft ligature wire measure the distance between the points where the projection is located on the alveolar bone level at the intersection of two lines. First line — tangent to the clinical necks canines and first premolars, second — the perpendicular dropped from a point of contact between the canine and the first premolar to the previous line. Ligature wire, tightly laid on the alveolar crest level points found on the wire marked with a pencil. Then, the wire is straightened, and the distance between the marked points with a ruler is measured (second measurement).

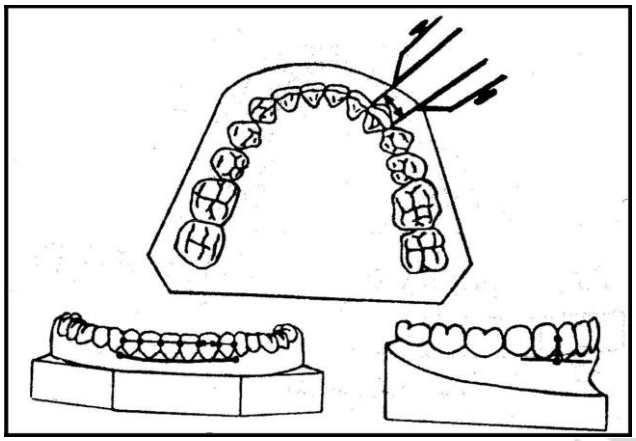


Fig. 27. Measurement of diagnostic models by Merrifield method

Second measurement minus first measurement. If negative, it is said about the lack of space in the bone of the alveolar arch.

METHOD R. LITTLE

The methodology put the fact that the incisors of the lower jaw have the greatest mesiodistal width in the area of the cutting edge due to their natural anatomical shape. The first measurement is width of the crowns of the lower incisors in their cutting edge. Then measure the distance between the contact points of the crowns of the lower incisors and canines — second measurement (fig. 28). Then calculated the difference between first and second measurements, if the results are equal to zero- there is no space problems. If the first dimension larger than second — it means, there are lack of space for the lower insisors.

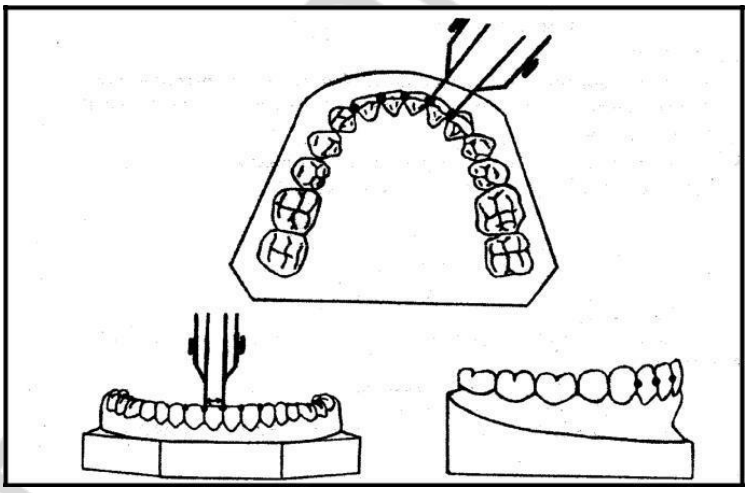


Fig. 28. Measurement of diagnostic models by Little method

These techniques complement each other and are held in parallel, in order to clarify the indications for the removal of individual teeth for correction of dentofacial anomalies.

Methods of forecasting of the lack of space in the mixed dentition.

METHOD R. MOYERS.

Moyer's mixed dentition analysis was created in 1971 by Robert Moyers. This is method of forecasting of the lack of space for teeth in posterior segment (canine, 1st premolar, 2nd premolar from one side).

Measure widths of each of four permanent mandibular incisors. The total mesiodistal width of the mandibular incisors is calculated. The second measurement is distance between mesial surface of 1st molar and distal surface of lateral incisor from one side (tabl. 7). And after calculating difference between the expected.

Table 7

Forecasting value for posterior segment by Moyers

Sum of 4 lower insisors	Forecasting		Sum of 4 lower insisors	Forecasting	
(mm)	maxilla	mandible	(mm)	maxilla	mandible
19,5	20,6	20,1	24,5	23,4	23,1
20,0	20,9	20,4	25,0	23,7	23,4
20,5	21,2	20,7	25,5	24,0	23,7
21,0	21,3	21,0	26,0	24,2	24,0
21,5	21,8	21,3	26,5	24,5	24,3
22,0	22,0	21,6	27,0	24,8	24,6
22,5	22,3	21,9	27,5	25,0	24,8
23,0	22,6	22,2	28,0	25,3	25,1
23,5	22,9	22,5	28,5	25,6	25,4
24,0	23,1	22,8	29,0	25,9	25,7

METHOD OF TANAKA AND JOHNSTON

This analysis was developed by Dr. Marvin M. Tanaka and Dr. Lysle E. Johnston in 1974 after they conducted a study on 506 orthodontic patients done in Cleveland at the Case Western Reserve University School of Dental Medicine.

To predict the size of undererupted premolars and canines:

1/2 of Mesio-Distal width of four lower incisors + 10.5 = Estimated width of mandibular premolars + canine in one quadrant on the lower jaw

1/2 of Mesio-Distal width of four lower incisors + 11.0 = Estimated width of maxillary premolars + canine in one quadrant on the upper jaw

This analysis takes 3 measurements into account:

The Mesiodistal widths of the mandibular incisors.

Predicted size of permanent canines and premolars.

Distance between mesial surface of 1st molar and distal surface of 2nd incisor from one side. After calculating difference between expected and real distance (fig. 29).

Width measurement of dentition.

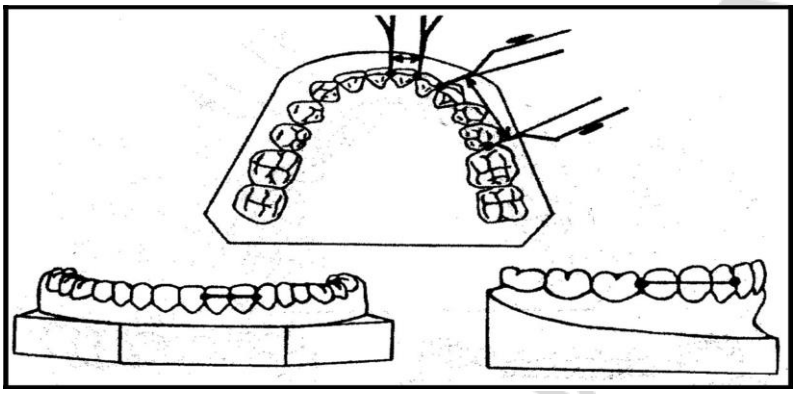


Fig. 29. Measurement by Method of Tanaka and Johnston

PONT`S INDEX

Pont's Analysis is an analysis developed by Pont in 1909. In the period of permanent teeth *Pont's technique* is used for detecting the transversal dimensions of dental arches. The technique is based on the dependence between the mesiodistal dimensions total of the 4th upper incisors and the distance between the 1st premolars and the 1st molars on the upper and lower jaws. The analysis helps to determine if the dental arch is narrow or normal and if expansion is possible or not.

The widths are measured from occlusal grooves of both premolars and molars.

One of the drawbacks of this analysis is that the analysis was initially done on French Population by Pont. Therefore, the data cannot be used to make predictions for other populations.

Linder Harth Index.

Linder Harth index is derived from Pont's Index. The Harth index has a slight variation from Pont's analysis. In the maxillary arch instead of 80, Linder Harth Index uses 85 to achieve the Measured Molar Value.

Diagnostic Pont points.

With this purpose Pont offered measuring points, which coincide at the closure of the upper and lower teeth. So, their dental arches width is identical (fig. 30).

In the region of the 1st premolars dental arch width is measured, according to Pont:

– on the upper jaw — between points in the middle of the intertubercular fissure;

– on the lower jaw — between distal contact points on the clivus of the buccal tubercles of 1st and 2nd premolars.

In the region of the 1st permanent molars dental arch width is measured: on the upper jaw — between points in the frontal recesses of the longitudinal fissure.

$$\textbf{Premolar index} = \frac{\text{width of the upper incisors}}{\text{the distance between the premolars}} \times 100\,\% = 80\,\%$$

$$\textbf{Molar index} = \frac{\text{width of the upper incisors}}{\text{the distance between the molars}} \times 100\,\% = 64\,\%$$

Fig. 30. Diagnostic Pont points

Further, for evaluation of measurement results for models Pont using standard table 8.

Table 8

Norm of width of dentitions

Sum of mesio-distal of 4 insisors (mm)	Premolars width Linder Harth	Molars width Linder Harth
27,0	31,8	41,5
27,5	32,3	42,3
28,0	32,9	43,1
28,5	33,5	43,8
29,0	34,1	44,6
29,5	34,7	45,4
30,0	35,5	46,2
30,5	36	46,9
31,0	36,5	47,7
31,5	37	48,5
32,0	37,6	49,2
32,5	38,2	50

End tabl. 8

Sum of mesio-distal of 4 insisors (mm)	Premolars width Linder Harth	Molars width Linder Harth
33,0	38,8	50,8
33,5	39,4	51,4
34,0	40	52,3
34,5	40,6	53,1
35,0	41,2	53,8
35,5	41,8	54,6
36,0	42,4	55,4
36,5	43	56,2
37,0	43,5	57
37,5	44	57,7
38,0	44,7	58,5
39,0	46	60
39,5	46,5	60,8
40,0	47	61,5

G. KORKHAUS' METHOD

In the period of permanent occlusion the length of the anterior part of the upper and lower dental arches in the sagittal direction is measured by **G. Korkhaus' method**. G. Korkhaus supplemented Pont's method, having offered to measure the length of the anterior dental arch part depending on the sum of mesiodistal dimensions of the 4th upper incisors. The measurement is conducted from the contact point on the superior surface of central incisors to the point of intersection with the line drawn through Pont's points in the region of the 1st premolars. Korkhaus comprised a table of the values of the length of the anterior upper dental arch part at different totals of the 4th upper incisors width (tabl. 9). These figures, reduced by 2 mm (according to the upper incisors thickness), may be used to detect the length of the anterior lower dental arch part (fig. 31).

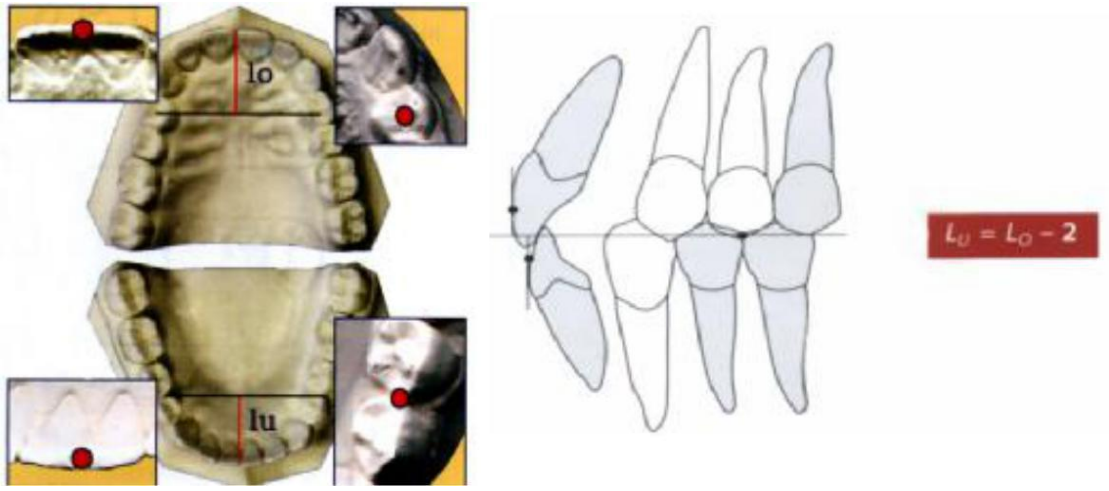


Fig. 31. Measurement method of diagnostic models Korkhaus

Table 9

Total of the 4"[1]upper incisors width, mm	Length of the anterior part of the upper dental arch, mm	Length of the anterior part of the lower dental arch, nun	Total of the 4* upper incisors width, mm	Length of the anterior part of the upper dental arch, mm	Length of the anterior part of the lower dental arch, mm
27.0	16.0	14.0	32.0	18.5	16.5
27.5	16.3	14.3	32.5	18.8	16.8
28.0	16.5	14.5	33.0	19.0	17.0
28.5	16.8	14.8	33.5	19.3	17.3
29.0	17.0	15.0	34.0	19.5	17.5
29.5	17.3	15.3	34.5	19.8	17.8
30.0	17.5	15.5	35.0	20.0	18.0
30.5	17.8	15.8	35.5	20.5	18.5
31.0	18.0	16.0	36.0	21.0	19.0
31.5	18.3	16.3	36.5	21.5	19.5

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TASKS FOR INDEPENDENT WORK OF STUDENTS

1. Requirements to working plaster dental casts for orthodontic appliances fabrication are:

a) a clear picture of the dentition;

b) a clear picture of the dentition, alveolar process, transitional fold, frenulum, palate, retromolar area, sublingual space;

c) a high quality image/impression of soft tissues which will be in contact with an orthodontic appliance;

d) a high quality picture of the dentition, alveolar process, palate, sublingual space.

2. The measuring diagnostic methods to determine the space for lower anterior teeth are :

a) Johnson-Tanaka and Mojers method;
b) Merrifield'sand Little's method;
c) Korkhauz and Pon method;
d) Herlach and Snagina method;
e) Little and Mojers method.

3. Johnson-Tanaka method is used to:

a) find out the general lack of space for the teeth in the dental arch;

b) forecast the lack of space for the posterior group of permanent teeth in the dentition in the initial period of the mixed occlusion;

c) find out horizontal parameters of the dentition;

d) diagnose mesial displacement of the posterior teeth groups;

e) find out the optimal form of the dentition.

PRACTICAL SESSION 5

TOPIC: Anthropometric research method in orthodontics. Diagnostic dental casts. Diagnostic dental casts analysis in the period of permanent dentition.

Total time of session: 6 academic hours.

Topic description. Correct diagnosis is the key point in the dentist's work. It is impossible to understand the causes of the pathology, to determine the level of morphological disorders, and therefore, to develop an optimal plan of treatment without it Information , which has been received during dental examination of the patient, in most cases is insufficient. Additional information can be received by conducting laboratory (additional) research methods. One of such methods in orthodontics is the study of diagnostic models of the jaws. Each qualified specialist should not only be able to conduct such research, but also correctly interpret it.

Purpose and objectives of the lesson. Students should:

1. know the requirements to diagnostic models of jaws, to be able to make diagnostic models;
2. know the methods of studying diagnostic models;
3. know how to assess the results of studying diagnostic models.

Requirements to the initial level of knowledge. Student should review from the Course of General Dentistry, Orthopedic Dentistry and Anatomy:

1. Technique of manufacturing of diagnostic casts.
2. Planes of the jaws: mid-sagittal, occlusal and tuberal.
3. Anatomical features of the structure of the primary and permanent tee.th

Practical questions from related disciplines:

1. Which anatomical formulations should be represented in the diagnostic casts?
2. Through which anatomical structures do the mid-sagittal, occlusal and tuberial planes conditionally pass?
3. Through what anatomical formations do dental, alveolar and basal arches conditionally carry out?
4. At what level is the largest mesiodistal size of the crowns of the upper and lower incisors determined?
5. What can be called a contact point between the adjacent teeth of one jaw?

Practical questions:

1. Name the main differences in fabrication techniques, storage and aims of application of work and diagnostic plaster models.

2. Which instruments are used for measurements of diagnostic plaster models? Methods for studying of crown sizes of deciduous and permanent teeth, evaluation of their results.

3. Methods of study by Nance, Shmudt (measurement protocol and interpretation).

4. Which method is used to reveal the rotation of first permanent molars?

5. Methods of study by Gerlach, Snagina, Bolton

6. Graphical method of study by Hawley-Herber-Herbst (protocol and interpretation).

Educational grants.

METHOD H. NANCE

To measure the total length of the dental arch and conformity mesiodistal size of teeth crowns using **H. Nance method.** The first measurement is the mesiodistal width of 12 teeth (central and lateral incisors, canines, first and second premolars, first permanent molars) at the equator.

The second is measurement of the actual length of the dental arch of the same jaw with a soft ligature wire, which is formed according to the individual shape of the arc from the distal approximal surface of the first permanent molar from one side to the distal approximal surface of the first permanent molar opposite side. The posterior teeth wire has a region in the middle of the chewing surfaces, and in the anterior area — on their cutting edges.

Calculating the difference between the expected (the sum of the width of crowns of 12 teeth) and the actual length of the dental arch.

Determination of mesial offset of posterior teeth.

METHOD SMUDT

Method Smudt used to determine mesial offset of posterior teeth on maxilla according to (RPT), which passes through posterior margin of incisor papilla and first pair of transversal palatal folds perpendicular to raphe mediana. Normally diagnostic line (RPT) passes through the center of canines. If there is mesial offset, RPT passes distal to the orientirs. Mesial offset can be only on one side or both sides (fig. 32).

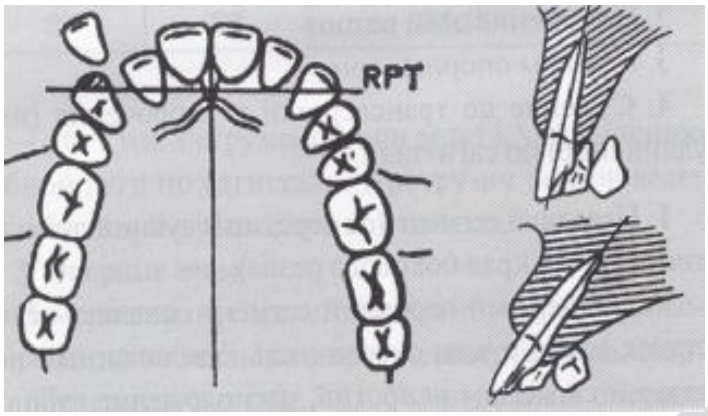


Fig. 32. Method Smudt

METHOD OF RICKETS

Determination of rotation of the first permanent molars on the upper jaw. Rotation around the vertical axis palatal root the first permanent molars of the upper jaw can be determined by the method of RM Rickets (1989). A distal buccal and mesial lingual cusps of the first permanent molars carried straight lines which under normal position molars must cross the opposite side of the middle of the crown of canine (fig. 33). Deviation straight towards premolars indicates mesial rotation of the first permanent molars and incisors toward - their distal rotation.

