KNMU

Department of Pediatric Dentistry, Pediatric Maxillofacial Surgery and Implantology

Topic of lecture:

«Orthodontic appliances, its constructive parts and rules of its activation».

Plan of lecture:

1. General Characteristics of Orthodontic Appliances Historical Development.
2. Classification of orthodontic appliances (F.Y. Khoroshilkina).
3. Constructive elements of orthodontic appliances.
4. Functionally acting orthodontic appliances (passive). Source of force. Their therapeutic action, indications and contraindications, constructive elements, advantages and disadvantages, recommendations for user, complications.
5. Functionally directing orthodontic appliances (passive). Their therapeutic action, indications and contraindications, constructive elements, advantages and disadvantages, recommendations for user, complications. Source of force.
6. Appliances of mechanical action (active). Therapeutic action of appliances of mechanical action. Constructive elements of appliances of mechanical action. Advantages and disadvantages of appliances of mechanical action. Source of force for appliances of mechanical action.

Orthodontics has come far since the days when finger pressure was being advocated to move teeth. With the development of this branch of dentistry is associated an inseparable quest of researchers to create appliances which can move teeth "ideally".

This endeavor to achieve "ideal" tooth movement has led clinicians to create numerous appliances, which move teeth. ***Orthodontic appliances can be defined as devices, which create arid/or transmit forces to individual teeth/a group of teeth and/or***

maxillofacial skeletal units so as to bring about changes within the bone with or/without tooth movement which will help to achieve the treatment goals of functional efficiency, structural balance and esthetic harmony.

Most of the orthodontic appliances are restricted to bringing about tooth movement. But as our knowledge of growth and development of the maxillofacial unit has increased, so has our endeavor to modify the growth of underlying skeletal structures.

An orthodontic appliance for the treatment of various dentognathic anomalies is chosen taking into consideration the **patient's age** and **anomaly evidence**.

Not infrequently there arises the necessity to modify the construction of one or another appliance. One and the same type of anomaly may be treated by a couple of appliances, but it is always expedient to use **the most sparing and effective technique**.

In the period of milk and early mixed occlusion mainly removable appliances should be used.

At late mixed and permanent occlusion fixed appliances of mechanic action may be also used, especially at full-blown anomalies.

Some authors note that skilled use of an appliance is more important than the appliance type.

The essence of orthodontic appliances action lies in continuous, interrupted, or alternately active pressure on teeth, alveolar processes and jaws with the help of special mechanical devices, which are activated by expanding screws, spring wire, rubber rings, ligatures or the force of the masticatory and expression muscles (at disconnected occlusion) or the change of motor stereotypy of the lower jaw with the help of directing occlusive and biting platforms, inclined planes and elements providing expression muscles normalization: labial bandages, buccal shields, vestibular mantels — valves for the tongue, etc.

Continuously acting force presses on a tooth without the phase of rest during a long period of time and thus does not allow necessary tissues reorganization, as a result of which hyalinization happens easily. If forces of such type are used, they should be

exceptionally weak. Raitan thinks that in most cases it is impossible to avoid the processes of hyalinization, therefore in future the growth of tooth occurs after indirect resorption.

Continuous forces arise at applying "opening" or "closing" spiral springs. At first big forces are quickly reducing due to the short way, so the phase of rest is possible for tissues. Similarly, at applying rubber-elastic materials, when saliva weakens the action of the big force at the beginning soon after devices application.

Alternately acting force is met at removable plates and functional orthodontic devices. They are characterized by regular phases of rest as the device is not worn during some time in the course of a day. Despite the pauses, bone resorption continues during this time, because osteoclasts activity does not stop after the phase of pressure is over.

Here attention should be also paid to the degree of helical spring stretch or compression.

There also exist orthodontic appliances, whose therapeutic action is based on the directed change of dynamic balance between the expression muscles, which continuously effects dental arches in the lingual direction, and the tongue, which counteracts this pressure in the vestibular direction.

