FUNCTIONAL TREATMENT IN ORTHODONTICS

Minsk BSMU 2021

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ
КАФЕДРА ОРТОДОНТИИ

ФУНКЦИОНАЛЬНОЕ ЛЕЧЕНИЕ В ОРТОДОНТИИ

FUNCTIONAL TREATMENT IN ORTHODONTICS

Учебно-методическое пособие для курса по выбору студента

Минск БГМУ 2021

УДК 616.314-089.23-08(075.8)-054.6
ББК 56.6я73
Ф94

Рекомендовано Научно-методическим советом университета в качестве учебно-методического пособия 23.06.2021 г., протокол № 6

А в т о р ы: И. В. Токаревич, Л. В. Кипкаева, Д. В. Гарбацевич, Е. Г. Коломиец, А. С. Корнеева

Р е ц е н з е н т ы: д-р мед. наук, проф., зав. каф. ортопедической стоматологии С. А. Наумович; канд. мед. наук, доц., зав. каф. общей стоматологии Н. М. Полонейчик

Функциональное лечение в ортодонтии = Functional treatment in orthoФ94 dontics : учебно-методическое пособие для курса по выбору студента / И. В. Токаревич [и др.]. – Минск : БГМУ, 2021. – 30 с.

ISBN 978-985-21-0912-3.

Изложены основные принципы функционального лечения зубочелюстных аномалий. Рассматриваются некоторые виды функциональных аппаратов, используемых при ортодонтическом лечении.

Предназначено для студентов 4–5-го курсов стоматологического факультета, обучающихся на английском языке.

УДК 616.314-089.23-08(075.8)-54.6
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INTRODUCTION

Functional appliances affecting jaw growth and muscles surrounding dentitions are important in treatment of dento-facial abnormalities.

In the recent years, new standard functional appliances, such as trainers, LM activators, myobraces, have appeared following the development of functional treatment of dento-facial abnormalities. They normalize teeth position and facilitate early correction of dentition abnormalities.

Functional appliances train muscles in the maxillo-facial area, facilitate normalization of dentition shape, optimize its formation during jaw growth and development. All these, in turn, ensure stable treatment results.

Clark's twin block is used for correction of class II and III occlusion and normalization of dento-facial functions.

There now exists a large group of fixed inter-maxillary appliances — Herbst appliance, Jasper Jumper, Sabbagh spring, Forsus appliance — providing correction of distal occlusion by moving forward the mandible not only in adolescents but also in patients after completion of active jaw growth.

STANDARD FUNCTIONAL APPLIANCES

PRE-ORTHODONTIC TRAINERS

One of the sharp issues in orthodontics is treatment of dento-facial abnormalities in children with mixed bite. The most common abnormality in children aged 6 to 12 years is distal occlusion, leading to TMJ pathology, periodontal problems or caries. Such patients often have psychological issues due to unsatisfactory facial aesthetics. Modern custom-made functional orthodontic appliances used for distal occlusion treatment in children are bulky, difficult to make and require dentist and dental lab technician of high qualification. All these urge the orthodontists to search for optimal solutions to this problem.

Global practice has recently seen the introduction of modified standard positioners called pre-orthodontic trainers. There are five types of them:

1) soft and hard pre-orthodontic trainers;
2) appliances allowing simultaneous use of fixed orthodontic appliances;
3) retentive appliances;
4) appliances for correction of joint abnormalities;
5) multi-purpose protective appliances for contact sports.

This section focuses on preorthodontic trainers for children. They were first introduced for normalization of dento-facial system functions and elimination of bad habits and bruxism. Yet, as practice shows, these appliances can have positive effect on morphological structures of dentition as well.

In children of 6 to 10 years, pre-orthodontic trainers with the following properties are used for distal occlusion treatment:

1) dental alignment;
2) elimination of myofunctional disorders;
3) jaw relationship correction.

The average duration of treatment is from 6 months to 1 year. Advantages: significant manufacturing cost reduction, minimum orthodontist time cost.

A pre-orthodontic trainer looks like a double-jaw gum guard or positioner. It is made of elastic polyurethane of variable hardness and absolutely compatible with oral cavity tissues. The appliance combines elements of functional and mechanical orthodontic appliances. The trainer is developed using computer modelling, industrially manufactured and comes in one universal size (Fig. 1).

Figure 1. Pre-orthodontic trainer

A pre-orthodontic trainer consists of two parts: labial bows acting as projections putting pressure on anterior teeth; tongue tag for proper tongue positioning as in myofunctional appliances; tongue guard preventing the tongue from slipping between the teeth on the sides; lip bumpers with spikes reducing excessive pressure of lower lip on the teeth. The trainer is constructed in a way to position a patient's teeth under Angle's class I.

Indications for pre-orthodontic trainer application:

– crowding of upper and lower incisors;
– open anterior bite;
– Angle's class II, subdivision 1 and 2;
– deep bite;
– Angle's class I, crowding of incisors;
– mild Angle's class III;
– bad habit of thumb sucking, lip sucking, etc.;
– breathing, swallowing function disorder.

Contraindications for pre-orthodontic trainer application:

– children-parents conflict;
– severe Angle's class III;
– posterior cross bite;
– significant nasal blockage.

A pre-orthodontic trainer does not require special fitting inside the oral cavity. After a doctor's explanation, a child can put it in his/her mouth by themselves and compress the teeth. Should the trainer cause pain, it shall be cut with scissors. Such manipulation is seldom required.

It is recommended to apply a blue soft pre-orthodontic trainer first. Children get used to it better because tooth tenderness feels less than with a hard pink pre-orthodontic trainer. Front side of the appliance has holes in the middle to allow breathing through the mouth. It is very important, since it is difficult for a child to switch to breathing through the nose. Hard pink trainers are recommended after six months or a year of using soft trainers.