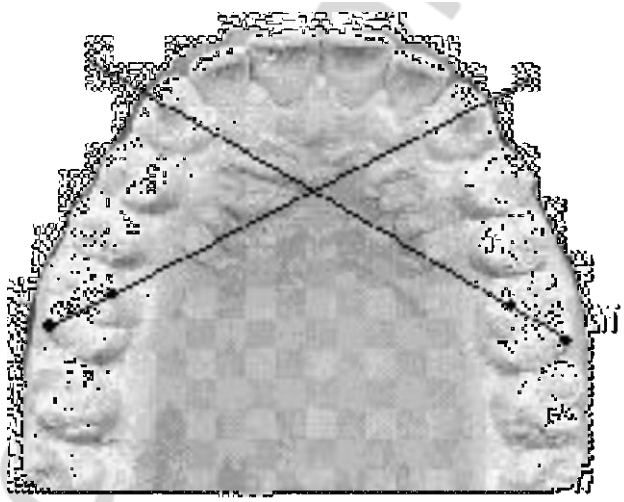


Fig. 33. Method of Rickets. Normal position of 1st molars

GERLACH` METHOD

Gerlach offered to study the proportionality of the dental arches of the upper and lower jaws by the correlation of segments, which were singled out by him: anterior, which includes 4 incisors, and two lateral (right and left), which include a canine tooth, premolars and 1st permanent molars. The anterior upper segment *(SI)* and the anterior lower segment *(Si)* are detected by the sum of the mesiodistal dimensions of the upper and lower incisors. The lateral segments of

both upper *(Lor* and *Lol)* and lower *(Lur* and *Lul)* jaws on the right and on the left are measured by the size of a cord — the line, which joins the mesial surface of canine teeth in the point of contact with the lateral incisors and the distal surface of 1st molars in the point of their contact with the 2nd molars (fig. 34).

Gerlach's formula for studying dental arches segments correlation:

Lor ≥ SI ≤ Lol

——||———||———||

Lur ≥ si' ≤ Lul

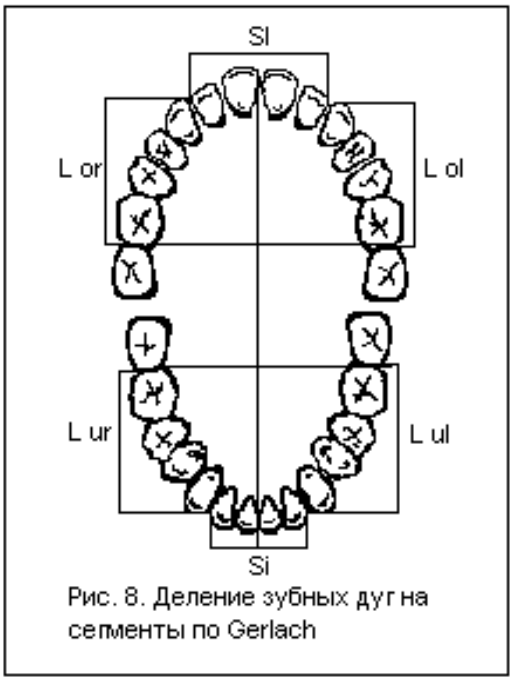


Fig. 34. Gerlach Method

Where is **si'** — calculated value depending on:
Normal overbite — **sum of the lower incisors*1,33 (Tonn Index).**
Deep bite — **sum of the lower incisors*1,42 (Malygin Index).**
Minimal overbite — **sum of the lower incisors*1,22 (Gerlach Index).**
Primary dentition — **sum of the lower incisors*1,3 (Dolgopolova Index).**

DIAGNOSTIC OF APICAL BASES BY N. G. SNAGINA METHOD

Apical bases — is a conditional line passing at the level of the tops of the roots of teeth. N. G. Snagina established relationship between the length and width of the apical basis depending on the mesiodistal sizes of the 12 permanent teeth.

1st measurement is sum of the mesiodistal width of the 12 teeth from first molar to first molar.

The width of the apical bases (B) measured on the upper jaw in the deepest points fossae caninae — in the recess between the tops of the canines and premolars (fig. 35). On the lower jaw width measured apical basis, indents 8 mm

downward from the intersection point of two lines: 1 — the horizontal necks to clinical canine and first premolar, 2 — vertical passing through the top of the interdental papillae.

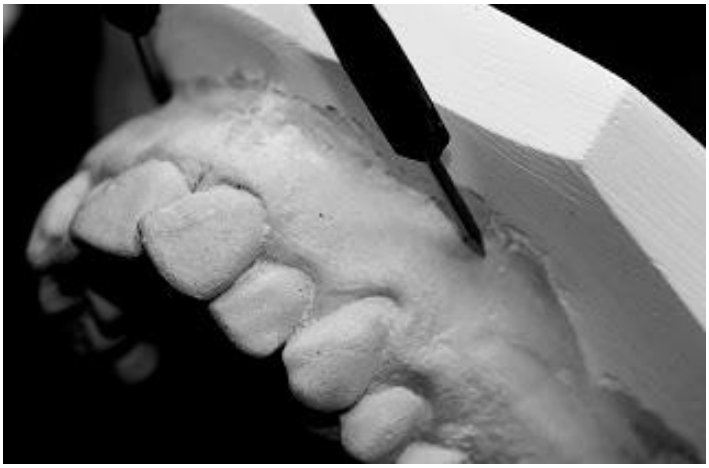
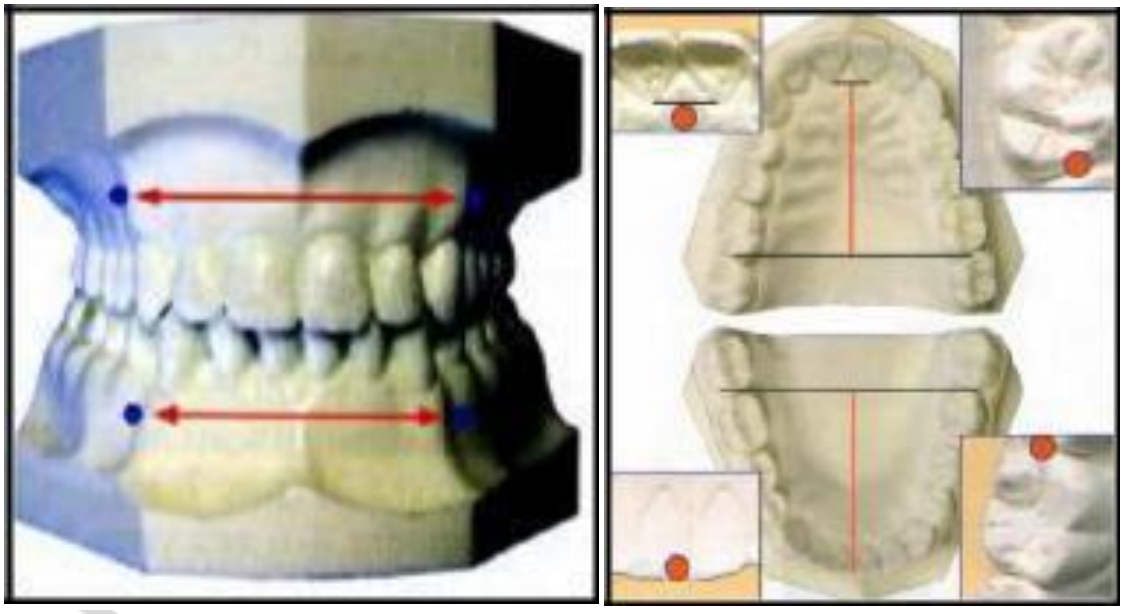


Fig. 35. Width of apical bases of upper jaw by Snagina method

The length of the apical bases (L) on the plaster model of the upper jaw measured along a perpendicular from the point of intersection of the median palatine suture line connecting the central incisors in the neck palatal surface, to a line linking the distal interproximal crown surfaces of the first permanent molars (fig. 36). On the bases of the mandible apical length measured from the contact point of the medial angles of crowns mandibular central incisors to a transverse line connecting the distal interproximal crown surfaces of the first permanent molars (fig. 36).



a ***b***

Fig. 36. Measurement of the apical basis by the method of Snagina:
a — width; *b* — length

To evaluate the corresponds to the length and width of the apical bases mesiodistal size 12 of the permanent teeth using values

Index which normally are equal

to the upper jaw $\frac{100\ B\ x}{\Sigma 12d} = 44\,\%$ and $\frac{L\ x\ 100}{\Sigma 12d} = 40\,\%$

for mandibular $\frac{B\ x\ 100}{\Sigma 12d} = 43\,\%$ and $\frac{L\ x\ 100}{\Sigma 12d} = 39\,\%$

where B — width of apical basis;
L — length of apical basis;
Σ12 d — amount of mesiodistal size of 12 permanent teeth.

In practice, the table should be used depending on the width and length of the jaws apical basis of the sum of the teeth 12 sized Snagina (tabl. 10).

Table 10

Normal sizes of length and width of apical bases

Sum of 12 teeth	Width Of apical basis	Length Of apical basis	Width Of apical basis	Length Of apical basis
	Of upper jaw		Of lower jaw	
75	33	29,2	30	30,2
76	33,4	29,6	30,4	32,6
77	33,8	30	30,8	33,1
78	34,3	30,4	31,2	33,5
79	34,7	30,8	31,6	33,9
80	35,2	31,2	32	34,4
81	35,6	31,5	32,4	34,8
82	36	31,9	32,8	35,2
82	36,5	32,3	33,2	35,6
84	36,9	32,7	33,6	36,1
85	37,4	33,1	34	36,5
86	37,8	33,5	34,4	36,9
87	38,2	33,9	34,8	37,4
88	38,7	34,3	35,2	37,8
89	39,1	34,7	35,6	38,2
90	39,6	35,1	36	38,7
91	40	35,4	36,4	39,1
92	40,4	35,8	36,8	39,5
93	40,9	36,9	37,2	39,9
94	41,3	36,7	37,6	40,6
95	41,8	37	38	40,8
96	42,2	37,4	38,4	41,2
97	42,6	37,8	38,8	41,7
98	43,1	38,2	39,2	42,1
99	43,5	38,6	39,6	42,5
100	44	39	40	43

End table 10

Sum of 12 teeth	Width	Length	Width	Length
	Of apical	basis	Of apical	basis
	Of upper jaw		Of lower jaw	
101	44,4	39,3	40,4	43,4
102	44,8	39,7	40,8	43,8
103	45,3	40,1	41,2	44,2
104	45,7	40,5	41,6	44,7
105	46,2	40,9	42	45,1
106	46,6	41,3	42,4	45,5
107	47	41,7	42,8	46

BOLTON ANALYSIS

Bolton Analysis is a tooth analysis developed by Wayne A. Bolton to determine the discrepancy between size of maxillary and mandibular teeth. This analysis helps to determine the optimum interarch relationship. This analysis measures the mesio-distal width of each tooth and is divided into two analyses.

An *Overall Analysis* measures the sum of mesio-distal width of all 12 (first molar to first molar) mandibular teeth and compares them to the 12 maxillary teeth. The overall ratio known to be 91.3 %. The A*nterior analysis* measures the sum of mesio-distal width of front 6 mandibular teeth and compares them to 6 maxillary teeth. The anterior ratio is known to be 77.2 %, the average value is 74.5–80.4 %, if anterior ratio more than 80,4 % means that the mandibular anterior teeth are bigger or anterior upper teeth are smaller compared to normal, if less- than 74.5 % means that the anterior mandibular teeth are smaller compared to normal or means that anterior upper teeth are bigger compared to normal. An overall ratio of more than 91.3 % means that the mandibular teeth are bigger compared to normal or upper teeth are smaller compared to normal. A ratio smaller than 91.3 % would mean the mandibular teeth are smaller than normal or the upper teeth are bigger compared to normal. Having a different ratio than normal is referred to as Bolton Discrepancy.

$$\text{Anterior Bolton ratio} = \frac{\text{Sum of mesiodistal widths of mandibular anterior 6 teeth}}{\text{Sum of mesiodistal widths of maxillary anterior 6 teeth}} \times 100$$

$$\text{Overall Bolton ratio} = \frac{\text{Sum of mesiodistal widths of mandibular anterior 12 teeth}}{\text{Sum of mesiodistal widths of maxillary anterior 12 teeth}} \times 100$$

Graphic method of research of form and sizes of dental arc.

DIAGRAM OF HAWLEY-HERBER-HERBST

To build the diagram the total of the mesiodistal dimensions of three upper teeth (central and lateral incisors and a canine tooth) is detected — the AB radius, with which a circle is drawn from the point B. Then, on the circumference with AB radius from the point A the segments AC and AD are laid off. The CAD arch is a curve of the location of six frontal teeth. To detect the location of lateral teeth one more circle is drawn. For this purpose from the point E of BE radius straight lines are drawn through the points C and D to the intersection with the tangent to the point A, as a result of which an equilateral triangle EFG is obtained. With the radius, equal to one side of this triangle, from the point A on the extension of AE diameter the point O is marked, from which a circle is drawn with EE radius. On an additional circle from the point M with AM diameter the points / and 12 H are laid off with AO radius. Having connected the point if with the points C, J, and D, HCADJ curve is obtained, which is the curve of all the surface of the upper dental arch according to Hawley. Lateral teeth are to be located on the HC and DJ segments. Herbst substituted lateral straight lines with CN and DP arches. The centers of these arches are L and K, which lie on the diameter (KL), perpendicular to the AM diameter. The CN arch is described with LC radius, the DP arch — with KD radius. Thus, Hawley–Herber–Herbst's NCADP arch is a curve of the correctly shaped upper dental arch. To get the right curve of the lower dental arch at —drawing the diagram the initial radius, to Hawley's point of view, is to be by 2 mm less. Besides, not only incisors and canine teeth, but also the 1st premolars are located on the CAD curve. To define the form of dental arch a model is laid on the diagram in such a way, that its median line, which goes along the palatine suture, would coincide with the AM diameter, and the sides of the equilateral triangle PEG would go between canine teeth and premolars. After that the dental arch circuit is drawn out with a sharpened pencil and the obtained shape is compared with the diagram's curve (fig. 37).

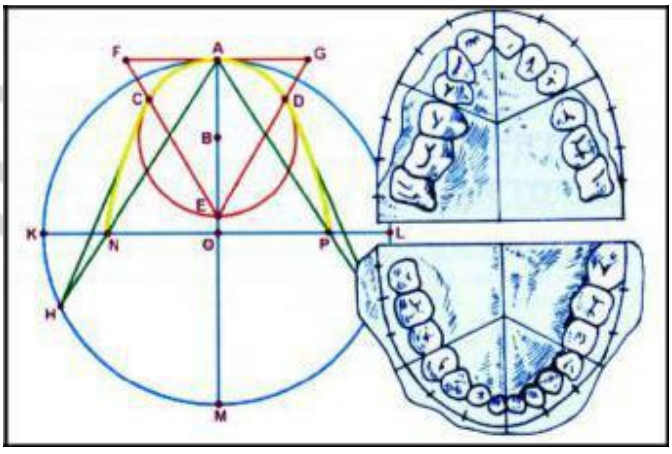


Fig. 37. Diagram of Hawley-Herber-Herbst

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TASKS FOR INDEPENDENT WORK OF STUDENTS

1. Gerlah's method of studying diagnostic models of jaws allows the dentist to:

a) identify individual differences in dentition segments;
b) determine the proportionality of the dentition segments;
c) explore an individual form of dentition;
d) explore characteristics of apical bases of the jaws.

2. Snagina's method of studying diagnostical models of jaws allows the dentist to establish:

a) the length of the anterior segments of dental arches;
b) the width of dental arches;
c) the length of the apical base;
d) the width of the apical base;
e) mesial displacement of the posterior teeth.

3. Geometrical graphic method of Hawley-Herber-Herbst is used to determine:

a) an individual dental arch length;
b) an individual dental arch width;
c) individual form of the upper and lower dental arches;
d) an individual the length of the anterior segment of the dentition;
e) the size of the permanent dentition crowns.

PRACTICAL SESSION 6

TOPIC: General ideas about orthodontic devices, the layout of forces in their application, the ways of fixation, the principles of anchorage. Types of orthodontic devices.

Total time of session: 6 academic hours.

Topic description. In the process of orthodontic treatment, complex morphological and functional changes in the dentoalveolar system come simultaneously with its natural growth and formation. The construction of orthodontic devices should be chosen, taking into account the anatomical and physiological characteristics of the dentoalveolar system, strength for the successful movement of the tooth in the desired direction, stable anchorage for the device and secure its

fixation. Orthodontic devices are used to treat dentoalveolar anomalies, the preservation of the result after its termination and prevention. To date, many diverse orthodontic devices are known. Knowing all beforementioned material will help the orthodontist in choice of the most effective orthodontic device, depending on the period of formation of the occlusion.

Purpose and objectives of the lesson. Teach students which orthodontic devices are used to treat dentoalveolar anomalies, for prevention and consolidation the results achieved treatment. To study the alignment of forces when using orthodontic devices, methods of fixing them and principles of support. The student should know classification of orthodontic devices, be able to assess the relationship between strength and support with the use of various orthodontic constructions.

Requirements to the initial level of knowledge. Student should repeat from:

– Physics (Newton's third law).

Practical questions from related disciplines:

1. Force of action and reaction
2. Direction of force of action and counteraction
3. What is the anchorage and load?

Practical questions:

1. General concept of orthodontic apparatus, their purpose, classification.
2. Possible changes in the dentoalveolar system when applying medical orthodontic devices.
3. Characteristics of medical devices, depending on their effect on tooth-jaw system.
4. Forces used in orthodontic appliances for treatment.
5. The relationship of force and anchorage.
6. Conditions necessary for the movement of teeth.
7. Types of movement of teeth.
8. Methods of fixation of orthodontic devices

Educational grants. Dental orthodontic care consists of preventive and therapeutic measures — myotherapy, orthodontic, orthopedic, surgical and combined methods of treatment. The most common of these is the method with using appliances. Many diverse orthodontic devices are known. All orthodontic devices according to their purpose are divided into preventive, curative and retentional. Preventative devices are used to prevent dentofacial anomalies and deformities that may occur due to bad habits (thumb sucking), wrong position of the tongue, mouth breathing, as well as in the early loss of primary and permanent teeth. They can be removable and non-removable.

Retention devices are used for consolidating the results of treatment and preventing relapses. Their application is necessary in view of the fact that the processes of histological tissue reconstruction occur more slowly than the ana-

tomical changes achieved in process of treatment. Retention devices are removable and fixed.

Medical devices are the largest group. Formed deformations are corrected with help of Medical devices. Their action is based on the use of pressure and traction forces. By design, the orthodontic treatment device is a rational combination of active, functional and supportive elements depending on the goals of treatment and available clinical and laboratory possibilities.

