"JOURNAL OF SCIENCE-INNOVATIVE RESEARCH IN UZBEKISTAN" JURNALI
VOLUME 3, ISSUE 01, 2025. YANUARY
ResearchBib Impact Factor: 9.654/2024 ISSN 2992-8869

Types of dental braces and their placement techniques

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Abstract: This article provides information about dental briquettes. The article explains the techniques for the correct placement of dental briquettes.

Key words: braces, Ribbon arc, E-arc, Vestibular braces, Gold braces.

Braces (from English *brace* "bracket"), orthodontic braces complex orthodontic non-removable structures (appliances) for correcting the position of human teeth in case of bite disorders and unevenness of the dentition. They are devices that are fixed with orthodontic glue (bond) to the outer or inner surface of the teeth. The bracket has a groove in which an orthodontic arch lies, which has a " shape memory " (for example, a nitinol alloy based on nickel and titanium) or steel. The resistance of this arch when it is fixed by means of braces on crooked teeth is a force that slowly but steadily aligns the teeth and dentition under the influence of heat in the oral cavity.

Story Edward Angle is considered the father of braces and modern orthodontics not only for his contributions to classification and diagnosis, but also for his ingenuity in developing new orthodontic appliances. With only a few exceptions, the fixed appliances used in modern orthodontics are based on Angle's design, developed in the early 20th century. Angle developed four basic systems of appliances:

E-arc

In the late 19th century, the typical orthodontic appliance was some kind of rigid frame in which the teeth were mounted so that they could be expanded along the arch. Angle's first appliance, the E-arch, was of this type. Bands were placed only on the molars, and a strong vestibular archwire was placed along the teeth. The ends of the archwire were threaded, and a small nut screwed onto the threaded section allowed the archwire to be advanced to increase the perimeter. Individual teeth were simply tied to this expanding archwire. Such appliances could still be found in some orthodontic laboratory mail-order catalogues until the 1980s,

probably due to their simplicity, but despite this they provided only heavy intermittent forces.

Pin and tube

The E-bow was only capable of tilting teeth into a new position. It could not provide precise positioning of individual teeth. To solve this problem, Angle began to place bands on other teeth and used vertical tubes on each tooth that contained a pin soldered to a small wire arch. With this device, tooth movement was achieved by changing the position of each pin individually.

The construction and adjustment of such a pin-and-tube device required enormous effort, and although it theoretically had great precision in tooth movement, it was impractical for clinical use. It was said that only Angle himself and one of his students succeeded in making such a device. The relatively heavy supporting arch had poor elasticity, and the problem was precisely that it required a large number of adjustments to the device.

Ribbon arc

In his next appliance, Angle modified the tube on each tooth into a vertically positioned rectangular slot. A ribbon archwire of 10 x 20 gold wire was placed in the slots and secured with pins. The ribbon archwire was an immediate success, primarily because it was small and flexible enough, unlike its predecessors, to be effective in aligning misaligned teeth. Although the ribbon archwire could be twisted when placed in the slot, the appliance's major weakness was that it provided relatively little root control. The elasticity of the ribbon archwire simply did not allow for the moments needed to create root torque.

Edgewise technique

To correct the shortcomings of the band arch, Angle reoriented the slot from vertical to horizontal and inserted rectangular wires rotated at 90° into the slots, and this device was called the Edgewise system. The slot dimensions were changed to 0.022 x 0.028 inches, and a precious metal wire of 0.022 x 0.028 was used (nowadays, the slot size is usually indicated in an abbreviated form, for example, .022, removing the first 0 or 022, also removing the period). These dimensions were obtained as a result of numerous experiments and provided really good control of the position of the crown and root in three planes of space.

After its invention in 1928, this device became the mainstay of treatment using multi-ring fixed devices, although tape arches continued to be used for another decade.

Design of braces

The simplest design includes a slot for the wire arch, ligature wings for fixing the arch with ligatures, and retention elements on the base for attachment to the surface of the tooth enamel. The vertical movement of the teeth will be ensured by the simple presence of the arch in the bracket slot, lateral movement - by the ability to slide the arch inside the slot, and the rotational moment - by the mesiodistal size of the bracket. The vertical size of the bracket does not affect the movement of the teeth, but determines the strength of the ligature wings. The design of the retention points on the base of the bracket is responsible for the degree of mechanical fixation.