Authors recommend using pre-orthodontic trainer for an hour during the day and overnight. It is not enough, especially during adaptation period. Many patients think that an hour of wearing trainer during the day may be neglected and go straight to using it at night. However, if a child is not used to using the trainer during the day, the latter will unintentionally fall out of the child's mouth at night, even if the patient is interested in treatment. So the trainer should not be used at night during first 2 to 3 weeks. The appliance should be used with breaks for rest during the day, with the duration of use gradually increased. The total duration of using the trainer during the day should not be less than 3 to 4 hours. Lips should be closed when using the trainer during the day. If a patient can use the appliance for 2 hours without breaks during the day, this should be the criterion for using the trainer at night. Parents should check whether their children are sleeping with or without the trainer in their mouths in the first 2 to 3 weeks. If the appliance falls out of their mouth, it should be placed back in. Children usually do not wake up to this manipulation.

Despite the change in the mode of use, some patients and their parents noted that the trainer falls out of their mouth at night. This was the reason for searching for a better way of fixing it. So a method of fixing with the use of orthodontic bends and hooks and an inter-maxillary elastics was developed. Standard bends with buccal tubes and hooks (the rings can be custom-made and the hooks can be brazed) are fitted for the first permanent molars or the second deciduous molars. The distal opened hooks on the upper molars are located in the middle of the mesio-buccal cusp. Hooks on the lower ones should be opened mesial to avoid dropping of the rubber ring. For that purpose, standard bends with tubes are interchanged: the one on the right side is fitted on the left side and vice versa. The mesial opened hook is located in the labial tooth fissure. The rings are cemented. The trainer is inserted in the oral cavity and positions of hooks are marked with a marker on its outer leaves. Then the trainer is removed, its parts covering the hooks carved out with a disc. A shallow channel is carved on the trainer going from the upper hook to the lower to avoid elastic ring misplacement. The trainer is placed inside the patient's oral cavity and an elastic ring is stretched between the hooks as inter-maxillar elastics. These rings

facilitate the patient's adaptation to and mastering of the appliance. It is recommended to use separation rings after fixing the trainer inside the mouth by the patient him/herself. They are less elastic so they hold the appliance better, as well as the mandible inside it. The use of separation rings is especially indicated for children having distal occlusion, a large horizontal overjet and mouth breathing because the mandible is often located behind the trainer which contributes to its dropping (Fig. 2).

Figure 2. Method of trainer fixing inside the oral cavity

During distal bite treatment with pre-orthodontic trainers, the normal relationship of first permanent molars can seldom be achieved. For the proper molar relation, a trainer can be used in combination with a face bow. Standard bends with buccal tubes for the face bow are fixed on the upper molars and the face bow is fitted. In a horizontal plane, the place of the external and internal bows connection should be located between the lips and a little outwards (Fig. 3).

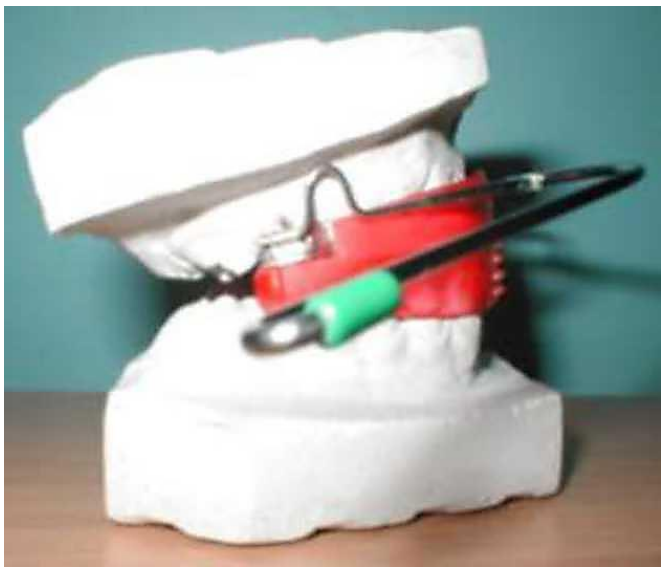


Figure 3. Pre-orthodontic trainer in combination with face bow

LM-ACTIVATORS

LM-activators are removable standard elastic positioners designed for early orthodontic treatment during the period of temporary occlusion and for correction of dento-facial abnormalities during the period of mixed and forming permanent occlusion. LM-activators are manufactured by LM-Instruments in Finland.

These appliances are qualified as functional, buccolingual, double-jaw, mono-block.

Elastic positioners are made of silicone bio-compatible with oral cavity tissues. Trainer hardness was selected so that the trainer would not be chewed and would not cause severe discomfort in use. Construction of an LM-activator includes: 1) extended labial edges acting as labial bandages dividing lip and cheek soft tissues, optimising growth and development of the jaws in a way similar to functional appliances; 2) cells for incisors, canines, first premolars affecting teeth alignment; 3) lingual edges helping a patient to position the trainer properly on mandible; 4) additional holes on the front side facilitating breathing and allowing to wear the appliance with diseases of ENT organs (Fig. 4).