Very often when carrying out orthodontic treatment is necessary to move one or more teeth, and this can be done in one direction (sagittal, vertical, transversal), and in two or three directions at the same time. Sometimes there is need to move the entire upper or lower dentition. In cases of severe forms of malocclusion several orthodontic devices different in the action are needed, since there is no comprehensive devices suitable for all age periods. That's why the originally designed apparatus becomes unsuitable.

Therapeutic devices used in orthodontics can be conditionally divided into 4 groups by the principle of action.

1 group — mechanically-acting appliances are devices, which action depends on the elasticity of its constituent parts. The power of orthodontic screw, wire, ligature, rubber rings is used. Due to their own source of effort, these devices are also called active. The size and intensity of the load is regulated by the doctor. An example of a mechanically-effective apparatus is the plate with screw to the lower jaw (removable), multi-bonding system (fixed).

2 group — functionally directing — these are devices, the source of forces of which is the force of masticatory muscles contraction, transferred to the displaced teeth through an inclined plane, a bite pad (in anterior segment) or occlusal lining (in posterior segment). The action of the apparatus of this group is based on the concentration of the masticatory pressure on single teeth that move in the direction created by inclined plane. To create favorable conditions for the growth of the jaw or its parts and unblock the jaws by teeth alignment, plates with bite pads or occlusal patches are applied. The same plate, concentrating the chewing pressure vertically on individual teeth, promote their intrusion and alignment of the dental arch in occlusal plane.

3 group — functional-acting — these are different combinations of arches, basic plates, lipbumpers and cheek shields, united in monoblock and received the name of activators or regulators. Treatment with these types of apparatus are based on the fixation of the lower jaw in necessary position, in activating or restraining the growth of the jaw or its parts, the using or balancing of the action on dental arches of different muscle groups.

4 group — combined — the elements of the first and second or first and third groups are used in one appliance.

To move the tooth successfully, group teeth or influence growth of the jaws sufficient force and appropriate support are needed.

The force of group 1 of the apparatus is determined by the active elements: traction, metal ligature, rubber ring, screw, spring (coil or helical). The source of force when applying the 2 groups of apparatus is force produced by contraction of masticatory muscles, which is transmitted to the displaced teeth through an inclined plane, a bite patch, occlusive lining.

Apparatus 3 groups create conditions for the normalization of breathing, swallowing, speech, chewing and restoring myodynamic equilibrium in maxillofacial area. They provide the conditions for a normal growth of the jaws.

In addition to the force applied to the displaced teeth and called active force of action, it is necessary to take into account the recoil force, called the force of counteraction, i. e. reactive. Active and reactive forces can be directed towards each other or in opposite sides. They can operate within one jaws or active force is transmitted to one jaw, and reactive to the opposite jaw. There are also devices where the active force affects the teeth and jaw, reactive to the supporting tissues of the head and neck (extraoral devices). Part of the apparatus, moving teeth, called the mobile, the other, the fixed part — the support-fixing (anchorage).

According to Newton's law, these forces are equal, so when constructing it is important to choose an anchorage. Under the anchorage is understood the value, counteracting the force that moves the tooth. There are two types of anchorage: interacting (reciprocal) and stationary. Interacting anchorage, in which the force of opposition is used for better fixation of the apparatus and movement of the teeth, for example, anchorage and fixation of two halves of the expanding plate when the screw is untwisted.

Stationary is the anchorage at which the fixing part of the apparatus remains motionless and, therefore, does not cause tooth movement.

Increasing the anchorage, reduces the counterforce force each of the supporting teeth, which ensures the invariability of their location.

For example, to move one molar distally, all other teeth of the jaw must be in anchorage. In this case, the reactive force will not move them. Anchorage can be intraoral, extraoral. The intraoral anchorage can be single-jawed, double-jawed. As anchorage used teeth, alveolar processes, the palate, and extraoral anchorage can be the head cap, facial mask.

Orthodontic treatment is based on the transfering of power to the teeth, dental arches, jaw bones and facial skeleton as a whole. Therefore three components are to be considered: an existing force, an application of the force and anchorage.

The mechanical force can be primary or secondary. It leads to immediate structural changes. Primary force occurs directly in the wire arc, orthodontic screw, spring, ligature, rubber ring. Force orthodontic screw, elastic properties of wire in the form of an arc, ligatures, springs, elastic properties of rubber rings is used.

There are intraoral and extraoral forces, and intraoral forces, in their turn, is divided into one and two-jaw. Primary force (intraoral, single-jaw) makes it possible to move the teeth in three directions: sagittal, vertical, transversal, as well as rotate the tooth around the vertical axis. This is done with the help of orthodontic screws, arches, ligature, springs, rubber rings. Extraoral force occurs with the use of face bow, chin cap with elastic traction. As a force can be a rubber pull, and the anchorage part of apparatus — cervical or frontal stop, head gear. In that case secondary force affect the teeth.

The use of extraoral force makes it possible to move individual teeth (for example, molars), as well as dental arches. Extraoral devices affect the growth of the jaws, the tendency of their growth through exposure on the suture system, thus achieving skeletal effects. Given that orthodontic treatment can not only give positive, but also negative, an essential role plays choice of force on the tooth-jaw system. In the clinical practice it is difficult to calculate the direction of the current force, taking into account the age of the child, the stage of root formation, features of blood circulation and other factors. In recent years, doctors-orthodontists consider the use of light forces as appropriate (tabl. 11). Value of the applied force should not cause disorder of hemodynamics in zone of periodontal pressure and hyalinization as a consequence, it would be cell proliferation and direct bone resorption are possible, accompanying the movement of the tooth, the displaced teeth would not be too mobile, and the supporting teeth would retain their original position. The size of the load depends on:

– which tooth is to be moved (single-root, multi-root tooth, upper or lower jaws);

– the direction of the acting force;

– which teeth are selected as anchorage;

– qualitative characteristics of the materials used (the composition of the wire, its length and strength).

Table 11

The magnitude of the forces used for orthodontic tooth movement

Optimal magnitude of the forces used for orthodontic tooth movement	
type of movement	**Effort (g)**
Tipping	50–75
Bodily movement	100–150
Root leveling	75–125
Rotation	50–75
Extrusion	50–75
Intrusion	15–25

Orthodontic forces for the duration of the action is classified into:

– Continuous — forces acting for a certain time from the moment of visiting the patient and until the next visit;

– Interrupted — the force value drops to zero between activations;

– Intermittent — the magnitude of the force is abruptly reduced to zero, when the orthodontic device is removed from the patient.

Non-removable devices can create both continuous and interrupted forces. Intermittent forces are reproduced by all devices such as removable plates, extraoral traction, elastic pull.

Conditions necessary for moving teeth:

1. Choice of strength
2. Choice of direction of force (vector)
3. The presence of a place in the dentition
4. Choice of stable anchorage
5. Choice of reliable fixation
6. Taking into account the anatomical and functional features of the dentoalveolar system
7. Taking into account the patient's state of health

Bodily movement of teeth provides simultaneous moving the root and crown of the tooth in the same direction, i.e. in that case the root and tooth crown are moved to the equal distance. Inclined-rotational movement of the tooth implies movement of the root and crown at different distances. The force used to move, is different for the root and crown. Depending on final purpose in some cases the tooth root can be affected by a large force, and on the crown of the tooth — smaller; in other cases, vice versa.

Fixation of various designs of removable orthodontic devices and appliances is a difficult problem in orthodontics. Without reliable fixation it is impossible to transfer fully active and reactive forces to the movable and supporting teeth.

By the method of fixing, fixed and removable devices are distinguished. Fixed appliances have in their construction support-fixing parts such as bands, crowns or splints with soldered or welded to them tubes, screws, levers, hooks. Bands, crowns, splints are fixed to the teeth with using glass ionomer cements. Special compositions allow to insert the parts of the support-fixing devices directly on the enamel of the teeth.

A removable orthodontic device is fixing on the teeth with the help of clasps, arcs (bows), pilotes. Besides, anatomic retention and adhesion are used. Anatomical retention is achieved by using the shape of the alveolar processes, maxillary tubercles, arch of the palate, crowns of teeth, especially with their tipping, the gaps between them.

Adhesion is the bonding force that arises between two densely wetted surfaces, for example between mucous membrane of the oral cavity and orthodontic plate. But anatomic retention and adhesion is not sufficient for reliable fixation of removable devices. Therefore, beforementioned fixing elements are used in addition.

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TASKS FOR INDEPENDENT WORK OF STUDENTS

1. The aims of the use of orthodontic appliances are:

a) treatment; c) prophylaxis; e) combination.
b) removement; d) retention;

2. Retention orthodontic appliances are used to:

a) eliminate bad habits;
b) normalize the function of the dentoalveolar anomalies;
c) prevent the development of dentoalveolar anomalies;
d) consolidate the orthodontic treatment results and prevent the development of dentoalveolar anomalies recurrence.

3. Optimal magnitude of the forces used for orthodontic bodily tooth movement is:

a) 50–75; b) 100–150; c) 75–125.

PRACTICAL SESSION 7

TOPIC: The main principles for the orthodontic appliances design. Components of the removable orthodontic appliances (clasps, labial bow, springs). Classification, purpose, fabrication technique.

Total time of session: 6 academic hours.

Topic description. The main method of treatment of dentoalveolar anomalies is hardware. Today in practice of the orthodontist removable designs of orthodontic devices find broad application. In some cases they are only acceptable, especially at children during the periods of the temporary and admixed occlusion. The right choice of a design of the device with accounting of pathology expression degree, features of a clinical current, age of the patient, his somatic and general status provide the favorable course and qualitative result of treatment. Thus, each orthodontist has to own technology of production, appointment and the scope of various details of removable orthodontic devices.

Purpose and objectives of the lesson. Students should know:

1. Basic principles of designing of removable orthodontic devices and classification, appointment and the scope of removable orthodontic devices details.

2. The main technical characteristics on the orthodontic wire used for production of removable devices details.

3. Technology of production of clasps, vestibular arch, springs; – basic principles of removable orthodontic devices designing.

Requirements to the initial level of knowledge. Material is almost new, for its assimilation it is necessary to repeat from a course of the general and orthopedic dentistry:

1. Dental materials science.
2. Technical, physical and chemical characteristics on the orthodontic wire.
3. Clasp components, their appointment.

Practical questions from related disciplines:

1. What metals and alloys are used in the odontology for clasps production? Their physical and chemical characteristics.
2. What properties is the orthodontic wire used for? What are the purposes?
3. What components allocate in the design of the cast basic holding clasp?
4. Name a scope of wire springs in the orthopedic odontology clinic.

Practical questions:

1. What are the general principles in the removable orthodontic appliances design?
2. What clasps are used in orthodontics?
3. What are the main components of the clasps? What determines the springy properties of the clasps? What orthodontic wire is used for making clasps?
4. What are the steps in the Adams clasp fabrication?
5. What wire is used for the labial bow fabrication?
6. What kinds of springs are used in the removable appliances? Areas of application. Spring designs for individual teeth.
7. What springs are used for normalization of the dental arches shape?
8. What wire is used for the orthodontic spring fabrication?

Educational grants. When designing orthodontic appliances must adhere to the following basic principles:

1. If a patient has bad habits (biting lips, sucking fingers, tongue, etc.) it is necessary to eliminate them or provide components in appliance design, allowing to save the patient from harmful habits ;
2. The design of the orthodontic appliance is necessary to provide elements to ensure the development of the necessary forces in the right direction;
3. Appliance must have a reliable support and be well fixed in the oral cavity;
4. In the presence of space lack in the dentition in the construction of appliance must be components to space gaining;
5. If on the way of movement is occlusal interference, we must take it off.

All removable orthodontic appliances must be well fixed in the oral cavity. This is achieved by using clasps. Translated from German clasp — a retainer for fixing removable orthodontic appliances and prostheses. Clasp prepared from metal not oxidized in the mouth. For these purposes orthodontic wire is stainless

steel. This orthodontic wire contains 18 % of chromium and 8 % of nickel. Thus referred to as 18 : 8 stainless steel. This is called stainless because chromium contributes resistance to oxidation by forming passive surface layer of chromium oxide on metal. Nickel resists the corrosion. diameter 0.6, 0.8, 1.0, 1.2 mm.

The clasps have three parts: the retentive arm, pressing orthodontic device to a tooth; body that makes work clasp; process, locking clasp on the base plate.

The most widely spread **circumferential clasp** («C» clasp) (fig. 38). It consists of an arm, body, fixed process.

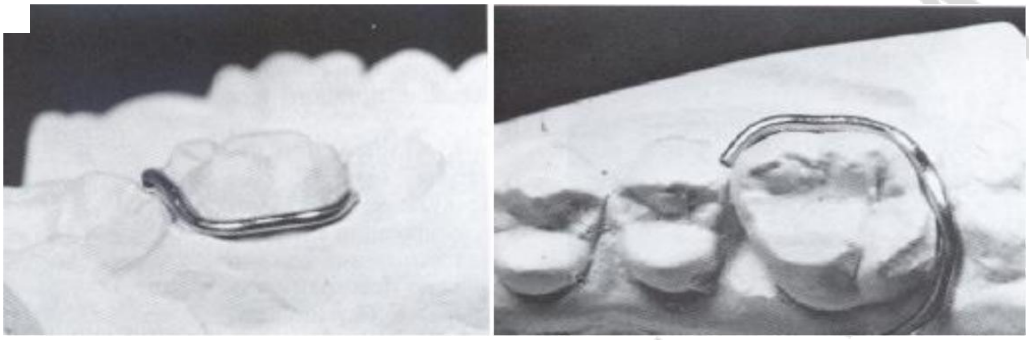

Fig. 38. Circumferential clasp

«C» clasp begins at the tooth contact point, it should apply the maximum amount of the tooth points during movement of the prosthesis or appliance does not exert pressure on the teeth in the resting state (to be passive). The arm should be at the level of the contact point opposite side rounded or polished (fig. 39).

For bending of C clasp we use universal Crampon pliers.

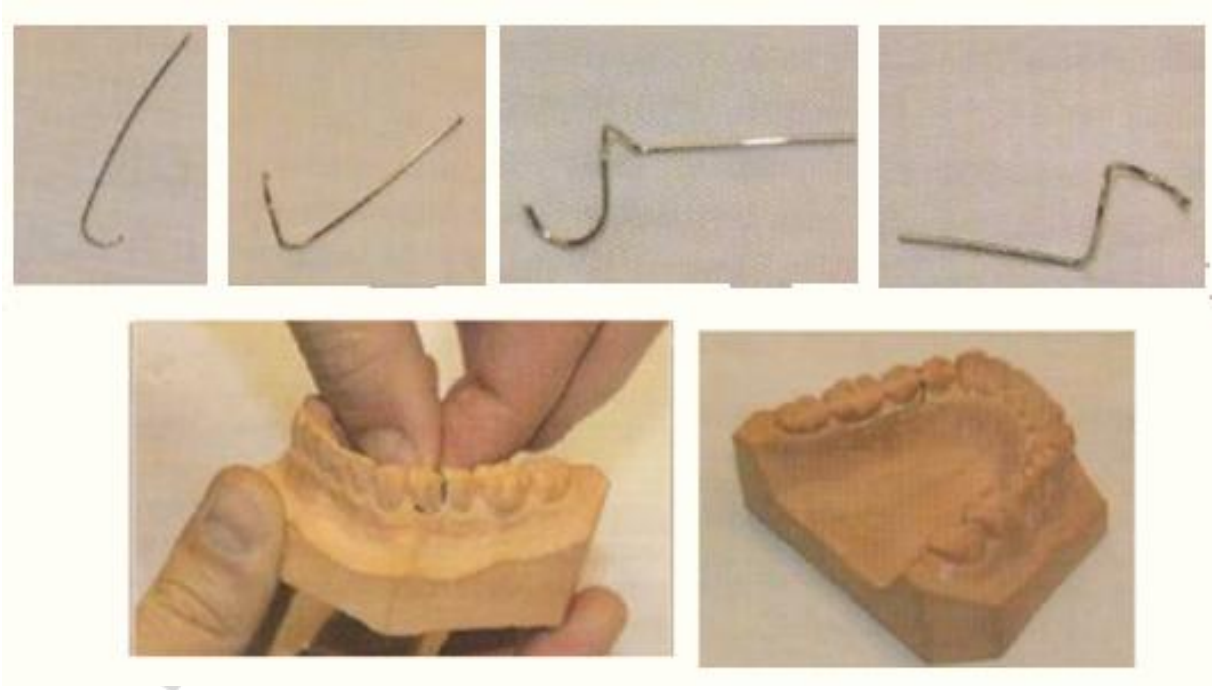

Fig. 39. The steps of manufacturing c clasp

Advantages:

1. Easy to bend.
2. Passive.

But retention is not enough for active appliances.

Adams clasp — the most useful and effective in orthodontics (fig. 40). It is prepared as single standing teeth, and the teeth are located in the dentition. Spot fit clasps to the vestibular surface of the crown in her cervical area provides reliable fixation device. The semi-clasp available in the free market, but further clasp should be formed for each individual case.

Fig. 40. Adams clasp

Steps (fig. 41):

1. Forming of bridge: Length of bridge should be two thirds of the mesiodistal width of crown. Bridge is made by bending the wire to slightly more than right angles.

2. Forming the arrowheads: At each of the above bends 'U' turn in the wire is made outside the tips of the pliers so that a tight acute bend is formed, sides forming the arrowheads being parallel. Arrowheads are then aligned to follow the gingival margin by bending them at 45° the horizontal bridge and tried on the tooth.

3. Forming the retentive tags: A bend is made grasping the arrowheads from the inside of the clasp with half the length of the arrowhead between the break of the pliers. This makes the bend at the level a little below of the bridge. The end is at an angle a little less than 90° to the arrowhead.

4. Trial of clasp: Clasp tried on tooth to check the angulation of the arrowheads to the teeth. Direction of tags towards the groove between marginal ridges of the tooth to be clasped and adjacent teeth.

5. Clasp is completed by bending tags over contact point between two teeth into the lingual embrasure slightly away from palatal mucosa. Clasp is sta-

bilized while the base plate is being constructed and tags are embedded securely in the acrylic material. Adjustment of Adam's Clasp is done by making a slight bend at each tag buccal to where the tag makes contact with teeth in crossing the contact point to obtain desired degree of grip.