General Characteristics of Orthodontic Appliances Historical Development. Orthodontics as a science and practice has come a long way, where rises took turns with falls, where progress depended on achievements in biology, medicine, science and technology. The simplest orthodontic methods were known in old times. Thus, Roman doctor Celsus applied the method of finger pressure to correct the position of teeth which had come out in a wrong way. The method went down in history as finger massage. Ligature binding, wide flat bands with openings, which were tied to teeth and with their pressure or pull influenced incorrectly standing teeth, were also used.

In 1723 Foshar was the first to use metal arches to treat incorrect teeth position; he also offered the dilating arch. In 1728 Foshar's work, which described the etiology and treatment of incorrect teeth position, was published.

Later, Hunter's inclined plane was created (1771). In 1886 Coffin offered the dilating spring. Head-chin strap and the device for disconnecting occlusion were offered

by Delabar; tread ring with a screw — by Shanzhe; rubber traction as the source of force — by Tuker; orthodontic arch — by Evans.

In the second half of the 19th century Kingsley offered a plate with a screw, and also with an inclined plane. In 1862 Kez and Becker worked out the system of intermaxillary traction. In 1887 Angle created a universal arch device, based on the construction of Evans' arch.

As science and technology were developing, old devices were improved, and new ones were created.

Instrument treatment was scientifically grounded only at the beginning of the 20* century, when Angle, Sanstedt, and Oppenheim began studying morphologic changes arising in the periodont at orthodontic treatment.

An orthodontic appliance for the treatment of various dentognathic anomalies is chosen taking into consideration the patient's age and anomaly evidence. Not infrequently there arises the necessity to modify the construction of one or another appliance. One and the same type of anomaly may be treated by a couple of appliances, but it is always expedient to use the most sparing and effective technique. In the period of milk and early mixed occlusion mainly removable appliances should be used. At late mixed and permanent occlusion fixed appliances of mechanic action may be also used, especially at full-blown anomalies. Some authors note that skilled use of an appliance is more important than the appliance type.

Classification of orthodontic appliances (F.Y. Khoroshilkina). According to F.Y. Khoroshilkina, basic constructions of orthodontic appliances are classified in the following way.

According to the principle of action they are divided into four groups:

- functionally acting;
- functionally directing;
- of mechanical action;
- of combined action.

According to the mode and place of action:

• onejaw;

• onejaw of intermaxillary action;

• two-jaw;

• extraoral;

• combined.

According to the type of support:

• reciprocal;

• stationary.

According to the place of location:

• intraoral — oral (palatine, lingual), vestibular (extracoronal);

• extraoral — cranial (frontooccipital, parietooccipital, combined);

• cervical;

• gnathic (supralabial, infralabial, chin, submaxillary, angles of the lower jaw, combined).

According to the type of fixation:

• fixed (nonremovable);

• removable;

• combined.

According to the type of construction:

• arch;

• gum shield type;

• laminar;

• block;

• skeleton;

• elastic.

Constructive elements of orthodontic appliances.

❖ Fixing harts:

- Crown
- Band

- Bracket
- Clasp (Adams Clasp, Circumferential Clasp, Lingual Extension Clasp, Ball clasp)
- Gum shield

❖ Acting parts:

- Screw
- Arch Wires
- Elastomeric products
- Spring
- Inclined plane
- Biting platform
- Oral screen (lip bumper, lingual pad and flanges, lip pad, buccal and lingual shield, crib)

❖ Supporting parts:

- Tube
- Hook
- Tangent bar

Functionally acting orthodontic appliances (passive). Source of force. Their therapeutic action, indications and contraindications, constructive elements, advantages and disadvantages, recommendations for user, complications.

Orthodontic appliances, whose therapeutic action is based on the directed change of dynamic balance between expression muscles, which continuously influence the dental arch in the lingual direction, and the tongue, which counteracts this pressure in the vestibular direction, are named functionally acting.