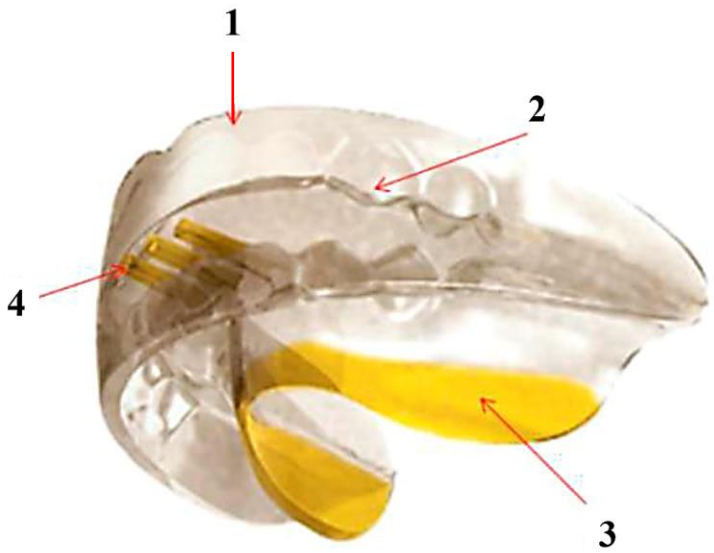


Figure 4. LM-activator:
1 — labial side; *2* — tooth cells; *3* — lingual edges; *4* — breathing holes

Construction of the appliance provides ability for introduction of additional mechanical elements during treatment (Fig. 5).

These appliances can be used in patients having space maintaining structures installed in their oral cavity (Fig. 6).

Figure 5. Additional wire elements introduced for diastema closure

Figure 6. Result of an LM-activator application with a space maintaining appliance installed in oral cavity

Indications for LM-activator use:
– elimination of bad habits;
– normalization of dentition functions;
– distal bite;
– open bite;
– deep bite;
– incisors and canines malalignment and rotation;
– gingival smile.

Contraindications for LM-activator use:
– Angle's III class abnormalities;
– midline shift of more than 3 mm;
– significant maxillary constriction.

There are two LM-activator modifications: low model (used for correction of deep bite) and high model (indicated for open bite correction). Low model has 13 sizes and high one has 11. There are also two LM-activator variants: short and long (Fig. 7).

There are two methods of LM-activator size selection. The first one uses a special LM-OrthoSizer ruler (Fig. 8). In this case the trainer size is read from a contact point between the second right incisor and canine to a contact point between the second left incisor and canine on the upper or lower jaw. The measuring ruler is autoclaved before re-use.

Figure 7. LM-activator variants

Figure 8. LM-OrthoSizer

The second method requires measurement of the distance from the contact point between the second right incisor and canine to the contact point between the second left incisor and canine with a ruler on the upper and lower jaws; the LM-activator is selected based on tabular data (Table 1).

When determining the LM-activator size, abnormalities of the anterior teeth position (crowding of incisors or protrusion of incisors with diastema or gaps) should be considered. Depending on pathology, a trainer of a larger or smaller size than one based on measurement results is used.

Trainers are disinfected by boiling and autoclaving, which is convenient for an orthodontist in cases when the appliance is selected by trying on.

It is no secret that the lack of the desired treatment result is often due to bad cooperation between doctor and patient, which leads to non-adherence to the treatment schedule.

Table 1

Measuring scale for LM-activator size determination

Low model		High model		Upper jaw	Lower jaw
number	**code**	**number**	**code**	**distance (mm)**	**distance (mm)**
10	LM 94010L	–	–	24.8–25.9	18.8–19.5
15	LM 94015L	–	–	26–27.1	19.6–20.3
20	LM 94020L	20	LM 94020H	27.2–28.3	20.4–21.1
25	LM 94025L	25	LM 94025 H	28.4–29.5	21.2–21.9
30	LM 94030L	30	LM 94030 H	29.6–30.7	22–22.7
35	LM 94035L	35	LM 94035 H	30.8–31.9	22.8–23.5
40	LM 94040L	40	LM 94040 H	32–33.1	23.6–24.3
45	LM 94045L	45	LM 94045 H	33.2–34.3	24.4–25.1
50	LM 94050L	50	LM 94050 H	34.4–35.5	25.2–25.9
55	LM 94055L	55	LM 94055 H	35.6–36.7	26–26.7
60	LM 94060L	60	LM 94060 H	36.8–37.9	26.8–27.5
65	LM 94065L	65	LM 94065 H	38–39.1	27.6–28.3
70	LM 94070L	70	LM 94070 H	30.2–40.3	28.4–29.1

To motivate a patient and for quick adaptation to the appliance, the manufacturing company has developed colorful handbooks and illustrations transforming treatment into a game, increasing the patient's contribution and achieving cooperation between the doctor and the child. The trainer is placed in a container allowing air circulation. Additionally, bright pictures of a bunny (LM-Bunny) are attached to the appliance, as well as instructions for small patient (a path-diary). The diary allows the orthodontist to control regularity of appliance use.

It is recommended to start wearing an LM-activator for 2 hours during day, dividing the time into 30-minute or 60-minute periods. In case the patient cannot follow the recommendations, the trainer should be used for 2 hours before sleep. After two weeks, the patient shall start using the appliance at night as well.

Clinical example 1. Patient G., 8 years old. Diagnosis: neutral occlusion 16/46, 26/36, distal 53/83, 63/73, overjet 13 mm, elongation of upper dental arch, protrusion of the upper incisors, premature 74 loss, impaired swallowing, breathing, lip closing functions. Bad habit of sucking the lower lip. This clinical performance and the results of LM-activator use are presented in Fig. 9, Fig. 10.

Clinical example 2. Patient Z., 8 years old. Diagnosis: neutral occlusion, dental arch shortening, rotations of 12, 11, 21, 22, 32, 31, 41, 42 (tooth space deficit), premature 75 removal (Fig. 11). Results of LM-activator treatment are presented in Fig. 12.