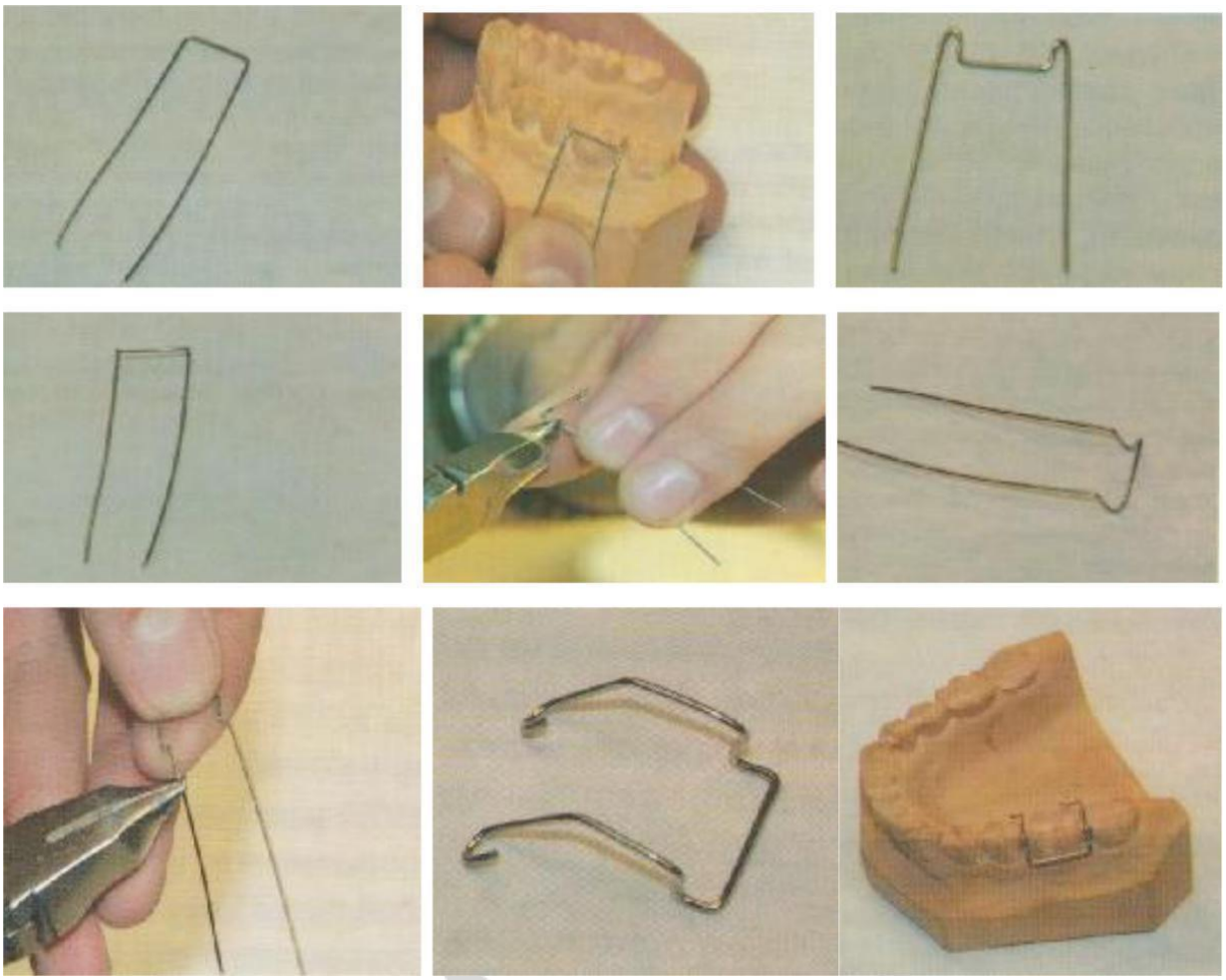

Fig. 41. The steps of manufacturing the Adams clasp

Advantages:

1. Clasp is small, neat and unobstructive. Takes minimum space in buccal sulcus.
2. Useful on deciduous, permanent teeth.
3. Strong enough for retention purpose.
4. No specialized pliers required.
5. Bridge is used for removal and insertion of appliance.
6. It resists the force of mastication.
7. Hooks, helixes can be soldered to the bridge and bent into the clasp.

Modifications of Adam's clasp

1. Adam's clasp with single arrowhead
2. Adam's clasp with J hook
3. Adam's clasp with incorporated helix
4. Adam's clasp with additional arrowhead

5. Adam’s clasp with soldered buccal tube
6. Adam’s clasp with distal extension
7. Adam’s clasp on incisors and premolars

Component of **labial bow** can be active and passive and used for:

1. Fixing.
2. Retraction of the insisors

Labial bows may be used to move the front teeth and for fixing the removable appliance. It is bended from hard stainless steel wire diameter of 0.6–0.9 mm.

Labial bow with the half bends member middle part, two semicircular curves and two fixing processes (fig. 42).

Fig. 42. Labial bow

Middle part is used for fixing the unit or after compression it bends — for transmitting pressure to the teeth in the oral direction.

Construction of Labial Bow (fig. 43). Wire 0.7 mm is used for labial bow preparation with universal crampon plier. First a smooth curve is made with fingers and wire adapted to labial surface of the upper six anterior teeth. «U» loop is started by bending the wire up at right angle at the center of the canine teeth. The point is marked with marking pencil, 90° bend is made. Curve of «U» loop is started, labial bow is on left. U loop is tried on the cast. Tag is brought over embrasure towards the palate between canine and premolar. Finishing of tag by bending a loop and keeping 1 mm away from palate. Similarly on the other side. On figure 44 you can see labial bow with M loops — shaped bends designed to tilt palatal canines erupted outside of the dental arch. On figure 45 you also can see modification if labial bow with a double semicircular bend.

Orthodontic spring. Orthodontic spring apply to move individual teeth or groups in three mutually perpendicular directions. Depending on the direction of the teeth movement distinguish spring:

1) for sagittal movement of the teeth;
2) for transversal;
3) for vertical movement of the teeth;
4) teeth for rotation about a vertical axis.

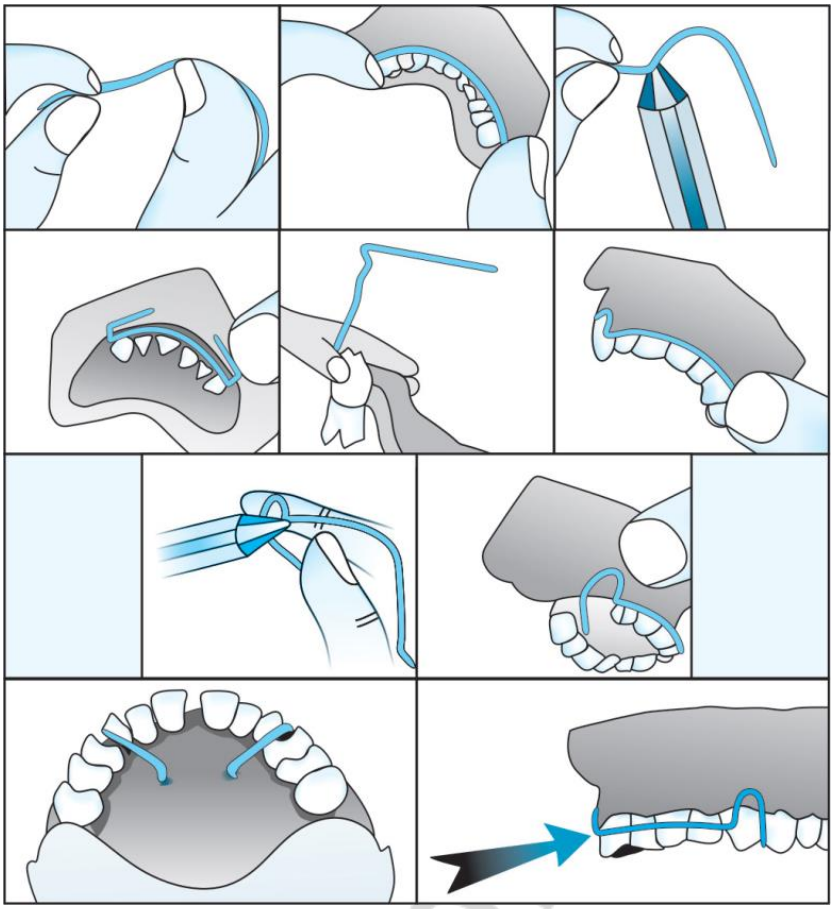

Fig. 43. Steps of Labial Bow Construction

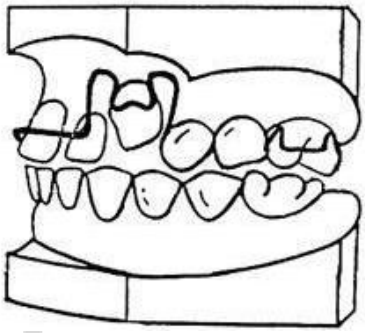

Fig. 44. Labial bow with M loops

Fig. 45. Labial bow with double semicircular bend

Springs are made of orthodontic hard stainless steel wire diameter of 0.2 to 1.2 mm, but most of the wire is 0,5–0,8 mm. The springs consist of three parts: the arm for pressure transmission to the movable teeth acting parts (helics for example) and process for fixing a spring in the base plate. Strength of the springs depends on:

1) the properties of the metal from which they are made;
2) the wire diameter;
3) the length of the spring arm;
4) the number of bends, their width;
5) the degree of activation.

Thus, with increasing wire diameter and decreasing length of the active arm of the spring force increases. Reducing the force of the spring occurs due to loss of its elastic properties, depending on the design of the spring and its degree of activation.

Depending on the number of movable teeth distinguish springs:

1) to move individual teeth (W spring, finger spring);
2) to move the teeth groups (oval);
3) springs for expansion and contraction of dentition (Coffin spring).

«W» Spring (fig. 46). Universal Crampon pliers are used to compress the «W» spring and increase the effective force of spring to labialize the incisor.

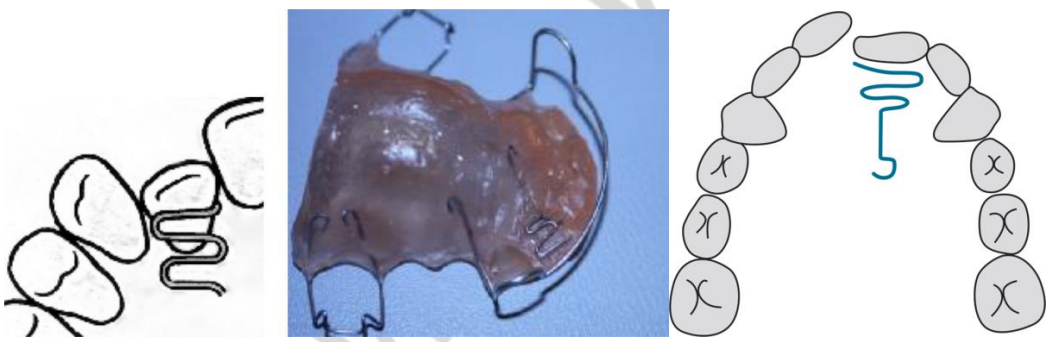

Fig. 46. «W» spring

Manufacturing stages:

Stage 1: Bending of active part. «W» spring desirably disposed perpendicular to the long axis of the movable tooth. Their width should not exceed the mesiodistal size of the crowns of the teeth moved. To do more than three bends is impractical because the acting part of the spring becomes long, flexible, easily slips with movable teeth and prevents the tongue movements. The most commonly used spring is with two – three curves.

Stage2: The bending of the fixing process. The spring should be fixed firmly in the basis orthodontic appliance, however ridge shape may be different (in the form of a ring, sloping lines), but not direct. The fixing process has been fully welded into the plastic base, it is placed on the working model of the jaw, some distance from its surface by 0.5–0.7 mm.

Stage 3: Fixing the spring on the working model. After placing the spring on the working model that secures the process, it is filled with molten wax. Spring bends desirable to have the basis of plastics. This prevents them from sliding off the movable teeth. Therefore, it is necessary to cover the spring bends with thin layer phosphate cement or gypsum, and thereby isolate them from wax, and then plastic.

Activated by extension spring twists semicircular 0.5–1 mm using Crampon plier.

Finger spring (fig. 47) is designed:

1) to mesio-distal tooth movement;
2) to introduce or traction teeth;
3) to oro-vestibular tooth movement.

It is cantilever spring. A finger spring is bent in the form of a long arm at the root of which is a coil with an internal diameter of about 3 mm where it emerges from plastic base. The spring should be placed or attached to the plastic base at a point midway between the present position of the tooth to be moved and the position it should occupy when the movement is complete. Hard stainless steel wire of 0.5 mm or 0.6 mm diameter is used to prepare finger spring.

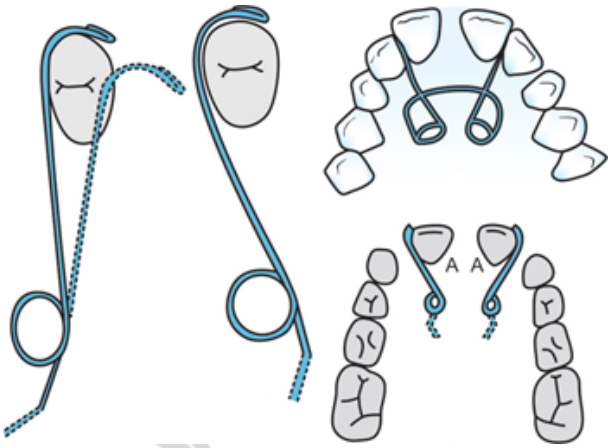

Fig. 47. Finger spring

Length of spring is about 2 cm from the point of application at the tooth to its insertion into the acrylic. Pressure applied is about 15 gm/square mm. The coil lies on the side of the wire away from the direction of tooth movement. Coil of one and half turn is sufficient. Activation is done by opening the coil. It should not exceed more than 2 mm at each time. Spring should not be bent where it emerges from base plate because it is a site of stress. Concentration and therefore fracture of wire is possible but it should be done at the free arm of spring as close to the coil as possible.

Advantages:

1. Spring provides light pressure; therefore well tolerated.
2. Several springs can be added if required to retract the teeth.

«T» Spring (fig. 48) Shape of the spring is like «T», 0.5 mm stainless steel wire is used. T shaped loop are made. Both arms of spring are embedded into base plate and cross piece rests on the palatal surface of the tooth to be moved.

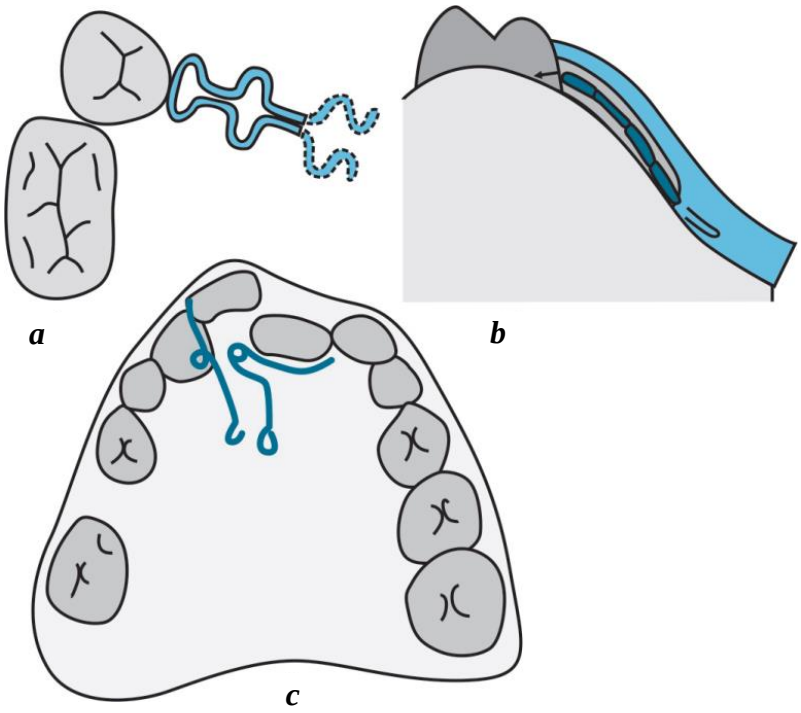

Fig. 48. Types of springs:
a — The most useful spring for buccal movement of premolars and canines. *b* — Palatal view of boxed in «T» spring. *c* — Two types of anterior helical springs. The one on the right is used to labialize an anterior tooth. The one on the left can be adjusted to move an anterior tooth toward the midline

Activated by simply seizing the cross piece of «T» and pulling the spring outwards and slightly away from the fitting surface of the acrylic so that it binds on the tooth during insertion.

Coffin Spring (fig. 49).

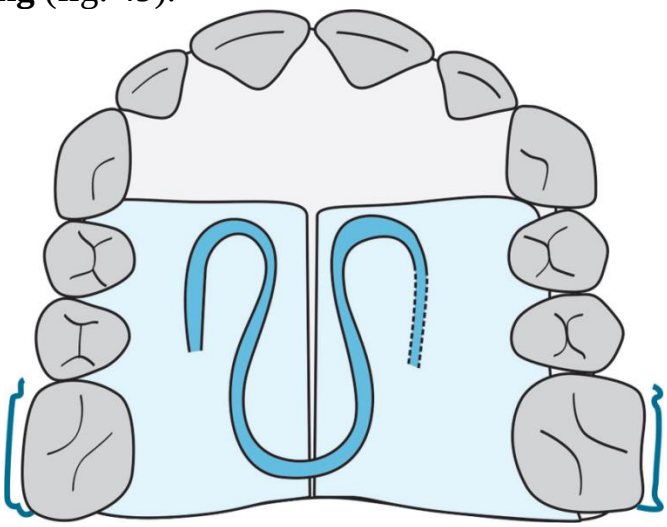

Fig. 49. Coffin Spring

Shape of spring is like a Greek letter Omega.

Indications:

1. Narrow arch.
2. Crowding to teeth
3. Expansion of arch in Anterioposterior and transverse direction.

Design

Coffin spring is made of 1.0–1.25 mm diameter wire.

Position of Spring

Anteriorly at intercanine region and posteriorly in the first molar region.

Retention

Retention is very important in coffin spring. So, four clasps are given. Anterior bends must not be incorporated into acrylic to permit full range of activation.

Activation and adjustment of coffin:

It is done with universal crampon pliers. Anterior and posterior bends are activated to get expansion in anterior and posterior region, reducing the curvature of bends by pliers.

Functions of Spring

1. Tongue trainer: It helps to correct the deviant swallowing pattern and tongue thrust by causing the base of tongue to seal against soft palate during swallowing; prevents the anterior tip of the tongue from slamming up against the lingual surface of anterior teeth and premaxillary regua area.