One of the main directions in developing these appliances was the creation of vestibularly located constructions for the normalization of the expression muscles function. Vestibular plates (of Korbitz, Schoncher, Craus, Muellemann, Dass, Hinz) protect dental arches from the pressure of the lips, cheeks, fingers, and different objects. They normalize lips closure, the functions of breathing and swallowing, train the orbicular

muscle of mouth. Appliances with a grid for the tongue normalize its correct position and prevent excessive pressure on the frontal group of teeth.

The usage of functionally acting appliances is effective in the young age (in the period of milk occlusion and at the beginning of the first period of mixed dentition), when it is possible to take account of the growth of jaw bones and especially of the apical basis.

Constructive elements of functionally acting appliances include: buccal shields, labial bandages, vestibular mantels, limiting grids for the tongue, etc.

Hinz' vestibular plates (Germany) is a preventive appliance for early orthodontic treatment of occlusion anomalies in children of 3—6 years, substantiated by 30-years experience of usage by orthodontists and children's dentists. The plates promote pernicious habits elimination and prevent the development of soft tissues dysfunction, which causes dental arch deformation in milk occlusion.

Vestibular plates (with a blue ring), radius 30 mm, for mixed dentition:

- eliminate the very reasons for anomaly development;
- promote speech defects elimination;
- correct tongue position;
- eliminate usual oral breathing;
- normalize lips closure;
- strengthen the orbicular muscle of mouth;
- promote myofunctional training.

Vestibular plates (with an orange ring), radius 22.5 mm, for milk occlusion:

- prevent the pernicious habit of sucking a finger;
- change oral breathing to nasal;
- eliminate tongue dysfunction;
- provide myofunctional therapy.
- Vestibular plate "H" — a bead for tongue control:
- prevents oral breathing at incorrect tongue position;
- prevents incorrect tongue position at rest;
- is helpful at speech defects.
- Vestibular plate "K" (shield):

• a shield for biting with lower frontal teeth;

• prevents the pernicious habit of sucking a finger at underdeveloped lower jaw;

• is indicated at all types of mandibular retrusion or protrusion of upper incisors; eases and trains lips closure.

If the plate is worn with the shield upwards, deep overbite is eliminated.

Vestibular plane with a wire valve:

• prevents open bite development;

• resists tongue dysfunctions at speaking and swallowing.

At each swallowing movement and at speaking a child lays the tongue between the dental arches and natural interocclusal contact may be violated. The valve, resisting the laying of the tongue, prevents open bite formation.

Preorthodontic Trainer. The trainer corrects myofunctional pernicious habits and evens erupting teeth.

1.Labial projection in the form of an arch exerts slight pressure on the frontal teeth in the process of coming out.

2.The "tongue" for the tongue actively trains the tongue apex position.

3.The restrictor for the tongue restricts tongue movements and its pressure on teeth.

4.Labial bumpers force the child to breath through the nose, take off redundant muscle pressure.

The initial trainer (blue) is soft, which provides its flexibility and quick adaptation, eliminates myofunctional problems. It is administered at evident disocclusion in most cases.

The final trainer — final levelling of teeth.

Further levelling of teeth is conducted with the help of a stiff (pink) trainer, which is rather tight. The principle of operation is the same as at applying an orthodontic wire arch. When teeth are in their places, big efforts are needed for their final levelling.

Myofunctional characteristics (design) are the same as in the initial trainer.

The final trainer is applied in subsequent 6-12 months. Longer wearing may be recommended depending on the results and the further phase of orthodontic treatment.

Lately, a new trend in orthodontic treatment — with the help of aligners (elastomers) — is widely popularized abroad.

The method of treating dentognathic anomalies offered by Frankel in 1960 also deserves attention. Frankel views violations of the function of mastication, swallowing, breathing, speech, and also the change of the tone of perioral, occipital, and cervical muscles as the underlying cause of dentognathic anomalies' arising. The author considers the habit of keeping one's mouth open and complicated nasal breathing to be especially harmful.