Standard elastic positioners have several advantages: no working jaw models are required, laboratory stage of manufacturing is not required; the appliances are cost-efficient, easy to use, the visit is short, the intervals between visits to the orthodontist are longer. Manufacturing individual

functional appliances is very labour consuming. Significant working time of an orthodontist and a dental technician are required, high qualification of the medical staff, modern high-quality materials and tools. Additionally, custom-made functional appliances have several deficiencies: complexity of manufacturing, high cost, fragility; difficult adaptation of patients to the majority of them.

a

b

Figure 9. Photographs of patient G. before treatment:
a — face; *b* — intra-oral

a

b

Figure 10. Photographs of patient G. after treatment:
a — face; *b* — intra-oral

a

b

Figure 11. Photographs of patient D. before treatment:
a — face; *b* — intra-oral

Figure 12. Intra-oral photographs of patient D. after treatment

MYOBRACE APPLIANCES

Myobrace appliances are a system of silicone elastic positioners with an integrated elastic frame to be used for mixed and permanent occlusion.

These appliances are qualified as functional, buccolingual, double-jaw, mono-block.

The Myobrace appliance system has three series:

– Myobrace Starter MBS;

– Myobrace itself;

– Myobrace No Core.

Myobrace Starter MBS is issued in a standard size (Fig. 13). The appliance has a red internal expandable frame in its structure, without tooth slots. It is recommended at the first stage of treatment during the period of mixed occlusion to correct crowded positioning of anterior teeth with space deficit of more than 4 to 6 mm and overjet of over 5 mm.

The Myobrace appliance is used in late mixed occlusion and early permanent one. Elastic positioner has a double base, a blue rigid DynamiCore frame inside and soft silicone outside. Extended distal ends of the appliance provide proper support for the second molars. The effect of dental arch alignment is achieved with an integrated frame working as a steel bow and with individual front teeth cells. The Myobrace appliance additionally has all the structural features typical for a myofunctional trainer: a tongue tag for proper tongue positioning, lip bumpers, a tongue frame, special thickenings in

the molar area providing decompression of TMJ. The Myobrace appliance, same as other myofunctional trainers, has holes for gradual shift in the type of breathing (Fig. 14).

Figure 13. Myobrace Starter MBS

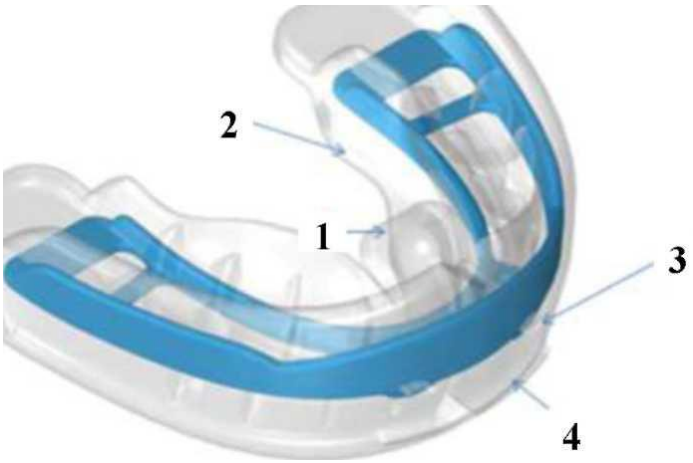


Figure 14. Structural features of Myobrace appliances:
1 — tag; *2* — tongue frame; *3* — breathing hole; *4* — lip bumpers

Indications for Myobrace use:
– dental arch narrowing;
– neutral occlusion with crowded anterior teeth;
– distal occlusion;
– mesial occlusion (dento-alveolar form);
– open bite;
– deep bite;
– dysfunction and bad habits.

Contraindications for Myobrace use:
– mesial occlusion (skeletal form);
– impossible free nasal breathing.

The Myobrace appliance is issued in seven sizes. An orthodontist shall select the size for each patient individually by measuring the distance from

the distal approximal surface of lateral right incisor to the corresponding surface of the lateral left incisor using a special ruler. Table 2 can also be helpful in selecting the size of the appliance.

Table 2

Size selection table for Myobrace and MBN appliances

Size (number)	Distance between 2-2 u.j. (mm)	Distance between 2-2 l.j. (mm)	Canine width u.j. (mm)	Canine width l.j. (mm)	Dental arch width 6-6 u.j. (mm)
1	30.0	22.0	7.0	6.5	55.0
2	31.5	23.0	7.3	6.8	55.0
3	32.5	23.8	7.5	7.0	60.0
4	33.5	24.5	7.7	7.2	60.0
5	35.0	25.5	8.0	7.5	60.0
6	36.5	26.7	8.5	8.0	60.0
7	38.0	28.0	9.2	9.0	60.0

The recommended appliance use regimen is 2 hours during the day and overnight.

Myobrace MBN (MYOBRACE No Core) are made of hypoallergenic medical silicone (Fig. 15). These appliances are more flexible and elastic due to the absence of internal frame. They are issued in seven sizes.

Figure 15. Myobrace MBN

The MBN series appliances allow effective correction of occlusion heights in case of hyper-correction treatment with Myobrace or MBS and facilitate a more precise adjustment of occlusion contacts at the final stage of treatment due to pronounced occlusion pads relief.

The MBN series appliances can be used as the basic treatment appliance for individual tooth position abnormalities in patients with pronounced teeth crowding. They are also effective as both the basic treatment appliance and a retainer at the final stage of orthodontic treatment.

Size selection with MBN series appliances is made using a special ruler or table (similar to Myobrace size selection).

APPLICATION OF TWIN BLOCKS (CLARK APPLIANCES) FOR MALOCCLUSION TREATMENT

The design of a twin blocks appliance is based on removable plates for the upper and lower jaws with occlusal pads, with system of inclined planes on them (Fig. 16). Since the appliances are not fixed to each other, they can be used to solve the dental arches problems independently of each other. Changing the shape of the dental arch can be done simultaneously with the correction of the jaw's sagittal relationship.

a ***b***

Figure 16. Standard twin blocks:
a — device for the upper jaw, *b* — device for the lower jaw

The design of a twin blocks includes the following elements:
– expansion screw for maxilla;
– occlusal pads;
– clasps on the upper molars and premolars;
– clasps on the lower premolars and incisors;
– vestibular arch for retrusion of upper incisors;
– springs for moving individual teeth.