2. Coffin spring can be used as an effective appliance to push buccal teeth laterally so that cross bite correction is possible.

3. Coffin spring gives the appliance strength durability and stability in the mouth.

4. Acrylic side plates have interproximal projections of acrylic which faces to the teeth. They act as interdental wedges. So by opening the coffin spring the acrylic pushes not only against the teeth but the alveolar bone. It becomes capable of moving the teeth.

Advantage of Coffin Spring:

1. Cheap as compared to screw.
2. Permits non-parallel and parallel expansion.
3. Easy to keep clean for the patient.
4. Patient does not have to adjust the appliance.

Disadvantage:

1. High degree of skill required for preparation.
2. Excellent retention is necessary.
3. It can be easily over activated.

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3. *Lecture* materials.

TASKS FOR STUDENTS' INDEPENDENT WORK

1. Constituents of the semicircular clasp are:

a) elbow; c) body;
b) shoulder; d) base.

2. The Adams clasp is made of wire diameter:

a) 0,2; b) 1,2; c) 0,6; d) 0,7.

3. The labial bow in the removable appliances is used for:

a) to move the teeth and their groups;
b) better fixation, stabilization;
c) elastic recoil fixing;
d) easy device removal.

PRACTICAL SESSION 8

TOPIC: Basis of orthodontic devices. Production in dental laboratory. Features of orthodontic crowns manufacturing.

Total time of session: 6 academic hours.

Topic description. Basis plate is the base of removable orthodontic and orthopedic appliances and dentures. Different details like arc, screws, stump areas, inclined planes, occlusal overlays can be connected to the basis of appliance. For fixation orthodontic appliances clasps, vestibular and lingual arc can be used.

One jaw and monoblock orthodontic appliances, appliances with inclined planes, removable dentures are usually made of acrylics hot polymerization.

Expanding plates with screws and clasps, retentional plates, tooth endings, sport tires, bite basis, retainers, positioners and another devices can be made in «Biostar» or «Ministar», where devices are stamps with vacuum from heated acrylic plates. One jaw plates with many springs, levers, arcs, screws and double-jawed wireframes are usually made of cold polymerization of self-hardening plastic under increased pressure. Modern methods of manufacturing orthodontic appliances facilitate the work of dental technicians and orthodontist can get quality reliable orthodontic plate.

Purpose and objectives of the lesson. Students should be able to:

– choose the method of making orthodontic devises; know clinical and laboratory stages of making orthodontic devises;

– manufacture one jaw devise and double-jawed devise at the medical office.

Requirements to the initial level of knowledge. Student should repeat from:

– physics of the mode of the acrylics hot polymerization, mode of cold polymerization of self-hardening acrylics under increased pressure;

– general dentistry types of impression materials and plastics.

Practical questions from related disciplines:

1. Mode of hot polymerization;

2. Mode of cold polymerization;

3. Types of impression materials;

4. Types of plastics for manufacturing basis of the removable dentures.

Practical questions:

1. The boundaries of the base plate on the upper jaw.

2. The boundaries of the base plate on the lower jaw

3. Manufacturing steps for one jaw removable orthodontic device hot polymerization method of plastic.

4. Fabrication steps for functional orthodontic appliances by the method of plastic hot polymerization.

5. Fabrication steps for functional orthodontic appliances by the method of plastic cold polymerization.

6. Punching orthodontic appliances and devices from heated plastic plates by their pneumatic vacuum formation method.

7. Features manufacture orthodontic crowns.

Educational grants. Basis plate is the base of removable orthodontic and orthopedic appliances and dentures. It also can be used for retention of the results of orthodontic treatment. Basis plate with active elements is one jaw mechanical-acting appliance. Functionally-guiding details can be connected to the basis plate. When intraoral rubbers or springs are fixed on the basis of the upper and lower jaw it turns to mechanical-acting intermaxillary appliance. Basis plates connected in one block is the construction base of double-jawed functional-acting frame and block appliances.

One jaw and monoblock orthodontic appliances, appliances with inclined planes, removable dentures are usually made of acrylics hot polymerization.

Manufacturing steps of removable one jaw orthodontic appliance acrylics hot polymerization method:

1. Clinical step. Getting an impression from the upper and lower jaws and making a working model.

2. Laboratory step. Bending fixing and mechanical-acting wire elements and strengthening with wax on the model. Heating plate of wax tightly press on the model. Thickness of basis plate is 2–2.5 mm.

For manufacturing basis plate on the upper jaw palate and palatine tooth surfaces are covered by wax to level of its chewing surfaces and cutting edges. The posterior basis edge ends on the line connecting last molars distal surfaces.

The simple removable appliance is made of three major components including the retentive component (clasps), a framework or baseplate and a tooth moving element (spring or screw).

Appliance Components

Clasps

The Adams clasp is the most widely used clasp used in removable appliances. It is made of stainless steel wire. The retentive points of the clasp must fit

well into the undercuts of the teeth for ideal retention. The more active the appliance, and the greater the force applied during its use, the more clasping required to keep it in place. Additional retention may be gained by soldering additional retentive elements to the clasp. Other, less popular clasp designs include the circumferential, ball and lingual extension clasps.

Framework

The framework or baseplate, component of the simple removable appliance can be made of the contemporary plastic materials variety. The framework must fit ideally for the appliance to be successful. In general, maxillary appliances are better stabilized than mandibular appliances. In addition, mandibular appliances tend to have greater lingual undercuts, making ideal posterior fit of these appliances less predictable.

Active Elements

The most common active element in the simple removable appliance is the stainless steel spring. Springs must have adequate springiness and range while remaining strong enough to resist deformation. In addition, the spring must be guided so its activation is concentrated on the appropriate tooth. The ideal spring is larger than «020» wire. The increase in the wire diameter provides the strength to prevent destruction while in the mouth. Range and springiness are built in by increasing the length of wire incorporated into the spring. However, the longer the spring, the greater difficulty one will have in directing the force to the target. Springs can be directed by placing the spring within the tooth undercut, by incorporating a guide into the appliance, or by bonding an attachment to the tooth that will serve as an artificial undercut.

The base plate is the basis of removable devices and dental prosthesis. As an independent apparatus, it is used for retention achieved results of orthodontic treatment. Design, consisting of the basic plate with active elements, refers to single-jawed mechanically acting apparatus. The base plate can be attached to the functionally directional parts. When reinforced on the upper and lower base plates of rubber traction or springs, they turn into the mechanical operating devices of intermaxillary action. Base plates, joined in a single unit, are the basis of the design of the two-jaw functionally operating block and wireframes. Single-jawed and monoblock orthodontic devices, devices with inclined planes, as well as removable dentures are often prepared with using the method of plastics hot polymerization.

The sequence of manufacturing the removable **single-jaw** orthodontic appliance by plastic hot polymerization by boiling the cuvette in water, is as follows:

I. Clinical stage:

Obtaining an impression from the upper or lower jaw and casting a working model.

II. Laboratory stage:

Bending the fixing, mechanically acting wire parts and fixing them with molten wax on the model. Preheat the wax plate and tightly squeeze the surface gypsum model. The thickness of the baseplate is about 2–2.5 mm. To produce the base plate on the upper jaw with wax cover the palate, the palatine surface of the teeth to the level of their chewing surfaces and cutting edges. The distal edge of the base ends on the line, connecting the distal surfaces of the last molars. In the manufacture of the base plate on the lower jaw, the posterior border also passes as on the upper jaw, the lower border is located in the sublingual region at the site of the alveolar process to the bottom of the oral cavity. In the anterior region of the base plate, groove for the tongue frenulum should be done. When manufacturing appliance with the screw soften the wax and fix the screw in which it is pre-inserted fixing clamp, holes and threads are isolated. Removable apparatus, formed from wax, is plastered together with the model in the cuvette, in order to replace the wax with plastic. The cuvette is a metal box consisting of two halves and two covers (fig. 50). In the manufacture of orthodontic devices, direct and combined methods of gypsum pouring are used. With the direct method, the model and wire parts after wax melting remain in one part cuvettes. The height of the model should be such that the teeth do not rise above level of the sides of the cuvette lower half. For better strengthening in plaster clasps, vestibular arches and other details it is recommended to cut with a spatula part of the gypsum tooth, so that there remains free space for filling with gypsum.

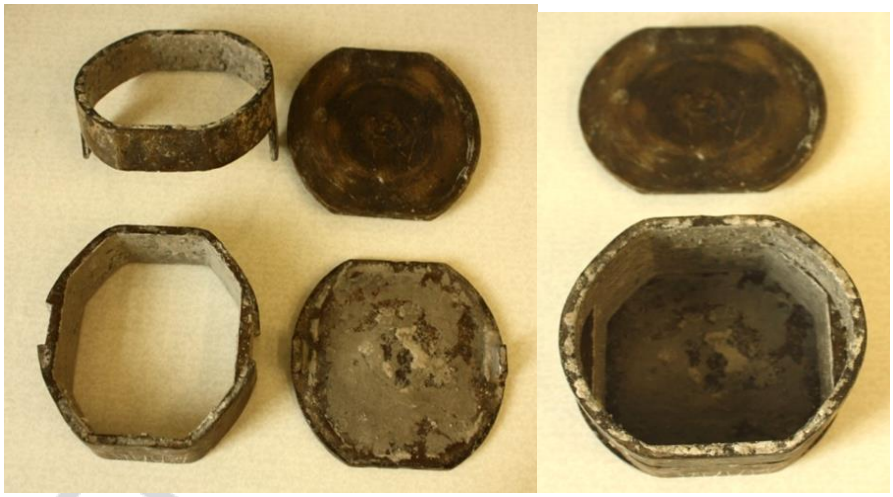

Fig. 50. Cuvette

Before the gypsum pouring, the model is immersed in cold water for 3 to 5 minutes. The gypsum is filled with the base of the cuvette, and the model, with preliminary covered with gypsum teeth, clasps, arcs, immersed in the cuvette, that a plate that covers the palate or alveolar process from the lingual side. Excess gypsum is removed and the surface is smoothed, so that nothing prevented the disconnection (opening) of the cuvette. The insulating layer is applied to the gypsum; both half of the cuvette are piled together and the gypsum is filled with the

cuvette, covered with a lid, put under a press, so that all parts tightly connected. The excess of gypsum is expelled outward. Mix according to the instructions of the plastic and after its swelling (not adheres to a spatula) form a base in cooled to room temperature cuvette. Connect both parts of the cuvette and tightly press, after 3 minutes exposure to the press immediately, screw into a metal bowl and place in a vessel with water room temperature; water is brought to a boil, boiling should continue for 60 minutes, after which the heating is stopped and the cuvette is left for 15 minutes in hot water (fig. 51, 52).

Fig. 51. Model with wax appliance in cuvette

Fig. 52. Press device

After cooling the cuvette in air or water at room temperature proceed to extract the appliance from the cuvette. Cleaned from gypsum machine grind, polished.

III. Clinical stage. Application of the device to the patient.

Clinical and laboratory stages of making a **double-jaw** apparatus:

I. Clinical stage. Obtaining impressions from both jaws and casting working models.

II. Laboratory stage. Wax base production with an occlusive roller on the model of the upper jaw. The model is covered with separating varnish (isokol, etc.), soften the wax plate and form hard palate and teeth; excess wax is cut with hot spatula. The occlusal roller is made from a heated wax plate, folded into several layers. Its height is 1 - 1.5 cm, width - 1 cm. Roller is fasten with a base of melted wax, smoothing all the irregularities.

III. Clinical stage. Definition of constructive occlusion (fig. 53).

Determine the constructive bite in three planes:

– in the sagittal — the patient is asked in the most cases to displace mandible to the neutral position of the molars;

– in the vertical — the posterior teeth are disocclused into 3–5 mm;

– in horizontal — ensure that the line passing between the central incisors of the upper and lower jaw, coincided.

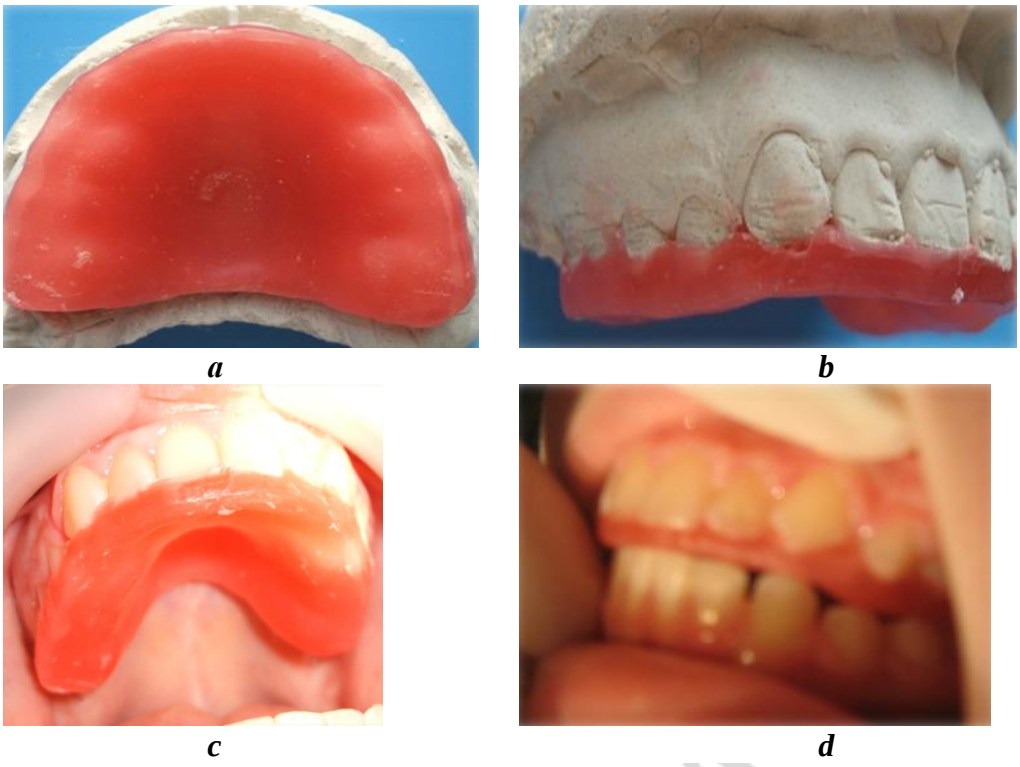

Fig. 53. Definition of constructive occlusion (wax palate with negative impression manufacturing):
a, b — wax base; *c* — intraoral; *d* — definition of constructive occlusion

The wax base is introduced into the oral cavity and gradually brought the occlusive roller, without heating it, and cutting off excess wax up to necessary position of the jaws. Then, a uniform wax layer is removed from the occlusal roller and replace it with a strip of softened wax. The base is again inserted into the oral cavity and the patient is asked to close his teeth, obtained on the occlusal roller imprinted teeth — are guided by drawing up the models.

IV. Laboratory stage.

After determining the constructive bite the dental casts are fixed in the occludator: the table is poured a little mixed gypsum, the lower arch of the occludator is immersed in the gypsum and, adding more layer of gypsum, put on it the bottom model. The upper jaw model is poured a new portion of gypsum and, lowering the upper arch of the occludator onto it, fill it with gypsum. Models with occlusal rollers glued with wax strips. When the gypsum hardens, cut off its excess. It is also necessary to ensure that the bar fixing the height of the occlusion contacts with a platform on the lower arch of the occludator. If you remove the wax base from occlusal ridges, the relative positioning of the models in the constructive bite remains fixed in the occludator. Then, the wire elements (arcs, springs, clamps and etc.) and fixing them with wax on the model; model the bases of the models of the upper and lower jaws, connect them to the occlusal plane. Gypsum models are sealed together with the wax composition of the apparatus. Separated from the occludator and plastered into a cuvette. Making two-jaws devices needs high cuvette, if not, one and a half ordinary cuvettes (2 bases

and 1 counter). In those cases when the length of the model does not exceed the height of the cuvette base, you can use a conventional cuvette. Use the direct method of the gypsum pouring, immersing the model with the front teeth down. The cuvette is opened after softening the wax to avoid breakage of the gypsum pieces. Cuvette is placed in boiling water for 5 minutes. If the direct method of the gypsum pouring is used, both models and all the wire parts are located in the bottom of the cuvette. If 1.5 cuvettes are used, models together with wire parts are located in different parts of the cuvettes. Next steps coincide with those described earlier. Expansion plates with screws and clasps, retentional plates, tooth and chin cap, mouthguards, retainers, positioners and other devices are prepared in appliance Biostar, Ministar, etc., in which they are stamped from heated plastic plates using vacuum (fig. 54). Single-jaw plates with a large number of springs, levers, labial bows, screws, as well as two-jawed wireframes are prepared mainly by cold polymerization of self-hardening plastics under increased pressure. Stamping orthodontic devices and devices from heated plastic plates by the method of their pneumo-vacuum formation are used. In the last decade, Biostar machines have become widely used and Ministar, produced by the firm «Shoy-Dental KG» with the aim manufacture of stamped orthodontic devices. For stamping devices from plastics Biostar uses both round and square blanks of plastic plates, and on Ministar — only round, with a diameter of 125 mm. Models of jaws for the manufacture of orthodontic devices and prostheses are cast from gypsum.

Fig. 54. Biostar

Using plastics rigid plates is possible when the appliance is removed from the gypsum chips, in connection with this duplicates of jaws models are prepared. The whole model is covered with elastic plastics, then it should be put on the working platform; if stamping plastics is performed on the part of the gypsum

model jaws, for example, in the manufacture of tooth-drop caps, the model is introduced into granules and leave only the part used to prepare the kappa or other devices. In the manufacture of devices used for stamping plastic pressure equal to 5 atm on Biostar and 2.5 atm on Ministar that provides a clear mapping of anatomical formations. Use various plastic plates:

1) rigid elastic «BioCryl C». For appliances that are permanently in oral cavity stay (removable dentures, expanding and retentional plates, mouthguards);

2) hard-soft mixed plastics «Impregon». From it devices for temporarily use are made (tires, therapeutic mouthguards for prevention of caries, bite patterns); «Impregon S» is used for the production of forming tires; «Durasoft» — for all types of tires;

3) soft elastic plastics — «Bioplast». It is used for manufacture of positioners, boxing tires, as well as models of their jaws duplicates are from gypsum; «Hardkast» is plastics used for manufacture of protective crowns.

Biostar and Ministar are used to produce a model print jaw and its subsequent duplication; individual and functional impression trays; bite bases; bases of dental prostheses; the basis for temporary and protective crowns; bridges prostheses; temporary kappas; partial plate prostheses; kappas for bruxism; tires for teeth whitening; carrying out of medical procedures — fluorization of teeth; mud treatment for periodontal disease; templates for implants; sports caps; expanding plates; retentional kapp and retention tires; Kapp for indirect bonding in the treatment with brackets; «Osamu», transparent retainers; positioners; chincap. Production of the jaw gypsum model impression. Used Materials: Bioplast plates 2.0–3.0 mm thick for elastic prints; «Copyplast» — 1.5–2.0 mm for acrylic prints (fig. 55).