Physiology of tooth movement with braces

The movement of teeth with the help of a bracket system occurs as a result of applying pressure to the crown of the tooth. Traditionally, four main elements are used in the treatment process: brackets, adhesive material , an arch and ligatures (in traditional brackets). Teeth are moved due to the effect of the arch force on the tooth through the bracket. Sometimes additional elements are used: opening springs and elastic chains, their main purpose is to apply additional forces in the required direction.

The orthodontist sets the arch shape determined by each specific clinical case. After that, it is placed in the slots of the brackets glued to each tooth of the upper and/or lower jaw. The arch tends to return to its original shape, applying a constant force to the tooth, thereby gradually moving it. That is, the bracket system initiates the emergence of constant forces that contribute to the movement of teeth to the desired position. The brackets are positioned on the teeth in such a way that the forces initiated by the arch move the teeth in the desired direction, bringing the dentition to a natural and aesthetic state. The result of this process is bone remodeling - resorption of the alveolar bone tissue on the side to which the tooth movement is directed, and the formation of new bone tissue on the opposite side.

Depending on the magnitude of the force applied to the tooth during its movement, two types of bone resorption can be distinguished: directed (direct) resorption and indirect (subsurface, retrograde) resorption, which occurs in cases where the periodontal ligament is subjected to excessive loads in terms of force and time.

Another important physiological process initiated by the tension of the periodontal ligament and providing tooth movement is the deposition of bone tissue along the stretched periodontal fibers. The combination of these two factors provides tooth movement during orthodontic treatment .

It was found that the fastest and most physiological tooth movement occurs when applying forces equal to the blood pressure in the capillaries of the periodontal ligament - 20-26 g / cm. The use of forces exceeding these values by at least 0.5 g leads to compression of blood vessels, oxygen starvation, cessation of cellular activity and such pathological processes as necrosis and hyalinization. As a result, subsurface resorption occurs instead of the desired physiological directed one, ensuring comfortable and rapid tooth movement.

Types of braces

Depending on their location on the tooth surface, there are vestibular (located on the outer side of the tooth) and lingual (internal) braces. Depending on the type of material used in their manufacture, brace systems are divided into metal, plastic, polymer (ceramic, sapphire) and combined. Depending on the method of attaching the arch to the braces, there are classic braces (using ligatures) and self-ligating (non-ligature). There are also aesthetic braces. These include equipment made from materials that are less noticeable on the teeth than metals (plastics, ceramics, sapphire), as well as completely invisible lingual systems.

Vestibular braces

The largest group of bracket systems that are located on the front surface of the tooth. Vestibular bracket systems essentially include all bracket systems with rare exceptions. The advantages of vestibular brackets compared to lingual (internal) brackets are the predictability of treatment results, a significantly lower price, ease of hygienic care and other manipulations with brackets. The main disadvantage of vestibular brackets is their high visibility. On the other hand, in 2017 and 2022 there was a trend of popularizing brackets as a fashion accessory, which levels out this disadvantage.

Lingual braces

Unlike vestibular braces, lingual braces are attached to the inner (lingual) side of the teeth and are completely invisible to others. Lingual braces are also classified as aesthetic braces. It is believed that this is the most aesthetic method of orthodontic treatment using non-removable systems. The disadvantage of lingual systems, in addition to their high cost, is the reduction of the inner part of the oral cavity. Therefore, patients initially experience diction disorders. As a rule, after 2-3 weeks the tongue adapts to the reduced size of the oral cavity, and diction becomes normal. In the case of using lingual braces, more labor-intensive oral care is also required. In addition, when using lingual braces, there is increased discomfort for the patient due to constant contact of the tongue with the brace system. In the Russian

Federation, you can find three models of lingual braces: WIN, Incognito (3M), STB (Ormco).

Metal braces

The oldest type of braces. They are made from stainless steel (usually grade 17-4), titanium or nickel-titanium alloy. Metal braces are still widely used due to their low price and wide range of different options. The appearance of modern metal braces differs from their ancestors - they are now smaller in size, can have different shapes and are much more effective than their predecessors. The main advantage of metal braces over other types is the minimal friction force between the groove and the arch, the value of which largely determines the duration of the entire treatment. In addition, metal braces are the most resistant to any kind of external influences. The main disadvantage of metal braces is their greater visibility on the teeth compared to other types. Also, some manufacturers may use low-quality alloys in the production of metal braces, which can lead to corrosion, deformation of the braces, and unpredictable treatment results. Common examples of metal braces include In-Ovation by Dentsply, Damon by Ormco, and SmartClip by 3M .