Twin blocks are used as a support for teeth and surrounding tissues. One of significant differences between twin blocks and monoblock functional appliance is that the first ones are not removed during meals. Thus, oral hygiene has a great importance for the entire period of treatment.

Twin blocks are used for sagittal and vertical malocclusion treatment at the age of 9–14 years in male patients and up to 13 years in female. Their action is most effective during periods of active jaws growth.

Indications:
– distal bite;
– mesial bite;
– open bite.

Contraindications:

– crowding of teeth, requiring extractions of premolars;

– deterioration of the patient's profile when the lower jaw is pushed forward (Eschler–Bittner test);

– vertical type of jaws growth.

Terms of treatment:

– the active phase lasts 6–9 months in average, until complete correction of distal occlusion and reduction of overjet takes place;

– holding phase — 3–6 months, until complete eruption of molars and formation of fissure-tubercle contacts accures;

– retention — 9 months. The appliances daytime wearing is reduced after stabilization of lower jaw position.

Therapeutic effect. There is a rapid improvement in patient's appearance after first few months of twin blocks treatment. Usually, changes in the dentition are followed by facial changes, until complete elimination of distal bite within 6 months of treatment. An overjet up to 10 mm in patients with normal jaw growth can be eliminated without reactivating the twin blocks during treatment. The activation of inclined planes is to increase the forward tilt of upper block mesially to move mandibula forward. Gradual activation of inclined planes is shown in the following cases:

1. The presence of a sagittal overjet more than 10 mm. At the same time, it is desirable to carry out the extension of lower jaw in two stages. The first activation is performed at 7–10 mm, the second activation moves incisors to edge to edge contact.

2. The predominance of the vertical type of jaw growth over the horizontal one. In this situation, it is necessary to extend the lower jaw in two stages to provide the time necessary for compensatory growth of the lower jaw

3. In all cases, when the complete correction of the relationship is not achieved after first activation. In such situation, it is necessary to re-activate.

During treatment with twin blocks, the patient does not experience difficulties when eating and talking. These processes are not accompanied by significant restriction of movement of the tongue, lips and lower jaw, so the patient can eat with the devices in the oral cavity. In this case, the chewing forces are used to enhance the effect of functional treatment.

Treatment. Before starting treatment with twin blocks, the patient is examined. Clinical, radiological (cephalogram, orthopantomogram, X-ray of the temporomandibular joint), anthropometric, photometric diagnostic methods are used.

The twin blocks are used for permanent wear. The contact between inclined plane of upper and lower blocks has a 70° angle in condition of complete closed jaws. This leads to displacement of lower jaw anteriorly in the position of direct contact with the cutting edges of upper incisors. The appliance prevents

the closing of the dentition in the usual occlusion, removes the occlusion block of lower jaw and leads to correction of malocclusion.

The first appointment after appliances delivery is prescribed in a week, the second — in a week, the third — in 4 weeks, the following-in 4–6 weeks. If insufficient growth rate of lower jaw, it is necessary to push it out every 3 months by layering self-cured resin on inclined plane of upper jaw appliance.

In distal bite treatment, the inclined planes of the blocks are positioned mesially in relation to the upper and lower first molars. In this case, the upper block covers the upper molars and the first premolars (temporary molars), and the lower block continues mesially, starting from the second premolar or the temporary molars area.

Before appliance manufacturing stage the constructive bite has to be determined: in case with a sagittal overjet of up to 10 mm — in the position of direct contact of cutting edges of incisors; in case with a sagittal overjet of more than 10 mm — initially the lower jaw is pushed forward by 7–8 mm, followed by reactivation of the device when sagittal relationship is corrected. The thickness of the blocks at the level of the first premolars or the first temporary molars is at least 5 mm. When correcting the distal bite, normalization of sagittal relationships is always achieved earlier than the vertical one. As the sagittal overjet decreases, an open bite is formed in the lateral parts. In such cases, treatment should be continued until the open bite is eliminated.

The design of a twin blocks is variable, the appliances can be modified: include screws, springs and bows. This allows you to normalize the shape of the dental arches and the position of the teeth at the same time as correcting the sagittal relationship of the jaws. Treatment of malocclusion with the help of twin blocks is more effective without labial bows, which inhibit the extension of lower jaw. At the same time, complete closing of lips is achieved without additional exercises, since the lips take on the function of a labial bow, under their pressure, the upper incisors come in correct position.

Treatment with twin blocks includes two stages. At first stage, the sagittal relationship is corrected. At second stage, the twin blocks are replaced by appliance with inclined plane to maintain the new position of lower jaw until the final formation of occlusal contacts of lateral teeth.

When mesial bite is treated, occlusal forces are used to move the upper jaw anteriorly and correct the jaws relationship. The lower jaw serves as a support in this case. The design of a twin block has an reverse ratio in contrast to a twin block for treatment of distal bite (Fig. 17).

Occlusal blocks are located on the upper dentition in the area of temporary molars, and on lower one — in the area of the first permanent molars. Adding a sagittal screw to the upper jaw allows the upper incisors to be protruded. The splits should be positioned distally to lateral incisors to protrude all the upper incisors. Reverse twin blocks stimulate the growth of the upper jaw

due to the reverse inclined planes, worn at an angle of 70°, which, when mandibula closed, ensure the movement of the teeth of upper jaw forward and at the same time prevent the growth of the lower jaw.