Fig. 55. Bioplast plates

Sequence of manufacture:

1) Smoothing of the base surface of the jaw gypsum model and its rapid wetting with water.

2) Placement of the modeling platform on one level with the top edge of the modeling cup.

3) Establish the model on the platform.

4) Set off code. The plate is heated according to the instructions.

5) Closing the press chamber. Its opening after cooling.

Production of the plate with a screw, clasps, vestibular edentulous arches, as well as retentional plates. They use: plates «BioCryl C» 2–3 mm thick — prosthetic or colored (pink, red, blue, yellow), plates and adhesive «Isoflan», «BioCryl-rubber, cutter».

Sequence of manufacture:

1) Slit the groove in the plaster model of the jaw, in which there is the Plastic screw holder from its short side.

2) Bend and adjust clasps, labial bows.

3) Smooth out the surface of the model base, set it on the platform and crimp the «Izoflan» plate on the model.

4) Trim excess material at the model base, place expanding screw in the groove, after removing the «scallop».

5) Fix clamps, arches, springs on the vestibular surface of the model with sticky wax.

6) Introduce the vestibular part of the model into the granulate to the occlusal surface.

7) Large undercuts from the lingual surface of the model are filled with protective material.

8) Install the code and heat the plate according to the instructions.

9) Apply a few drops of «BioCryl-resin» to the expanding screw and clasps, bows and other wire parts fixed in the basis of the part for 20–30 seconds of the heating period. After heating, close the pressing chamber and squeeze hot plate on transparent acrylics.

10) «Biocryl-resin» polymerizes during cooling in press chamber and is connected to the plate «BioCryl C».

11) Cutters are used for machining.

12) Clasps and other wire elements are released with cutting tool, made of soft alloys that do not damage the metal parts. In poorly accessible places, you can polish the material with «Acrypol».

The method of cold polymerization of self-hardening plastics under increased pressure. Cold polymerization method self-hardening plastics under increased pressure is widely used for the manufacture of single-jawed removable orthodontic devices with a screw, clasps, levers, edged arcs and springs, as well as for the manufacture of double-jaw apparatuses of intermaxillary action, monoblock and frame (activators, bionators, propulsors, regulators of Frenkel's functions, etc.) — with their special occluders use.

PNEUMATIC CURING UNIT (fig. 56). It is used during the polymerization of self-curing acrylic resins. The unit has a compressed air inlet that allows air pressure to fill the pot. Curing of the resin under pressure significantly reduces the possibility of pores or voids with the resin.

Fig. 56. Pneumatic curing unit

Sequence of manufacture:

1) Slot the groove in the appropriate place of the gypsum model of the jaw to insert the screw holder and to tighten the screw.

2) Fasten the wire parts — clasps, labial bows, etc. sticky wax in those parts of the model that are further will not be covered with plastics.

3) Isolate with a small portion of the refractory white wax active parts of springs with a curl, eight-shaped, S-shaped from contact with plastics, leaving their ends free, fixed in the basis.

4) Mix self-hardening plastics in accordance with the instruction on its application. Expect its swelling.

5) Apply the first liquid portions to the ends of the wire parts.

6) Model the base plate of plastics respectively described above. The device is done with some excess of plastics for the convenience of finishing the completed plate.

7) Place the appliance that is to be cured in the pot filled with ¾ of water at room temperature (18–20 °C). Follow as the parts of the apparatus, modeled from self-hardening plastics, are not against the jet of injected air. Lukewarm water is usually placed in the pot to hasten polymerization. Ensure the appliance is completely submerged in the water. Secure the pot top.

8) Fill the pot with compressed air. Raise the pressure to 2.5–3.0 atm WARNING You must never exceed the maximum air pressure indicated in the manufacturer's instructions. Excessive pressure may cause the pot to explode. Curing time may vary depending on the thickness of the resin being cured. After curing, use the air relief valve to let the air escape. Ensure that no air pressure remains in the pot when retrieving the cured prosthesis from the pot. Periodically check the seals, air inlets, and outlets for malfunction. Activate the pressure relief

valve to ensure it is operational. When it is necessary, lubricate the «O» ring inside the lid with petrolatum.

9) The harvested appliance is kept in the polymerizer under pressure of 45–50 minutes.

10) Gradually reduce the pressure to atmospheric, remove the lid.

11) Extract the finished appliance with the jaw model from the polymerizer. Wash off the wax with hot water, remove the machine from the model of the jaw.

12) Work out the appliance and polish it.

In the manufacture of two-jaw monoblock and frame orthodontic devices use the same sequence of actions. The difference is that the models of the upper and lower jaws are fixed in occludator with a constructive bite. The occludator is held together thick rubber rings, so that the ratio of jaws hasn't been changed. Harvested appliance with occluder or retainer is placed in polymerizer. «Poly-Drucktopf» is more commonly used and it is produced of different height and volume. Making orthodontic appliances by cold polymerization of self-hardening plastics under increased pressure prevents the possibility of their deformation, facilitates the work of dental technicians, as it excludes a number of labor-intensive stages of work.

For the immovable parts of orthodontic devices support and fixation on the teeth metal crowns or bands are used. The tubes or locks can be soldered to them. Individual stamped crowns, bands and mouthguards are made from standard metal sleeve thickness of 0.2 mm by stamping. Teeth under orthodontic crowns are not prepared. The edge of the crown comes to gums, but does not enter the tooth-gum groove. If the teeth are located tightly produce separation by wire ligation. Ligature is carried through the interdental space in the cheek-lingual direction. When the edge of the ligature went to the lingual side, both ends twist over the chewing surface with crimped forceps or needle holder. Before making a turn, it is necessary to tighten the ligature to chewing surface of the tooth. Turn until the ligature will become fixed, the ends of the ligature are folded into the chewing surface, so that it does not injure the mucous membrane. Ligature is left on 2–3 days. Before you try on the crown, remove the ligature. After fitting the crown again apply the ligature to prevent the teeth from converging

V. Clinical stage. From laboratory alliances come to dental office where dentist fits them in the patients mouth.

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1. *Contemporary* orthodontics / William R. Proffit [et al.] // P. 391–397.
2. *Textbook* of Complete Dentures, *Arthur O. Rahn, John R. Ivanhoe, Kevin D. Plummer*, PMPH-USA, Limited, 01/2009.
3. *Lecture* material.

TASKS FOR INDEPENDENT WORK OF STUDENTS

1. How many steps required for one jaw orthodontic appliance fabrication?

a) one; c) three;
b) two; d) five.

2. How many steps required for functional orthodontic appliance fabrication?

a) one; c) three;
b) two; d) five.

3. Wire elements of double orthodontic appliance are made:

a) before plaster casts are mounted on an occludator;
b) after plaster casts are mounted on an occludator;
c) during mounting plaster casts on an occludator;
d) after basis orthodontic appliance modelling.

PRACTICAL SESSION 9

TOPIC: Orthodontic screws. Types of orthodontic screws. Special aspects of their installation into orthodontic appliances. Screws for movement of separate teeth and teeth groups.

Total time of session — 6 academic hours.

Topic description: Orthodontic screws are mechanically acting parts representing the main part of mechanical appliances. The great number and variety of orthodontic screws used in orthodontics generated a need for their systematisation. Depending on the purpose of use and design features they can be divided into three main groups. The first group is comprised of appliances used for movement of individual teeth or groups of teeth. The second group — for normalisation of shape of the dentition. The third group — for normalisation of occlusion. The appearance of modern orthodontic screws enables the orthodontist to achieve more effective results when treating complex dento-maxillofacial anomalies in children.

Purpose and objectives of the lesson. To learn how to install orthodontic screws in appliances, taking into account special aspects of treatment of different anomalies of individual teeth, dentition and occlusion. Study the main types of orthodontic screws, their structure and how to install them in the basis of orthodontic appliance, taking into account the nosological type of dentofacial anomaly.

Requirements to the initial level of knowledge. Student should repeat from: Students should revise the following topics: in physics — the forces developing upon screw activation (loosening or tightening the spindle); in the field of general dentistry — mechanical parts of intraoral removable orthodontic appliances.

Practical questions from related disciplines:

1. Mechanical force. Definition.
2. Action and reaction.
3. Screw as a part of removable and fixed orthodontic appliances.

Practical questions:

1. Screws. Design. Use.
2. Screws for moving individual teeth or their groups.
3. Screws for extension of the dentition.

Educational grants. Orthodontic screws are mechanically acting parts representing an integral part of a great number of orthodontic appliances. The pressure required for teeth movement occurs when the screw spindle is loosened or tightened. The spindle is made of stainless steel; the screw body is made of steel or titanium, sometimes chrome plated. During installation, a plastic or metal holder is used to fix the screw. The screw should be located in the middle of the basis of the appliance. In case the screw does not have a special holder, then it is fixed with a wire pin using a jaw model. The spindle drum is insulated with plaster to ensure the plastic does not get into the drum. In case the method of low-temperature pressure polymerization is used, the drum can be filled with melted wax. The direction of screw loosening is usually indicated by an arrow or a coloured dot on the screw body.

Orthodontic screws, depending on the purpose of their application and design features are classified into 3 groups:

1. For movement of individual teeth or groups of teeth.
2. For normalisation of shape of the dentition, expansion or extension, simultaneous expansion and extension.
3. For normalisation of occlusion.

Screws for movement of individual teeth or groups of teeth.

1) Gast telescopic screw (fig. 57) is used for vestibular movement of teeth. It is comprised of a body into which a spindle is screwed in and a support pad with a needle to fix the screw on the plaster model of the moved tooth. After the appliance is made, the needle is cut. During fixation of the screw body in the basis of the appliance it is important to keep its end free of plastic, where the spindle head is located. Tooth movement is carried out under the pressure of the support pad, which extends when the spindle is screwed into its body.

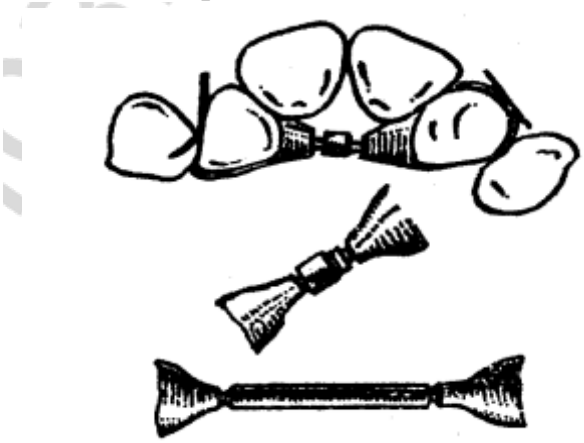

Fig. 57. Gast telescopic screw

2) Jaak push-pull screw (fig. 58) is used for simultaneous vestibular movement of two lateral incisors or first premolars. It has two support pads, a body and a spindle. In the course of treatment the screw is fixed on the moved teeth with the help of wires.

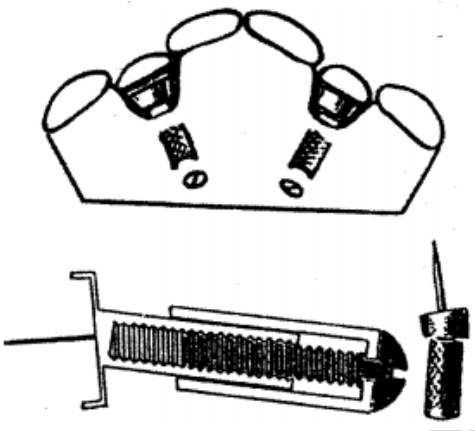

Fig. 58. Jaak push-pull screw

Lee-Bennet-Jaak push-pull screw (fig. 59) has a fixing pad with a spindle screwed into it. The fixing pad is used to fix the screw in the basis of the appliance. The long axis of the spindle is installed vertically to the long axis of the moved tooth.

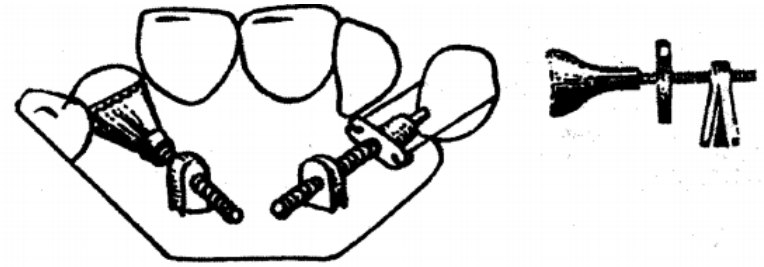

Fig. 59. Lee-Bennet-Jaak push-pull screw

3) Pulling screw for movement of individual teeth (fig. 60) can be a standard one or made from a segment of Angle's arch. In the basis of the appliance a tube from Angle's arch is fixed, in which a threaded segment of the arch is installed. Then nuts are screwed on the segment of the arch from both sides of the tube. Another end of the segment, not having a threading, is folded around the moved tooth. The pressure is transferred by loosening one nut and tightening another.

4) Skeleton type screw is stabilised with the help of a U-shaped guide pin (fig. 61). The part of the screw moving when the screw is loosened is fixed in the minor segment of the appliance. When the spindle is rotated, it glides along the guide pin together with the plastic segment and moves the tooth in the mesial, distal or vestibular plane. The width of the screw is 6 mm. It is used for movement of teeth in the lower jaw as well. Upon vertical installation of the screw to the long axis of the tooth its folded U-shaped pin is located along the slope of the dental arch so that it does not hamper tongue movement.

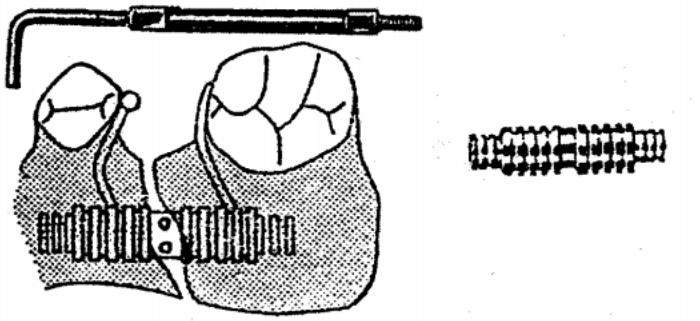

Fig. 60. Pull screw made from a segment of Angle's arch

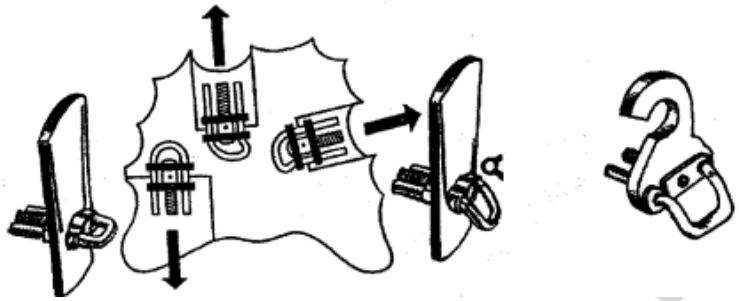

Fig. 61. Skeleton type screw with U-shaped guide pin

The pin is used to fix the supporting part of the screw in the basis of the appliance. When cutting a sector in plastic, equal to the width of the moved tooth, it is important to ensure that the sides of the cut are parallel. This prevents wedging of the moving sector. In case the oral movement of teeth is needed, a previously loosened screw is fixed in the basis. It is important to keep the segment of the dental arch away from plastic, into which the sector of the plate moves when the screw is tightened. The moved tooth is covered in the vestibular plane with the help of a fixing appliance.

5) Planas screw (fig. 62) is used for movement of a group of teeth and jaw expansion. It is comprised of a body in the form of a metal capsule and a spindle with a head. When the screw is activated, its head remains inside the capsule. The screw drum can be located in the middle or at the end of the body. It allows moving individual teeth, including movement in the mesiodistal plane. For better fixation of the screw in the plastic basis of the appliance, its body has incisions, and the processes have either straight or curved ends. The size of the screw allows installing it in the plate vertically to the long axis of the moved teeth without significant changes to the appliance size.

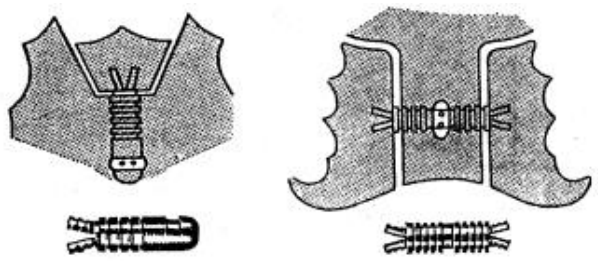

Fig. 62. Planas screw

6) A set of piston screws is used for movement individual teeth as well (fig. 63). These screws provide constant, flexible and easily controlled pressure on the moved teeth. The small size of these screws allows building them easily into the basis of the plate. Treatment begins with a 4 mm screw, which is then replaced by a 6 mm screw and then by an 8 mm screw.

Fig. 63. A set of piston screws

PRACTICAL SESSION 10

TOPIC: Orthodontic screws for normalization of dentition shape. Screws for normalization of occlusion. Types. Design features.

Total time of session – 6 academic hours.

Topic description: Orthodontic screws are mechanically acting parts representing the main part of mechanical appliances. The great number and variety of orthodontic screws used in orthodontics are generated the need for their systematisation. Depending on the purpose of use and design features, they can be divided into three main groups. The first group is comprised of appliances used for movement of individual teeth or groups of teeth. The second group — for normalisation of shape of the dentition. The third group — for normalisation of occlusion. The appearance of modern orthodontic screws enables the orthodontist to achieve more effective results when treating complex dento-maxillofacial anomalies in children.

Purpose and objectives of the lesson. To learn how to install orthodontic screws in appliances, taking into account special aspects of treatment of different anomalies of individual teeth, dentition and occlusion. Study the main types of orthodontic screws, their structure and how to install them in the basis of orthodontic appliance, taking into account the nosological type of dentofacial anomaly.

Requirements to the initial level of knowledge. Student should review: Students should revise the following topics: in physics — the forces developing upon screw activation (loosening or tightening the spindle); in the field of general dentistry — mechanical parts of intraoral removable orthodontic appliances.

Practical questions from related disciplines:

1. Mechanical force. Definition.
2. Action and reaction.
3. Screw as a part of removable and fixed orthodontic appliances.