The devices, offered by Frankel, were named function regulators. In contrast to most other orthodontic appliances they are hardly a source of mechanic influence on dental arches, but promote function normalization and correct formation of dental arches and occlusion. It is a removable two-jaw device, whose basic elements are lateral shields and vestibular bandages. The first liberate the lateral areas of teeth from cheeks pressure and stimulate the growth of jaws and apical basis of the upper and lower jaws in the sagittal direction.

Parts of the device are joined with the help of metal arches made of elastic wire. Depending on the clinical presentation, dental arches may be disconnected or their masticatory' surfaces may touch the biting platform. The lateral shields are adjacent to the vestibular surface of teeth or are distant from them. The author has offered three types of the devices: the I^{я} and the 2nd — for the treatment of posterior occlusion, combined with protrusion (the I^{я}) or retrusion (the 2nd) of the upper frontal teeth, the 3rd — for the elimination of mesial occlusion.

Treatment with appliances of functional action is combined with active myotherapy and constant observation of the lips and tongue position. Thus, anomalies are eliminated by means of influencing not dental arches and through them — jaws and muscles function, but vice versa, by influencing muscles and through them — jaws and dental arches.

Functionally directing orthodontic appliances (passive). Their therapeutic action, indications and contraindications, constructive elements, advantages and disadvantages, recommendations for user, complications. Source of force. The creation of functionally directing orthodontic appliances was a significant step forward in the development of the arsenal of medical orthodontic means.

Devices of functional action are differently constructed inclined planes (with 30—45° angulation), biting platforms, occlusive side plates, which transfer teeth or the whole lower jaw in the sagittal, transversal, and vertical directions. No actively acting elements are put into them. The source of force is the contractile capacity of the mastication muscles in the period of certain teeth closing with the inclined plane, biting platform or occlusive side plates; at that, in other areas dental arches are disconnected. The devices act in discontinuous manner.

A.Y. Katz is the initiator of the functional method in orthodontics. In 1933 he offered functionally directing appliances for the treatment of dentognathic anomalies. Katz believed that the force of functionally directing appliances is regulated by the parodontium receptors, i.e. it can only act within certain limits, and if it becomes excessive, pain appears and muscles contraction weakens or strengthens according to reflex. Such regulation of orthodontic force (depending on individual peculiarities and the reactivity of each patient's parodontium) should prevent pathologic changes in the parodontium tissues. But, according to the experimental data of H.T. Sukharev and D.A. Kalvelis, at application of functionally directing devices there arise severe tissue transformations, which overstep the limits of normal tissue reactions. According to I.S. Rubinov, therapeutic efficacy of directing appliances is connected with the function of mastication muscles and reflexes of occlusion disconnection.

Fixed Appliances of Functionally Directing Action. Fixed functionally directing appliances include Katz' crown. It consists of a metal crown (fixed on the upper incisors) with a soldered to its palatine surface inclined plane made of wire loops, touching the vestibular surfaces of the lower teeth. At dental arches closure the upper incisors are inclined in the vestibular direction, lower — orally, the alveolar process partially rebuilds in the vertical direction in the region of the upper and lower frontal teeth. Katz' crown as a result of occlusion

disconnection possesses considerable continuous action, as muscles are in constant tension at wearing these appliances. The speed of teeth transfer, observed under these conditions, and their longterm mobility testify to the fact that resorption processes advance apposition processes.

Schwarz' gum shield is a cast or stamped of metal or made of plastic gum shield with an inclined plane, which covers the frontal group of teeth on the lower jaw. It is fixed with the help of cement. The appliance is used at inverse incisor overbite, in mixed and permanent occlusion, if there is place in the dental arch for incorrectly located teeth, at deep frontal overbite (otherwise, open bite formation is possible). Gum shield's action reminds of the action of Katz' directing crown with a wire loop. Some authors recommend that the inclined plane touches not only the palatine surfaces of frontal teeth but also reaches the alveolar process of the upper jaw or borders upon it. To their mind, this promotes the transfer of frontal upper teeth and alveolar process in the vestibular direction. It is expedient to use the gum shield in this modification in the milk period of occlusion.