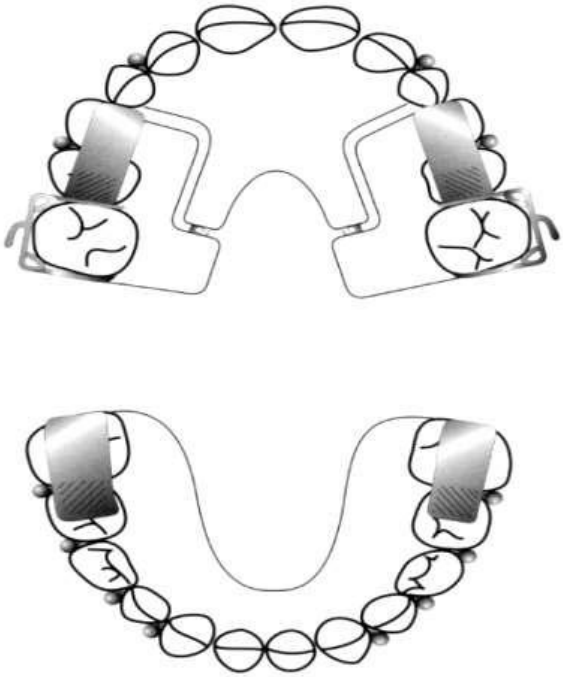


Figure 17. Reverse twin blocks

In the upper jaw appliance, in order to prevent the pressure of upper lip on upper incisors, lip bumper can be used, similar to those in Frankel function regulator type 3 (Fig. 18). The lip bumper should be located at some distance from the gingiva to prevent irritating effects. It is necessary to fix the lip bumper to the anterior part of the appliance so, that when the screw is activated, they move with it, otherwise this can lead to compression of the gum between the lip bumper and the appliance. In addition, as the incisors are protruded, the position of the lip bumper must be adjusted to maintain the gap.

a ***b***

Figure 18. Lip bumper in a twin block for correction of mesial malocclusion:
a — appliance in the oral cavity; *b* — appliance on the diagnostic model

As an additional force for extension of upper jaw, the Delaire face mask is used, which is attached to the upper twin block to increase the forces that push it out (Fig. 19). The elastic traction should gradually increase as the patient adapts to wearing a face mask. Treatment with a facial mask is carried out for 4–6 months for 12 hours a day.

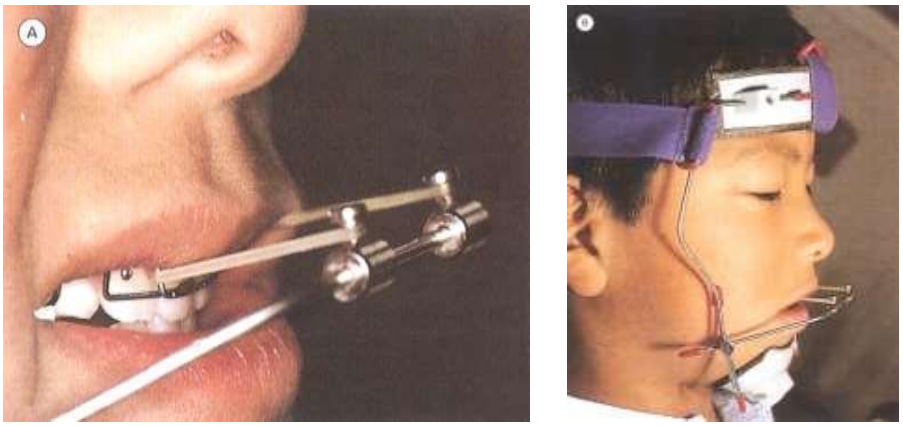


Figure 19. Delaire face mask

In treatment of deep incisor overbite, it is important to ensure the vertical growth of the lower molars from the very beginning by grinding the upper block in the distal parts. The upper block is trimmed off gradually over several months at each patient appointment, while each time a small gap of 1–2 mm is left above the lower molars to ensure their eruption into the occlusion (Fig. 20). This gradual grinding is necessary for the lateral teeth eruption and increasing of the vertical occlusion heights, resulting in an increase in the lower half of the face, which improves facial balance. Molars usually erupt into occlusion within 6–9 months.

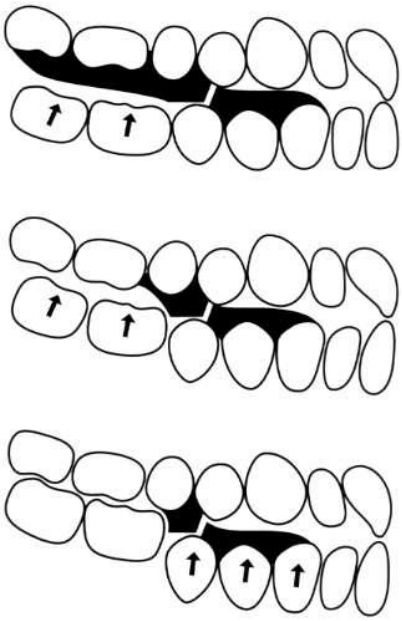


Figure 20. Grinding of blocks to reduce the depth of the incisor overlap

Twin block can be used to eliminate an open bite due to intrusion of lateral teeth. To achieve the desired effect, the upper appliance should cover upper posterior teeth, including second molars, to prevent their excessive eruption. If the second molars have not yet erupted, the appliance should still have occlusal pads in their projection to control the eruption. The design of lower appliance includes clasps on the lower molars and first premolars or temporary molars to improve the stability of the appliance. Such design promotes eruption of upper and lower incisors and eliminates open bite. To prevent tongue from moving between upper and lower incisors, a tongue stop is inserted into appliance. For treatment of open bite, the design of a block on the upper jaw includes labial bow, which is necessary to normalize the position of upper incisors, which are significantly pushed forward under the influence of the tongue. When reducing the incisor overlap, it is important that the blocks are not grinded during treatment, and lateral teeth are occluded throughout the entire course of treatment.