Practical questions:

1. Screws for symmetrical expansion of the dentition.
2. Screws for asymmetrical expansion of dentition.
3. Screws for simultaneous expansion and extension of dentition.
4. Screws for intermaxillary action.

1. Screws for normalisation of dentition

1) Skeleton type screws are commonly used for expansion or extension of dentition. These are:

a) screws with one pin guide
b) screws with two pin guides (fig. 64)
c) screws with four-sided pins

These screws are securely fixed in the removable appliance. The body can be equal to half or one third of the length of the spindle.

Fig. 64. Skeleton type screw with two guide pins

Screws for expansion of the lower dentition are narrower than those designed for expansion of the upper dentition, and have one guide pin.

Four-sided guide pins prevent the occurrence of play during expansion of the screw (fig. 65). This allows using them for expansion of the median palatine suture.

Fig. 65. Screws with four-sided guide pins

The screw is usually installed in the deep part of the palate vault at the level of the upper premolars parallel to the occlusal plane or in the frontal part of the sublingual area at the midline. The distance between the model and the screw should be 0.5–0.7 mm. In some cases, a previously loosened screw is installed in the basis of the plate. It is important to wax the parts where the spindle moves when the screw is loosened, to keep them away from plastic. Upon the polymerisation of plastic, wax is extracted by steaming.

1) Hausser spring screws (fig. 66) have a closed body, having an amortisation spring, as well as a spindle. Due to this, loosening of the screw ensures a continuous pressure on the dentition.

2) Biederman screw (fig. 67) is designed to accelerate the expansion of the median palatine suture with the help of a fixed appliance. The screw body has four wires spreading outwards in different directions, which are folded to follow the shape of the palate and are welded to the supporting rings, fixed on the premolars and molars.

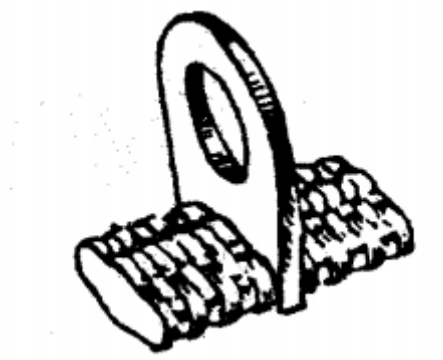

Fig. 66. Hausser screw

Fig. 67. Biederman screw

3) Phillip screw (fig. 68) is used for even expansion of the lower dentition. Its body has long wires spreading outwards in both directions, which are used to fix the screw in the basis of the appliance. Due to this, the screw body is not covered with plastic, and the plate appliance is thinner in the front part, making it more comfortable for the patient. Before installing the screw, its clasp is folded to follow the shape of the alveolar process in the sublingual area so that it is 0.5 to 0.7 mm from the jaw model.

4) V-shaped expansion screw (fig. 69) is designed for uneven expansion of the upper dentition. The two halves of the screw body are interconnected by a spindle and a restrictive hinge. It also has fixing loops ensuring a better fixation of the screw in the basis of the appliance. In order to prevent wedging of the spindle during fan-shaped divergence of the plate halves, it is connected by the hinges to the main body of the screw. When the spindle is loosened, these parts rotate towards each other to remain parallel. The screw is installed in the deep part of the palate vault and shifted forward as far as possible. The stopper in the form of a screw hinge must be located in the back of the plate. It is not covered by plastic.

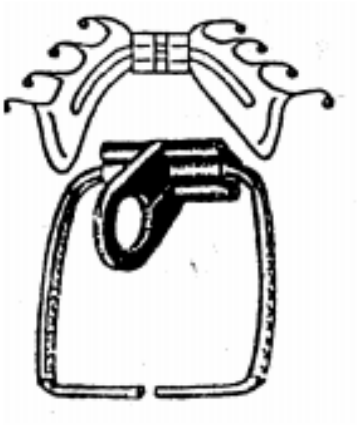

Fig. 68. Phillip screw

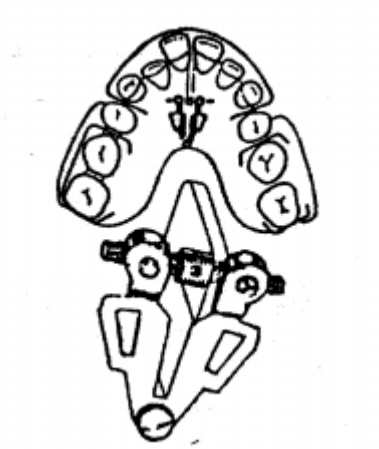

Fig. 69. V-shaped expansion screw

5) Expansion screw with a restrictive hinge (fig. 70) is used for expansion of the upper dentition in the front section, i. e. mainly in the area of incisors, canines and first premolars.

Fig. 70. Screw with a restrictive hinge

It is comprised of two parts: a screw and a restrictive hinge. The spindle of the screw is attached to two freely rotating cylindrical bodies. The size of the screw allows to installing it horizontally in the canine area. The stopper is two rigid perforated metal strips connected by a hinge. This stopper is placed in the distal part of the appliance along the midline of the palate. The hinge of the stopper is not covered by plastic.

6) Muller arc screw (fig. 71) is used for expansion of the lower dentition in the frontal section. A short or long segment of arc-shaped wire is used as a stopper.

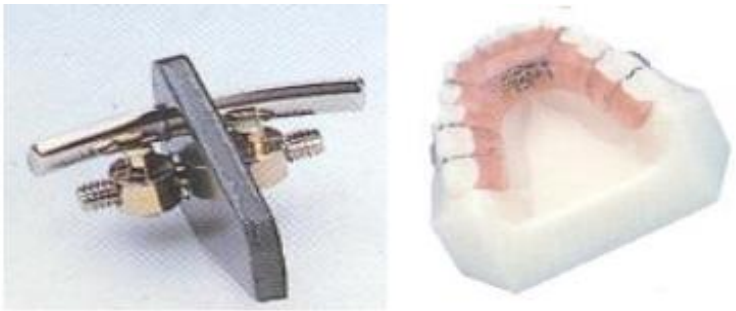

Fig. 71. Muller arc screw

For simultaneous expansion or extension of dentition, the following types of screws are used:

7) Bertoni multi-sector screw (fig. 72). It is comprised of two or three connected screws. The screw is installed on the working jaw model in the deep part of the palate vault so that it is parallel to the occlusal plane.

Fig. 72. Bertoni multi-sector screw

2. Screws for intermaxillary action.

1) Weise screw is used in Wunderer activator (fig. 73), designed for treatment of mesial occlusion. The upper part of the body transfers the action force of the screw (active force) to the upper teeth and moves them forward, the lower part of the body transfers the reaction force (reactive force) to the lower teeth and moves them back, correcting the occlusion. The screw is fixed on the jaw model between the dentition arches in the front section. The activator is cut across along the midline of occlusal inlays.

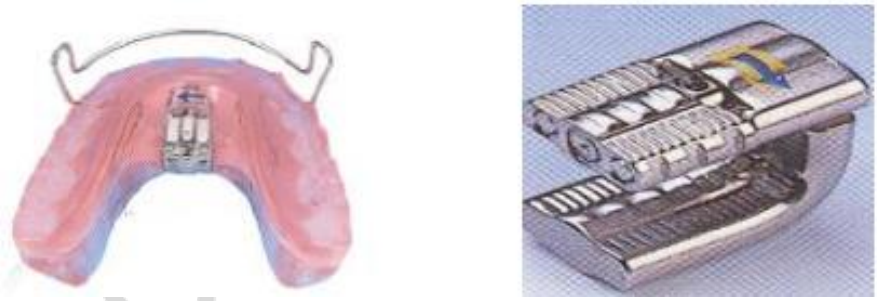

Fig. 73. Weise screw in Wunderer activator

2) Frentzen screw (fig. 74) is used to treat sagittal anomalies of occlusion. The spindle of the screw is placed in a long cylindrical body. When the spindle is rotated, the nut connected to the fixing processes moves as well. The fixing processes are used to fix the screw in the bottom part of the activator. The upper part of the screw is placed in the area of the upper central incisors inside the plate, leaving the spindle head free. The activator is cut across. When the spindle is rotated, the upper and lower parts of the activator move in mutually opposite directions.

3) Weller reciprocal screw (fig. 75) is indicated for treatment of sagittal anomalies of occlusion and is used in vestibular removable appliances: vestibular plates, Frankel functional regulators. The body of the screw is comprised of two shifted parts, located in the same plane. The screw has one round guide pin. The screws located in both side shields of the appliance are used to correct the occlusion. When the screws are loosened, they have a reciprocal effect on both halves of the appliance and thus on the dentition.

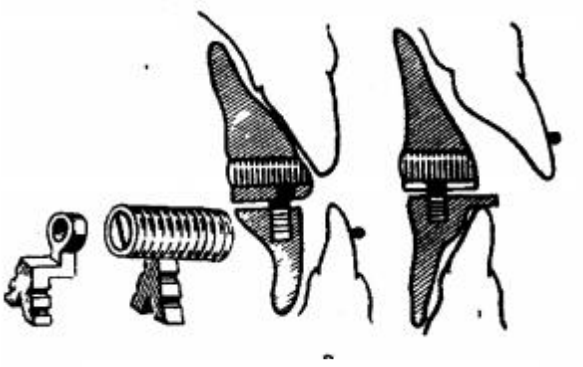

Fig. 74. Frentzen screw

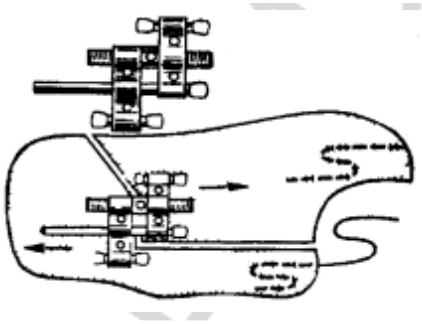

Fig. 75. Weller reciprocal screw used in Frankel functional regulator

For simultaneous expansion of dental arches of the upper and lower jaw, skeleton type expansion screws with two guide pins are used. In the activator, the screw is installed between the dental arches in the front section and the appliance is cut across, i.e. on the line of the median palatine suture, taking into account the midline of the lower jaw. If the screw is placed in the area of palate vault, then the upper dentition is mainly widened.

TASKS FOR INDEPENDENT WORK OF STUDENTS

Types of orthodontic screws by their designation (tabl. 12)

Table 12

Movement of individual teeth of groups of teeth	Normalisation of the shape of the dentition	Normalisation of occlusion
Gast telescopic screw (for vestibular movement).	Skeleton-type screws: a) with one guide pin; b) with two guide pins; c) with four-sided guide pins	Weise screw (used in Wunderer activator designed for treatment of mesial occlusion).
Jaak push-pull screw (for simultaneous vestibular movement of two lateral incisors or first premolars)	Hausser spring screws (for even expansion or extension of the dental arch)	Frentzen screw (for treatment of sagittal anomalies of dentition).
Lee-Bennet-Jaak push-pull screw (for vestibular or palatal movement of lateral incisors or canines)	Biederman screw (for accelerated expansion of median palatine suture)	Weller reciprocal screw (used in vestibular removable appliances, vestibular plates, regulators for treatment of sagittal disocclusion)
Pull screw (made from a segment of Angle's arch) for movement of individual teeth	Phillip screw (for even expansion of the lower dentition)	

End tabl. 12

Movement of individual teeth of groups of teeth	Normalisation of the shape of the dentition	Normalisation of occlusion
Planas screw (for movement of a group of teeth and jaw expansion)	V-shaped expansion screw (for non-even expansion of dentition)	
Skeleton type screw stabilised with U-shaped guide pin (for movement in mesial, distal or vestibular plane)	Expansion screw with a restrictive hinge (for expansion of dentition in the front section)	
Piston screws (for movement of individual teeth)	Muller arc screw (for expansion of the lower dentition in the front section)	

SELF-CHECK TEST

1. Name the screw used for accelerated expansion of median palatine suture:

a) Weise screw; c) Bertoni screw.
b) Biederman screw;

2. Name the screws used for normalisation of occlusion:

a) Gast, Jaak, Planas screws;
b) Phillip, Bertoni, Biederman screws;
c) Weise, Frentzen, Weller screws.

3. Name the screws used for simultaneous expansion and extension of dental arches:

a) Bertoni and Clay; c) Weise and Frentzen.
b) Planas and Jaak;

PRACTICAL SESSION 11

TOPIC: The concept of the norm and pathology in orthodontics. Rate of occlusion in different periods of its formation. General ideas about diagnosis of dentoalveolar anomalies.

Total time of session — 6 academic hours.

Topic description. The problem of orthodontic care for children, adolescents and adults in the presence of functional, morphological and aesthetic disorders in the dentofacial area is very relevant.

Clarification of the influence of functional disorders on the development of malocclusions and deformation of the face made it possible to pay attention to the need for elimination of functional, morphological and aesthetic abnormalities simultaneously, in order to achieve the interdependence of functions and form as soon as possible.

Purpose and objectives of the lesson. Students should:

know norm of the occlusion in different age periods;

Practical questions:

1. Definitions:

a) ideal occlusion;

b) normal occlusion;
c) physiologic occlusion;
d) functional occlusion;
e) balanced occlusion.
2. The concept of «disease», anomaly in orthodontics.
3. The rate of occlusion in different periods of formation.

Educational grants. During developing of orthodontic diagnostics, the researchers tried formulate concepts of the norm and pathology of development, structure and functioning of the dentofacial system. The process of cognition was consisted of the following stages: the accumulation of facts, their logical comprehension, abstract thinking, putting forward hypotheses or theories and testing them in practice.

Occlusion is defined as relationship between all the components of masticatory system in normal function, dysfunction and parafunction. An ideal occlusion is the perfect interdigitation of the upper and lower teeth, which is the result of developmental process consisting of the three main events: jaw growth, tooth formation and eruption. The term occlusion has both static and dynamic aspects. Static refers to form, alignment and articulations of teeth within and between dental arches and relationship of teeth to their supporting structures. It may be defined also as the contact relationship of the teeth in function and parafunction. To date several definitions of occlusion are existed. First of all, it is ideal occlusion, preconceived theoretical concept of occlusion structural and functional relationship that includes idealized principles and characteristics that an occlusion should be. The second is normal occlusion; it is class 1 relationship of maxillary and mandibular first molars in centric occlusion. Physiologic occlusion — occlusion that deviates in one or more ways from ideal yet, but it is well adapted to that particular environment, is esthetic and shows no pathologic manifestations. Functional occlusion — an arrangement of teeth that provides highest efficiency during excursive movements of mandible, which is necessary during function. Balanced occlusion — an occlusion in which balance and equal contacts are maintained throughout entire arch during all excursion of mandible.

Periods of occlusion development:

Pre-dental period (period of newborn) — the period after birth during which the neonate does not have teeth. This period lasts for 6 months. The upper and lower gum pads are almost similar to each other, the upper gum pad a both wider and longer than the mandible one. Thus when upper and lower gum pads are approximated, where is a complete overjet all around. Contact occurs between upper and lower gum pads in first molar region and a space exists between them in anterior region, this infantile open bite is considered normal and it helps for sucking. Neonate without teeth is about 6 months of life. During first year of life gum pads grow rapidly permitting incisors to erupt in good alignment.

Period of development deciduous dentition. Primary teeth begin to erupt at the age of about 6 months. Eruption time for primary teeth 2,5–3,5 years. A deep

bite, absence of spaces may occur in initial stages of development. The upper deciduous frontal teeth cover the lower ones by more than 1/2 length of the lower teeth crowns, the tubercle of the upper deciduous canine tooth crown is located between the lower deciduous canine tooth and the 1st deciduous molar, the mesial-buccal tubercle of the upper deciduous second molar is located in the transverse fissure of the similar lower tooth, the buccal tubercles of the upper lateral teeth cover the buccal tubercles of the lower ones, and the palatine tubercles of the upper teeth are located between the buccal and lingual tubercles of the lower teeth, teeth arches have shape of semicircle. Functions of the dental system: breathing — nasal; chewing — developing to 3 years old; swallowing — after eruption of temporary incisors — a mixed type (tongue at the moment of «starting» push on incisors), by 3 years — somatic type; speech- fully formed by 3 years; sucking — dying by the end of the first year of life.

Deciduous dentition period. Spacing appears between deciduous teeth. Spacing called physiological spaces or developmental spaces. Spaces in primary dentition are important for normal development of permanent dentition. Absence of spaces in primary dentition can cause crowding (when the larger permanent teeth erupt). Spacing invariably is seen mesial to maxillary canines and distal to mandibular canines. The deep bite is later reduced due to eruptions of deciduous molars, attrition of incisors, and forward movement of mandibula due to growth. From the age of four cusps of deciduous teeth begin to wear off. The upper deciduous frontal teeth cover the lower ones by 1/3 length of the lower teeth crowns, the tubercle of the upper deciduous canine tooth crown is located between the lower deciduous canine tooth and the 1st deciduous molar, the mesial-buccal tubercle of the upper deciduous second molar is located in the transverse fissure of the similar lower tooth, the buccal tubercles of the upper lateral teeth cover the buccal tubercles of the lower ones, and the palatine tubercles of the upper teeth are located between the buccal and lingual tubercles of the lower teeth, upper teeth arch semielliptical, lower teeth arch semicircular. In this period, it is common to identify early symptoms of dentoalveolar anomalies: the tuberous ratio of the teeth of the upper and lower jaws, the vertical gap between the incisors of the upper and lower jaw is more than 4 mm, insufficient wearing of deciduous cusps after 5 years. Functions of dentoalveolar system are completely formed.

Mixed dentition period is characterized by eruption of permanent teeth, active growth of jaws. Mixed dentition period begins at approximately 6 years of age with eruption of first permanent molar. During mixed dentition deciduous teeth along with some permanent teeth are present in oral cavity. The tubercle of the upper canine tooth crown is located between the lower canine tooth and the 1st premolar, the mesial-buccal tubercle of the upper 1st molar is located in the transverse fissure of the similar lower tooth, the upper frontal teeth cover the lower ones by 1/3 length of the lower teeth crowns, the centerline between the central incisors of the upper and lower jaws coincides, the buccal tubercles of the upper lateral teeth cover the buccal tubercles of the lower ones, and the palatine tubercles of the upper teeth are located between the buccal and lingual tubercles

of the lower teeth, the upper dental arch is semielliptical, the lower — parabolic, absence of spacing.