Still, earlier created fixed functionally acting appliances had such an element in their construction — inclined planes cast or bent of metal plates. As these appliances were fixed, their usage often lead to complications: injuries, inflammatory diseases of mucous tunic, teeth, and TMJ. Therefore they were less and less used in the clinical practice, and more and more often in experiments on animals.

Removable Appliances of Functionally Directing Action. With the purpose of eliminating the rigid action of fixed appliances on teeth they were removable: Schwarz' gum shield, B.N. Bynin's gum shield, Schwarz' device with a biting platform, etc. The usage of masticatory muscles contraction as the main source of energy for teeth transfer allowed attaching intermaxillary action to onejaw fixed and removable appliances due to the presence of a passively acting functionally directing element in their construction (inclined plane, biting platform, occlusive side plates, etc.).

B.N. Bynin's gum shield with an inclined plane is made of plastic, covers the whole lower dental arch, and goes under the upper teeth with its inclined plane. Indications to its application and principles of its action are the same as in Schwarz' gum shield, but it may

be used at middle frontal overbite (in this case the lower frontal teeth are almost not inclined orally). In the process of treatment, when lateral teeth start touching the gum shield, their masticatory surfaces are filed off, which provides repeated occlusion disconnection and device's action prolongation.

Schwarz' plate on the upper jaw with an inclined plane for the treatment of posterior occlusion.

Schwarz' plates on the upper jaw with a biting platform in the region of frontal teeth for deep overbite elimination or occlusive side plates in the region of lateral teth for open bite treatment.

Biting Katz' platform, used for the treatment of prognathism and deep overbite. The peculiarity of its construction is throw-over hooks, which lean over the cutting edges of frontal teeth onto their labial surface, and an inclined plane. The platform does not border on the mucous tunic of the frontal part of the palate and necks of teeth. At biting the frontal part of jaws rebuilds. In their lateral parts vertical growth takes place due to occlusion disconnection. Besides, at the moment of closure the lower frontal teeth slide on the inclined plane and the lower jaw dislocates forward.

Appliances of mechanical action (active). Therapeutic action of appliances of mechanical action. Constructive elements of appliances of mechanical action. Advantages and disadvantages of appliances of mechanical action. Source of force for appliances of mechanical action. The force of these devices' action lies in the very construction of the device and does not depend on the contractile ability of the masticatory muscles. The active part of the device is the source of force: arch and spring springiness, elasticity of rubber recoil and ligatures, the force developed by the screw, omega, levers, etc. The intensity of appliances' action is regulated arbitrarily by the doctor, who uses their active part. The used force of pressure or recoil should be individual. To avoid complications it is expedient to use small forces of action, which approach natural forces, and activate appliances under the control of dosaging devices, providing the period of rest.

Development of the instrument method of orthodontic treatment, substantiated scientifically and practically, is connected with the name of Angle. The method is

characterized by the following principles: the treatment is aimed at achieving ideal occlusion without teeth extraction; the idea of the $I^{я}$ permanent molar as the '"key" of occlusion; patient's age; treatment with standard mechanical appliances. For this purpose Angle offered vestibular round arches (stationary, expansive, sliding). These appliances got further development in the arch devices of Herbst, Mershon, Simon, Korkhaus—Lindy, Stanton, Cwillford. They include screw appliances and bracket systems.

These orthodontic appliances are fixed with the help of crowns or rings on unprepared permanent teeth (premolars, molars) after conducting the so-called orthodontic separation. For this purpose there are used elastics, spring separators, plastic wedges, ligature, which are introduced between teeth and left for a couple of days. If it is necessary to disconnect dental arches for the treatment, crowns are used, if it is not needed to raise occlusion — rings are applied. Crowns and rings reach the teeth necks and are fixed with phosphate cement, but rings may decement. To improve their fixation they should be cemented with glassinomer cement or special adhesive glue, made on the basis of epoxide resins.