After delivery of appliance in oral cavity, the patient's appearance improves remarkably, there are significant changes in proportions of the face, which can be noted as early as in 2–3 weeks after the start of treatment with twin block. The appliance moves the lower jaw down and forward, which makes it difficult to lay the tongue between the lower lip and the teeth. Since the appliance is worn constantly, including during meals, the rapid normalization of position of the soft tissues leads to improvement of chewing and swallowing functions.

Retention. After completion of active treatment, a retention period follows, with the use of upper jaw plate with inclined plane. After the complete formation of occlusion, you can limit the use of retention device to night wear. When treating sagittal and vertical anomalies in patients during mixed dentition period, wearing of upper jaw plate with inclined plane should continue until the permanent teeth are completely erupted.

Advantages of twin block:

1. Easy to manufacture.

2. Convenient. Patients can wear a twin block for 24 hours a day, eat without experiencing discomfort.

3. Aesthetics. Twin blocks are made without labial bows.

4. The occlusal inclined plane is the most physiological mechanism among all functional appliances. The freedom of lateral and anterior movements of the lower jaw is preserved, which is limited when using functional devices.

5. Immediately after application of a twin block, the appearance of a patient is significantly improving. Normalization of facial balance occurs gradually during the first three months of treatment.

6. Twin blocks do not interfere with speech, as they do not restrict the mobility of the tongue and lower jaw.

7. The correction and activation of the appliance is simple. The appliances are durable and not prone to breakage.

8. The design of upper and lower twin blocks can be modified by including screws, springs and other elements in appliances.

9. Twin blocks can be easily combined with fixed appliances.

10. Treatment results are stable.

11. Twin blocks allow you to fully control the depth of incisor overlap in treatment of deep and open bite due to constant wearing.

12. Twin blocks allow you to achieve faster correction of malocclusion in comparison with functional appliances.

Thus, the twin blocks are a comfortable and aesthetically acceptable appliance among all functional appliances, they are easy to manufacture, and children can easily adapt to them. They can be used easily to carry out effective treatment of sagittal and vertical malocclusions during periods of active jaws growth.

FIXED FUNCTIONAL APPLIANCES

Orthodontic treatment of distal occlusion without tooth extraction gained popularity in the second half of the 20th century, when doctors began to pay attention not only to occlusion, but also to aesthetics of the face in common. Over the past 20 years, there has been a significant evolution in orthodontic practice in methods of using functional orthodontic appliances. This especially concerns the choice of the device, the timing of its use and the need for orthodontic correction before starting treatment. At the moment, there is a large group of non-removable intermaxillary devices that provide correction of distal bite by extending the lower jaw not only in puberty children, but also in patients after the period of active growth of the jaws.

Main features of distal bite treatment after completion of period of jaws active growth:

1. Bone tissue is less malleable and more difficult to rebuild under the influence of orthodontic appliances.

2. Orthodontic treatment is longer.

3. Patients find it more difficult to get used to the apparatus.

4. After orthodontic treatment of anomalies, there is a risk of double bite formation and relapse.

5. Long-term retention is required after orthodontic treatment.

All intraoral devices that correct the position of lower jaw can be divided into two groups: 1) pulling; 2) pushing.

The first group (pulling) includes the intermaxillary elastics (Fig. 21). When applied, changes usually occur on dental level. Among other things, they not only produce sagittal forces, but also create extrusion movements at

the places of force application (upper canines and lower first permanent molars). Such forces are indicated for those patients who require an increase in the lower facial height.

Figure 21. Bracket-system in combination with intermaxillary elastics for correction of class II anomalies

The second category of intraoral devices used to correct class II anomalies is pushers. This group includes various types of removable functional devices and so-called fixed functional devices. Kingsley in 1887 was the first to put forward the idea of possibility to correct distal bite formed due to retroposition of lower jaw using orthopedic appliances.

Classification of fixed functional appliances:

1) rigid — Herbst apparatus and its modifications MARA, FNTA (functional non-removable telescopic apparatus);

2) elastic — Jasper Jumper, Flex developer;

3) hybrid — Forsus, Twin Force Bite Corrector, Sabbagh universal spring (SUS).

The Herbst apparatus was developed in 1905 by Emil Herbst and re-introduced into use by H. Pancherz in 1979. The apparatus was changed many times, the literature describes many of its variants with alternative designs (crown, splint, brace). Herbst braces are a telescopic device that includes a tube, a plunger, 4 bolts and 4 screws (Fig. 22).

The length of the tube is determined by the magnitude of extension of lower jaw. To prevent the tube from slipping out, the stem length is kept to the maximum.

Indications for the use of Herbst apparatus:

1. Skeletal pathology of II class of moderate and severe severity.

2. Inability of patients to cooperate in treatment with removable functional devices.

3. Objection of patients against the size of removable functional apparatus.

4. Bilateral cross bite.

a ***b***

Figure 22. Herbst apparatus:
a — disassembled; *b* — in the oral cavity

Contraindications for the use of the device are mental disorders, severe somatic pathology.

Compared to removable functional devices, the Herbst device has a number of advantages: the device actively affects the dentition for 24 hours a day, and no action is required from the patient; it can be used in mouth-breathing patients; the treatment period is 6–10 months. The Herbst apparatus is compatible with all types of bracket systems.

J. J. Jasper and J. A. McNamara suggested, that one of the disadvantages of Herbst apparatus is its rigid mechanism, which excludes lateral movements of lower jaw. In attempt to eliminate this negative point, Dr. Jasper in 1987 developed a new pushing device — the Jasper Jumper apparatus (Fig. 23). This device, like Herbst apparatus, acts on the dentition through a floatable force, but it provides the patient with a certain freedom of lateral movements of lower jaw. The delicate design allows patients to quickly adapt to the device. After a short period of time after installing it, they barely feel the spring in their mouth due to its slowly developing forces.