Permanent dentition period is characterized by following features :

– the upper frontal teeth cover the lower ones by 1/3 length of the lower teeth crowns;

– the tubercle of the upper canine tooth crown is located between the lower canine tooth and the 1st premolar;

– the centerline between the central incisors of the upper and lower jaws coincides;

– the mesial-buccal tubercle of the upper 1st molar is located in the transversesulcus of the similar lower tooth;

– every tooth of the upper jaw has two antagonists — similar and standing behind (except for the lower central incisors and upper wisdom teeth);

– the buccal tubercles of the upper lateral teeth cover the buccal tubercles of the lower ones, and the palatine tubercles of the upper teeth are located between the buccal and lingual tubercles of the lower teeth;

– the upper dental arch is semielliptical, the lower — parabolic;

– the dental arches of the upper and lower jaws are symmetrical;

– in the state of central occlusion there is a full occlusive contact between all teeth (except for unerupted ones);

– in the state of physiological rest an interocclusive space varying within 2 mm arises between dental arches.

Anomaly (Greek) — is a deviation from the norm, from the general pattern, wrong. In medicine anomalies are called a deviation from the structure (form) and function inherent in this biological species or organ, caused by a violation of the development of the body. A large number of anomalies in the dentoalveolar system are known. The multiplicity and variety are explained, firstly, by the set the reasons that cause them, and secondly, the peculiarities of the mechanism of their development (pathogenesis) and, thirdly, individual characteristics of the organism, with which the same causes lead to the development of completely dissimilar anomalies. A large number and variety of forms of anomalies explains necessity of their taxonomy.

TASKS FOR INDEPENDENT WORK OF STUDENTS

1. What is typical for the period of completed primary dentition?

a) an active growth of the jaws;
b) gaps between the teeth;
c) deep overbite;
d) a semicircle shape of the dentitions;
e) temporary teeth cusps without abrasion.

2. What is typical for the period of newborn?

a) somatic swallowing;
b) retrogenia with 14 mm sagittal fissure (overjet);

c) an infantile type of swallowing;
d) a semicircle shape of dentition;
e) an active sucking function.

3. What is typical for initial and final periods of mixed occlusion?

a) a semicircle shape of dentition;
b) no gaps between the teeth;
c) overbite 1/3 of the size of lower incisor;
d) the mixed type of swallowing;
e) active jaws growth.

PRACTICAL SESSION 12

TOPIC: Classification of maxillodental-facial abnormalities and deformities.

Total time of session: 6 academic hours.

Topic description. A large number and variety of forms of anomalies give rise to the necessity of their systematic. Nowadays there are many classifications of dentoalveolar anomalies. However, the most widespread among doctors received the classifications of Engle (1889) and the World Health Organization (WHO, 1975). Classification is needed for uniform registration of deviations from the norm, their systematization, choice of treatment plan and international communication. The final stage of diagnosis of dentoalveolar anomalies is the diagnosis. Diagnosis is a short medical conclusion about the essence of the disease and the patient's condition, expressed in terms of modern medical science, which is necessary for treatment planning.

Purpose and objectives of the lesson. Students should:

1. know various classifications of dentoalveolar anomalies;
2. know their advantages and disadvantages;
3. be able to make an orthodontic diagnosis.

Practical questions:

1. What are the main development periods and authors of orthodontic Classifications?

2. What are the main principles of the Engel's classification of mesial distal relation of jaws? Give clinical characteristic of sagittal jaw relations according to Angle classification.

3. What are the main disadvantages of the majority of orthodontic classifications in different periods of their development? How to minimize their impact on the diagnostic process?

4. Describe the basic principles of modern nomenclature and terminology of malocclusion.

5. Describe the basic principles of the system morph functional approach in malocclusion diagnostics.

6. Give an analysis of the system approach in the description of orthodontic diagnosis.

Educational grants. A wide range of anomalies and deformations with similar clinical manifestation are known. In this connection there have been offered numerous different classifications, which allow systematizing various types of dentoalveolar anomalies. Anomalies systematization enables to choose a correct approach to their understanding, study etiopathgenetic factors of their origin, put a diagnosis and plan treatment. All the classifications of dentoalveolar anomalies are mainly built on the registration of morphologic deviations, functional disorders, etiologic factors or their combination. The most widespread are the classifications built on the basis of morphologic changes. They are based on the immovable junction of the facial skeleton, excluding the lower jaw, with other cranial bones. Thus, according to schoolars, the facial skeleton does not undergo the harmful influence of internal and external factors. Moreover, the facial skeleton is not exposed to such changes as the dentognathic apparatus is exposed.

The first morphologic classification, based on the principle of dental arches correlation overall, was offered by E. Angle in 1889. The classification is grounded on the mesiodistal correlation of the 1st permanent molars of both jaws, which are defined by the author with the term «occlusion key». Angle considered that the localization of the upper 6th tooth always corresponds to the localization of the *crista zygomatica* thanks to its eruption in this place only. The author named the 6th tooth *«punctum fixum»* (the fixed point). The permanent localization of the 6th tooth, according to the scientist, is determined, first of all, by the immovable junction of the upper jaw with the cranial base, and secondly, by the fact that it always comes out behind the 2nd temporary molar. Therefore, all atypical correlations of permanent molars arise only at the expense of the irregular position of the lower jaw.

Angle divided occlusion anomalies into three classes.

The 1st class — «occlusion key» is correct: the mesial buccal tubercle of the 1st upper permanent molar is located in the intertubercular fissure of the lower 1st permanent molar. Thus, the pathology is only localized in front of the 1st molars and concerns either teeth arrangement or alveolar process and jaws bodies development (fig. 76, *a).*

The 2nd class is characterized by the distal localization of the lower 1st permanent molar. At such correlation, the mesial-buccal tubercle of the upper 1st permanent molar is in front of the intertubercular fissure of the lower 1st permanent molar. Either the contact is defined by similar tubercles or the mesial-buccal tubercle of the upper 1st permanent molar is located between the tubercle of the 2nd premolar and the mesial-buccal tubercle of the lower 1s1 permanent molar, which depends on the complexity of the deformity. The changes of teeth correlation concern the whole dental arch. The 2nd class may have two divisions of the anomaly: the 2nd class, 1st division — the distal location of the lower jaw, at which the upper frontal teeth are inclined forward and are fanlike allocated, with diastems and diaereses (fig. 76, *b).* The 2nd class, 2nd division — the upper frontal teeth are inclined in the oral direction, deeply

covering the lower ones (fig. 76, *c*). In both divisions the distal correlation in posterior areas may be uni- and bilateral.

The 3rd class is characterized by the mesial position of the lower 1st permanent molar relative to the similar upper tooth. At such correlation, the mesial buccal tubercle of the upper 1st permanent molar is behind the intertubercular fissure of the lower 1st permanent molar. The lower frontal teeth cover the upper ones. 3rd class anomalies also may be uni- and bilateral (fig. 76, *d).*

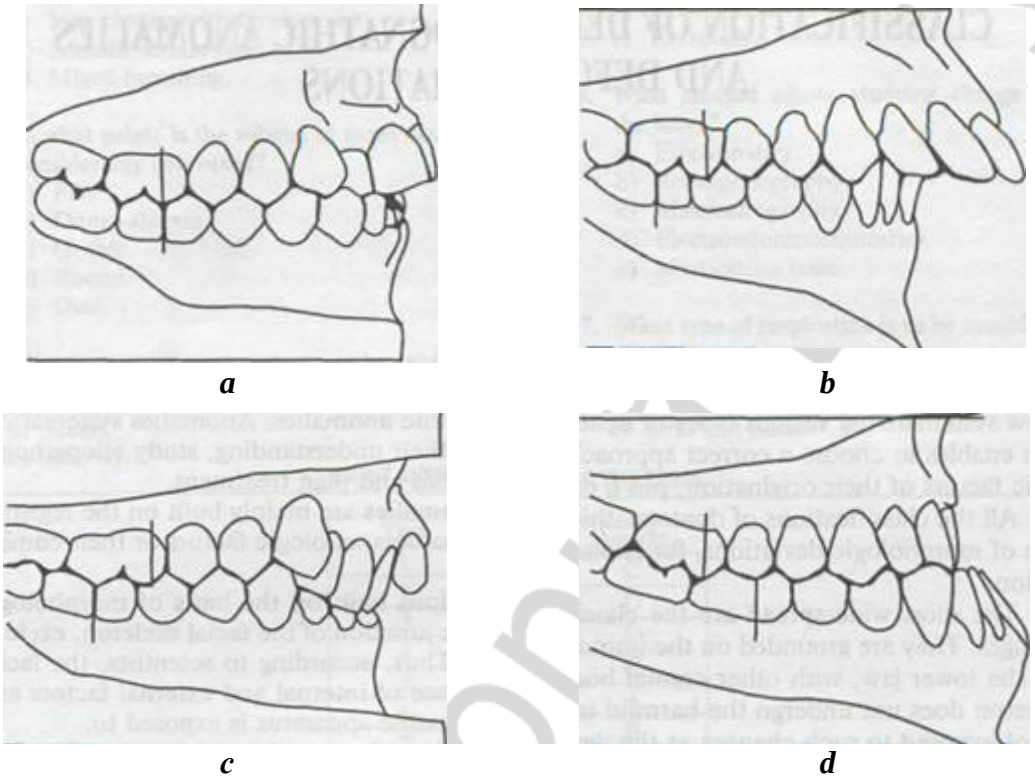

Fig. 76. Occlusion anomalies according to Angle:
a — Angle's 1st class; *b* — Angle's 2"d class, 1st division; *c* — Angle's 2nd class, 2nd division; *d* — Angle's 3rd class.

Also Angle differentiates seven types of individual teeth anomalies:

1) labial, or buccal occlusion;
2) lingual, or palatine occlusion;
3) medial occlusion;
4) posterior occlusion;
5) torsion occlusion;
6) infra occlusion;
7) supra occlusion.

Angle's classification was very popular at the end of the 19th century as it somehow ordered the diagnostics of dentognathic anomalies and deformations. This was the first accessible by its simplicity, the only generally accepted occlusion anomalies classification in the world, which is used by specialists also nowadays. However, in spite of this Angle's classification has a number of draw-

backs. Firstly, the upper 1st molar does not always have a stable place: at premolars extraction or their adentia the place may change mesially. Besides, the upper jaw may take the front position in the cranium, and then the location of the 1st molar changes. Secondly, it is possible to use the classification only when examining transitional dentition and permanent occlusion. Thirdly, the classification reflects occlusion anomalies only in the sagittal plane, not taking into account vertical or transversal anomalies. Fourthly, the classification does not take into account functional and esthetic disorders.

D. A. Kalvelis (1957) considers that classification should be based on the morphologic changes of teeth, dental arches, and occlusion in general taking into account the etiology and value of these derangements for function and esthetics.

Dentognathic anomalies and deformations are classified in the view of work convenience of a practicing orthodontist and have three groups:

1) anomalies of individual teeth;
2) anomalies of dental arches;
3) anomalies of occlusion.

D. A. Kalvelis's classification:

I. Anomalies of individual teeth.

1. Anomalies of the number of teeth:
– adentia – partial and full anodontia;
– supplemental teeth (hyperdontia).
2. Anomalies of the size and form of teeth:
– gigantic teeth;
– spiked teeth;
– distorted forms of teeth;
– Hutchinson's, Fournier's teeth.
3. Anomalies of hard tooth tissues structure:
– hypoplasia of the tooth crown.
4. Disorder of the process of eruption:
– premature eruption of teeth;
– delayed eruption of teeth.

II. Anomalies of dental arches.

1. Derangement of dental arches formation:
a) Anomalous position of individual teeth:
– labio-buccal eruption of teeth;
– palatine-lingual eruption of teeth;
– mesial eruption of teeth;
– distal eruption of teeth;
– low position (infra occlusion);
– high position (supra occlusion);
– tooth torsion (torsion anomaly);
– teeth transposition;
– dystopia of upper canine teeth.

b) Dense position of teeth.

c) Spaces between teeth (diastems).

2. Anomalies of the form of dental arches:

– narrowed dental arch;
– saddle-shaped squeezed dental arch;
– V-shaped dental arch;
– quadrangular dental arch;
– asymmetric dental arch.

III. Anomalies of occlusion.

1 . Sagittal anomalies of occlusion:

a) prognathism;

b) progenia: false and true.

2. Transversal anomalies of occlusion:

a) narrowed dental arches;

b) disproportion of the width of the upper and lower dental arches:

– disorder of the correlation of lateral teeth on both sides;
– disorder of the correlation of lateral teeth on one side (transversal or unilateral cross bite).

3. Vertical anomalies of occlusion:

a) deep overbite:

– covering occlusion;
– combined occlusion with prognathism (roof-shaped);

b) open bite:

– true occlusion (rachitic);
– traumatic occlusion (caused by bad habits).

The disadvantage of the classification is that insufficient attention paid to the functional disorders of the denthognathic apparatus.

L.S. Persin's classification:

1. Anomalies of dental arches occlusion.

1.1. Lateral area.

1.1.1. Sagittal:

– posterior (distal) occlusion;
– mesial occlusion.

1.1.2. Vertical:

– disocclusion.;

1.1.3. Transversal:

– cross bite;
– vestibular occlusion;
– palatine occlusion;
– lingual occlusion.

1.2. Frontal part.

1.2.1. Sagittal:

– sagittal incisive disocclusion;

– reverse incisive occlusion;
– reverse incisive disocclusion.

1.2.2. Vertical:

– vertical incisive disocclusion;
– straight incisive occlusion;
– deep overbite;
– deep incisive disocclusion.

1.2.3. Transversal:

– transversal incisive occlusion;
– transversal incisive disocclusion.

2. Anomalies of the occlusion of opposing teeth pairs:

2.1. Sagittal.

2.2. Vertical.

2.3. Transversal.

It should be noted that none of the above classifications of dentofacial anomalies completely satisfies orthodontic science and practice. The classification reflects a certain level of knowledge, in which it cannot be unchanged.

Central to the diagnosis of dentoalveolar anomalies is definition of the underlying disease and its complications. The main are those diseases, whose treatment is possible by orthodontics or combined with them methods. Complications include disorders, which are pathogenetically associated with the underlying disease.

Before diagnosis, it is necessary to determine the morphological, functional and aesthetic disorders in the dentoalveolar system, and, if possible, indicate their etiology and pathogenesis.

Scheme of setting an orthodontic diagnosis (F. Ja. Khoroshilkina, 1986)

1. Bite, occlusion.

a) sagittal plane:

– neutral bite (fig. 77, *a*) — the mesial-buccal tubercle of the upper 1st molar is located in the transverse fissure of the similar lower tooth, the tubercle of the upper canine tooth crown is located between the lower canine tooth and the 1st premolar.

– distal bite (fig. 77, *b*) — mesial buccal tubercle of the upper first molar located forward of the in the transverse fissure of the similar lower tooth; the tubercle of the upper canine tooth crown is located forward of the lower canine tooth and the 1st premolar.

– mesial bite(fig. 77, *c*) — mesial buccal tubercle of the upper first molar located behind of the in the transverse fissure of the similar lower tooth; the tubercle of the upper canine tooth crown is located behind of the lower canine tooth and the 1st premolar.

b) vertical plane:

– open bite;
– deep overbite;

c) transversal plane:

– crossbite, one- or two-sided, with or without a displacement of the jaws, buccal or lingual.

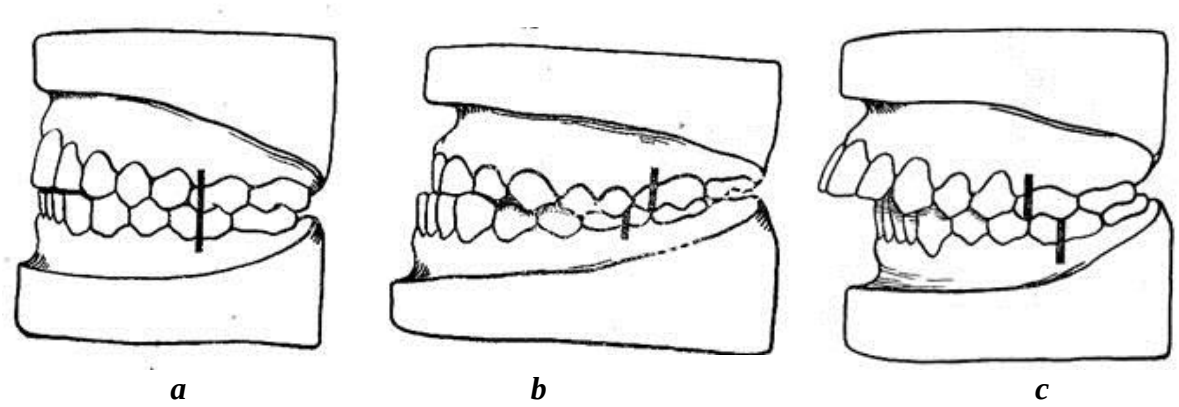

Fig. 77. a — neutral bite; *b* — distal bite; *c* — mesial bite

There are symmetrical and asymmetric bite disorders.

2. Anomalies of teeth:

a) of the number of teeth (adentia, hyperdontia, supplemental teeth);

b) the size, shape (crowns, root of the teeth);

c) colours;

d) hard tissues;

e) eruptions (early, late, retention, impaction);

f) abnormalities of the teeth (protrusion, retrusion, mesial occlusion, palatine occlusion, lingual occlusion, vestibular occlusion, distal occlusion, supra occlusion, infra occlusion, rotation, transposition).

4. Anomalies of hard and soft tissues: anomalous attachment of upper and lower lips frenulums; shortening of the frenulum of the tongue; change the size and mobility of the tongue; degree of expression of non-pharyngeal tonsils; inborn isolated, complete clefts of the lip, alveolar bone, solid and soft palate; exostoses.

5. Functional disorders and bad habits, impaired nose and mouth breathing, speech impairment, infantile swallowing, slow, flaccid chewing, dysfunction of the temporomandibular joint.

6. Aesthetic disorders: changes in the shape of the face in the facet, in profile, in vertical and horizontal directions, asymmetry.

7. Condition of adjacent organs and the whole organism: state nasopharynx, impaired vision, cardiovascular disease, diseases of the gastrointestinal tract, disorders of posture, ossification disorders of the skeleton.

8. Etiology of dentoalveolar anomalies and deformities: data-the results are determined from the analysis during the examination of the patient.

TASKS FOR INDEPENDENT WORK OF STUDENTS

1. The base of Persin's classification of dentoskeletal anomalies are:

a) malocclusion;
b) anomalies of teeth antagonists occlusion;
c) morphological changes of the dentition;
d) esthetic abnormalities;
e) functional impairments.

2. Choroshilkina's diagnosis scheme is based on the following factors:

a) morphology;
b) esthetics;
c) anatomy;
d) function;
e) etiology.

3. What is the right sequence of diagnosis by Choroshilkina:

a) anatomy-function-esthetics;
b) function-anatomy-esthetics;
c) esthetics-function-anatomy.

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