Angle's appliances are called universal, because they may be used for the treatment of different types of dentognathic anomalies. The main part of these appliances consists of a vestibular arch made of stainless steel wire 0.8—1.0 mm thick. There are threads on its either part, on which nuts are wound. Crowns or rings are put onto the abutment teeth (the $I^{я}$ permanent molars) — Angle used bandage rings — with tubes located horizontally from the buccal side. The arch, bent with the help of fingers by the form of the dental arch, is inserted into the tubes. Nuts allow fixing the arch in any sagittal position: from contact with teeth to a certain distance from them.

Angle's stationary arch is used for the vestibular transfer of irregularly located frontal teeth: tying them up to the arch with ligatures, transferring them. The arch is activated by means of tightening nuts and moving the arch forward. Not infrequently hooks are soldered to the arch, or incorrectly located teeth are covered with crowns, vertical bars or hooks are soldered to them and under the influence of rubber recoil or ligatures teeth are moved to the needed side (mesially, distally, vertically) or rotated.

Angle's expansive arch is used for dental arch dilation. Depending on the region, in which dental arch should be dilated (in the region of molars or premolars), the

arch is set accordingly. To dilate dental arch in the region of molars the arch is straightened and by means of drawing its ends together under tension is introduced into tubes; if it is necessary to dilate it in the region of premolars and canine teeth, one uses the arch bent by the needed form of dental arch, and teeth are pulled to it with ligatures.

Angle's sliding arch is used for the inclination of the frontal teeth to the palatine or lingual side. The arch is turned into the sliding one: nuts are taken off. and in the region of canine teeth medially open hooks are soldered to the arch. After the arch is introduced into tubes, on both sides rubber rings are put on the hooks and fastened on the posterior end of the tube. Rubber recoil dislocates the arch distally, and in such a way pressure is exerted onto the frontal teeth.

When treating vertical occlusion anomalies with Angle's appliance one acts in the following way. For teeth drawing the arch is located closer to their cutting edge and with ligature wire it is pulled to the necks of the transferred teeth. At teeth immersion the arch is set closer to the necks and also tied up to the teeth with a wire ligature. In both cases the arch due to its elasticity tries to take its initial position and pulls along all the teeth tied to it.

The appliance is also used for the levelling of sagittal dental arches correlations (at progenia, prognathism) by means of applying oblique intermaxillary rubber recoil (Bekker is considered the inventor of oblique intermaxillary rubber recoil (1892); Angle improved the method). In this case Angle's appliances are used simultaneously on the upper and lower jaws. The arches are tightly fixed to the teeth with ligatures; there is a hook on one of them. If the hook is soldered to the arch of the upper jaw in the region of canine tooth—premolar, rubber recoil force dislocates the upper dental arch backwards, and the lower one — forward to some extent. If the hook is located on the arch of the lower jaw, reverse action takes place.

Aisnwort's appliance. Crowns or rings are made for the 2^{nd}, more seldom —I^{s1} premolars.

Tangent bars are bent using orthodontic wire 0.8—1.2 mm in diameter, spanning the teeth, subject to dislocation, from the palatine side in the neck part. The bars are pressed close to the crowns (rings). From the vestibular side to the rings on the premolars vertical

tubes are soldered with the internal diameter by 0.1—0.2 mm larger than the diameter of the wire, using which the arch is bent.

The vestibular elastic arch is bent using orthodontic wire 0.8-1.2 mm in diameter in such a way that it touches the frontal teeth only. The arch ends are bent at a right angle straight or in the form of a hook, then inserted into tubes and shortened by the size of vertical tubes. Rings with bars are fixed with cement on abutment teeth. On the next day the arch is introduced with its ends (with an effort) into the tubes. Arch elasticity, which is activated periodically, dislocates teeth. If the vestibular elastic arch becomes short in the process of treatment, a new one is bent or another arch is prepared right away with compensatory U-loops near the canine teeth.

Aisnwort's appliance is used for irregular dilation of dental arch and elimination of the narrow location of incisors.