Figure 23. Jasper Jumper in the mouth

Structural elements of Jasper Jumper device:

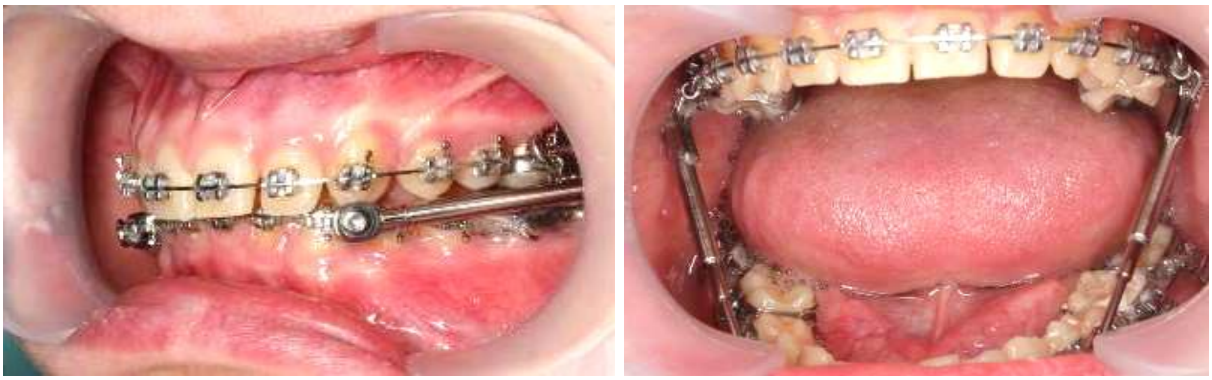
1. Power modules. They are surrounded by a polyurethane coating for improved hygiene and comfort.

2. Anchoring parts.

The power modules are fixed to the rings of the first permanent molars on upper jaw using pins with balls. Anteriorly, the apparatus is fixed to the orthodontic arch wire of the lower jaw, distally to the canine; small beads are attached over the arch to prevent mesial sliding of the spring to the canine bracket. Due to the flexible modules, the device creates soft long-term forces that can move the teeth either one by one or in groups. The device has seven sizes. To strengthen the support, in addition to the spring, the transpalatal arch can be installed to the upper jaw, and the lingual arch on the lower jaw.

SUS I, II, Forsus devices are a generation of hybrid fixed functional devices for treatment of distal occlusion, which are fixed to the orthodontic arch wire. Such devices are combinations of two devices: Herbst (telescopic apparatus) and Jasper Jumper (spring). The purpose of creating SUS and Forsus devices was the desire to eliminate the disdvantages of previous devices as much as possible.

The SUS apparatus (Sabbagh Universal Spring) (Fig. 24) is a telescopic element that includes a continuously acting spring, which allows upper teeth to move distally and lower teeth to move mesially. Although, if necessary, the effect of the spring can be eliminated in order to use the element as a rigid as in the Herbst apparatus.



a ***b***

Figure 24. Universal Sabbagh spring:
a — in a constructive bite; *b* — with an open mouth

The spring has a delicate design that allows patients to quickly and easily adapt to the device. The device can be fixed on three different support systems: crowns, in combination with braces and splints. The choice of a suitable support depends on the desired effect and the age of a patient. The crown system is similar to the conventional Herbst apparatus, but requires less labor. The device on aligners is recommended in early orthodontic treatment and for elimination of TMJ dysfunction.

Indications for SUS use:

1) distal occlusion after completion of active period of jaw growth;
2) unilateral correction of class II anomalies;
3) distalization of upper lateral teeth (replacement of facial bow);
4) closing the gaps in the lower jaw (with edentulous second premolars);
5) treatment of dysfunctions of temporomandibular joint.

The Forsus apparatus is a 0.5 × 3 mm spring rod (Fig. 25). The rods of the apparatus are presented in four sizes (25, 29, 32, 35 mm). The selection of the desired size of apparatus is carried out in usual occlusion by measuring the distance from distal tube on the first permanent molar of upper jaw to the distal border of lower canine bracket with the addition of 12 mm. Also, 3M Unitec offered a shortened version of the Forsus device. The fixation of the nail distal to the first lower premolar is ideal for treating patients with a tendency to open bite.

Figure 25. Apparatus Forsus

It is obvious that functional fixed devices have both advantages and disadvantages. The main disadvantage of the intermaxillary apparatus is an increase in the inclination of the occlusal plane, accompanied by protrusion or excessive inclination of lower incisors. To avoid this problem, it is recommended to install these devices on a rigid steel wire of 0.019″ × 0.025″ or perform a Bendback (bending of the arch behind the supporting lower molar). However, with the correction of Angle class II 2nd subdevision, a slight protrusion of lower incisors can be considered as a positive aspect of treatment.

The main reason for relapses after this treatment is persistent dysfunction of tongue and lips, as well as incomplete fissure-tubercular contacts. Since the therapeutic effect is achieved in a relatively short time (6–8 months), the use of retention devices is recommended for at least 3 years. Retention should be carried out using standard or custom-made functional removable devices in combination with fixed retainers or single-jaw plates.

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CONTENT

Учебное издание

Токаревич Игорь Владиславович
Кипкаева Лариса Владимировна
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Компьютерная вёрстка Н. М. Федорцовой

Подписано в печать 29.09.21. Формат 60×84/16. Бумага писчая «Xerox office».
Ризография. Гарнитура «Times».
Усл. печ. л. 1,86. Уч.-изд. л. 1,54. Тираж 50 экз. Заказ 499.

Издатель и полиграфическое исполнение: учреждение образования
«Белорусский государственный медицинский университет».
Свидетельство о государственной регистрации издателя, изготовителя,
распространителя печатных изданий № 1/187 от 18.02.2014.
Ул. Ленинградская, 6, 220006, Минск.

ISBN 978-985-21-0912-3