Simon's appliance. For the $I^{я}$ permanent molars supporting rings are made, to which, near the medial-buccal angles, vertical tubes are soldered with an internal diameter of 1.8-2.5 mm depending on the diameter of the tube wire. From the oral side tangent bars (made of wire 1.2—1.5 mm in diameter) are soldered to the rings, the bars being adjacent to the premolars and canine teeth. Vestibular elastic arch is bent of orthodontic wire (0.8—1.2 mm in diameter) with U-loops in the region of premolars, vertical prominences, which come into vertical tubes and fix the arch. Free ends of the arch are bent inwards at the angle of 10—15° in such a way that they set against the distal-buccal areas of molars. The arch itself should be tightly adjacent to the frontal and lateral teeth. With the help of the appliance the dental arch is dilated in the region of premolars and molars, the molars being rotated. The arch is activated by means of pressing the U-loops.

Mershon's appliance for dental arch dilation. Supporting rings with locks on the lingual-palatine side in the form of horizontal tubes soldered to a ring are made for the $I^{я}$ permanent molars. Lingual arch is bent of orthodontic wire (0.8-1.0 mm in diameter). Elastic processes with their being adjacent to the lingual surface of the teeth, subject to transfer, are made of orthodontic wire 0.4—0.6 mm in diameter. The processes may have the form of a snake or a safety pin. They are soldered to the arch by means of contact welding, or one of their ends is wound onto the arch for the processes not to lose

elasticity. Teeth transfer and dental arch dilation take place due to elastic properties of the arch and processes.

In 1926 Angle offered a tetrahedral arch with brackets for all teeth instead of a round arch with supporting rings for molars.

It should be mentioned that achievements of this period created real conditions for modern school appearance and creation of improved constructions of fixed mechanically acting arch appliances (Johnson, Tweed, Andrews, Rickets, Y.M. Malyhin, Block). Johnson offered a system of twin arches and tried to use advantages and eliminate defects of Angle's appliances with the help of this device. As this was a compromise (constructive), he could not solve the problem finally.

After the analysis of Angle's appliances' advantages and disadvantages the development of fixed arch devices was fundamentally going on in two directions.

Begg offered to use the round arch, making it light by means of creating austenitic steel together with Wilcock, and named his appliance the system of light wires. For the purpose the author used very elastic, so-called Australian wire — stainless steel wire 0.4 mm in diameter. Auxiliary springs can not be soldered to such a wire, therefore additional loops for rubber recoil are bent on the arch itself. To make the action of the vestibular arch more tender, Begg used vertical loops. They level the force of action between irregularly located teeth. The length of the arch increases at the expense of the loops, and in such a way the action of the force decreases. The number and type of loops depend on dental arch irregularity. The loops are usually applied at the beginning of treatment. Rings of stainless steal are made for the molars and all the teeth subject to transfer. Special bars for arch strengthening are soldered to them, and if it is necessary — also hooks for inclined or corpus transfer of teeth in the mesial or distal direction. Teeth corpus transfer of this system is achieved in two stages: at first, tilt-and-swivel transfer of the tooth crown, and then its root inclination.

Andrews continued improving the orthodontic lock (bracket) and tetrahedral arch. As a result, he patented an appliance of programmable action, in which it was not necessary to bend arches in the process of treatment, so the system was named the technique of straight wire.

F.Y. Khoroshilkina and Y.M. Malyhin denote that today many constructions are known, which are based on the application of edgewise technique. Edgewise-brackets differ in size and form, groove direction, its angulation relative to the base of the lock, the presence of an additional supportive platform for tacking it to the tooth, combination with other elements. These supplements are made to achieve different aims and to accomplish different tasks.

Due to the usage of modernized systems the treatment with fixed arch appliances becomes more efficient and exact, arches bending becomes simpler, errors at their bending are excluded, which provides universal teeth transfer in possible directions with achieving their corpus transfer. To quickly expose suture junctions Derichsweiler's appliances are used, as well as Malyhin's, Levkovych's, Khoroshilkina's, Tril's, etc., which provide intensive exposure of the palatine suture. To lighten the construction, improve oral cavity hygiene, and control the state of the mucous tunic, these constructions are made without the basis with Biderman's screw (Fig. 108), or made dismountable according to Khoroshilkina.

Fixed appliances of mechanical action also include a crown with hooks and vertical bars, put in action with the help of rubber recoil; fixed metal (made of soldered crowns) or plastic gum shields with hooks for the vertical transfer of teeth under the action of rubber recoil force with elastic loops for diastems elimination: appliances of Korkhaus and Schwarz. which preserve place in dental arch after the early extraction of milk or permanent teeth.

A.I. Pozdniakova's appliance for bringing teeth out of palatine position consists of crowns, fixed on the $I^{s'}$ permanent molar and the tooth with palatal location. A bar is soldered to the crown of the molar from the vestibular side, the other end of the bar bears on the tooth standing in front of the transferred one. Hooks are soldered to the crown of the palatally located tooth. The appliance is put into action with elastic recoil or ligature, which is applied on the hooks of the transferred tooth and vestibular bar.

A.I. Pozdniakova's appliance for canine teeth transfer in the distal-buccal direction two crowns are made — one for the canine tooth, and one for the 1" permanent molar. Hooks are soldered to the crown on the canine tooth from the vestibular and lingual sides. Bars

are soldered horizontally to the molar crown from the vestibular and lingual surfaces, which end with hooks at the level of the Iя premolars. Rubber rings are put on between the hooks of the canine tooth and the molar, and the tooth is transferred with the help of the rings. Rubber recoil should be changed every 1—2 days. The tooth is transferred orally and distally.

Aisenberg—Herbst's appliance is used to transfer the upper frontal teeth oraliy, change their inclination and dental arch shortening at the presence of spaces between the frontal teeth. For the Iя milk molars or 2nd permanent premolars rings (crowns) are made, to which horizontal wire (0.8 mm in diameter) bars are soldered from the vestibular side. The bars are directed forward, adjacent to the vestibular surface of teeth, and end in the region of canine teeth with hooks, opened backwards. After fixing the rings with cement, elastic rubber (rings) is stretched on teeth between hooks. The tractive force is regulated by a selection of rubber rings of necessary length, width, and thickness.

Z.S. Vasylenko's appliance for teeth rotation. For the rotated tooth a crown or a ring is made with a horizontally soldered oval tube from the vestibular side. Internal intersection of the tube equals the double diameter of the lever's wire in height and one diameter in thickness. On the 2nd premolar or the Iя molar of the dental arch side, opposite to the rotated tooth, a ring is put with a round bar 0.8—1.0 mm in diameter soldered to its lateral surface, tangent to two adjacent teeth. To the same ring from the vestibular side a U-brace is soldered with the length equal to the tooth width and distant from the ring by 1.5 mm. An elastic lever is bent of orthodontic wire 1 mm in diameter. The end of the lever, which enters the tube, is bent in the form of a loop with a bumper preventing lever rotation.

The other end of the lever is bent in the form of a hook and is brought behind the U-brace on the molar from the medial side. Tooth rotation takes place under the action of activated flexible lever until the hook stops at the distal end of the U-brace. This serves as an indication to the next activation of the lever or bending of a new one.

Fixed appliances have advantages over removable ones as they act constantly, round the clock, depend little on the patient, but have a number of drawbacks. These appliances do not provide full-value action on the dentognathic apparatus: practically do not stimulate

sutura! and appositional jaws growth, do not influence the renewal of myodynamic balance in the craniofacial area and renewal of the dentognathic apparatus function, violate the esthetics. Difficulty of the exact dosage of force, long-term stay of arches, reinforced with ligatures, of crowns, rings, and other details of fixed constructions in the mouth complicate oral cavity care, may be the reason for dental enamel damage. Ligatures, injuring dental bulbs, provoke swelling of the gingival margin and not infrequently lead to the formation of pathologic "pockets".