Gold braces

They are a type of metal braces. They are chosen by patients who want to emphasize their status and individuality. As biologically neutral, gold braces are also an option for patients who are allergic to other materials. In practice, at present (2017), only Incognito lingual braces manufactured by the dental division of 3M , Unitek, are made of gold.

Plastic braces

The advantage of plastic braces over metal ones is their more aesthetic appearance. However, they are characterized by a rather low strength compared to metal braces, which can cause plastic braces to break right in the oral cavity, and also have longer treatment periods due to the properties of plastic. Some manufacturers use a metal groove in the design of such braces to increase the strength and predictability of treatment results (for example, in Damon 3 braces manufactured by Ormco). Also, plastic braces can be stained under the influence of food dyes contained in coffee, tea and other products. Nevertheless, plastic vestibular braces are widely used due to their low visibility and lower price compared to ceramic, sapphire and lingual braces.

Ceramic braces

Ceramic braces are aesthetic braces made of polycrystalline aluminum oxide (for example, Damon Clear by Ormco, Clarity by 3M , Ovation C by Dentsply). Compared to plastic, ceramic braces are more expensive, but also more durable. The color of these braces is close to the natural color of tooth enamel, which makes them almost invisible to others. The disadvantages of ceramic braces include higher friction between the arch and the bracket groove (compared to metal braces), which can increase the duration of treatment. To solve this problem, a metal groove is sometimes introduced into the design, which worsens the aesthetics.

Sapphire braces

They are made of artificial sapphire crystal - monocrystalline aluminum oxide. They have the highest transparency, are as invisible and aesthetic as possible. They are more reliable than plastic and ceramic braces, and are more resistant to external influences. The disadvantages of these braces include their high cost. Examples of sapphire braces are Radiance (American Orthodontics), Inspire Ice (Ormco).

Classic braces systems

They are also called traditional braces, ligature braces. The oldest of the currently used types of brace systems. The design feature of these systems is that the bracket slot does not have a cover and the arch is attached to it using wire or elastic devices - ligatures. Without additional mechanisms for attaching the arch, these braces are easier to manufacture and cheaper (compared to self-ligating systems). However, they require more manipulations on the part of the orthodontist, additional costs for ligatures, more frequent visits to the doctor to change and tighten the ligatures and special care (ligatures contribute to the deterioration of the hygienic condition of the oral cavity).

Another disadvantage of such systems is the increased likelihood of increasing the treatment period and obtaining negative results. The fact is that when planning treatment, the orthodontist needs to calculate the forces that the arch applies to the bracket and, accordingly, the movement of the tooth. At the same time, the ligature with which the arch is fixed in the bracket groove exerts counter pressure, which partially neutralizes the force of the arch. In the case of treatment with bracket systems, even such a small counter pressure can significantly affect the timing and outcome of treatment.

Self-ligating braces

Ligature fixation of arches requires significant time expenditures. For example, during a regular change or activation of an arch, the doctor's work directly with the arch takes about 20-30% of the total time. Most of the appointment is associated with removing old ligatures and installing new ones. The use of elastic ligatures at many stages of treatment is a serious compromise. Therefore, a number of orthodontists and engineers have been attempting for decades to create brackets that have the function of fixing the arch in the groove without the use of ligatures or self-ligating brackets. A great many such designs have been proposed, but they have not received sufficient distribution. The first ligature-free brackets were bulky and unreliable. Some designs existed only in the form of drawings and prototypes, others experienced the rise and fall of their popularity. However, the entire variety of self-ligating bracket designs has over time been reduced to a simple classification of self-ligating brackets with a groove that closes with a lid:

- Active locking brackets or **active self-ligating brackets** . The mechanical shutter of the slot of such brackets exerts active pressure on the arch in order to move it towards the base of the slot.
- Passive self-ligating brackets or **passive self-ligating brackets** . Passive self-ligating means that the cover does not exert active pressure on the archwire towards the bottom of the bracket slot. A passive self-ligating bracket in its closed form can be compared to a buccal tube.

Passive self-ligating brackets are the most advanced type of bracket systems. They are distinguished by the greatest reliability of the design, stability and predictability of treatment results. While in active self-ligating systems the orthodontist must also take into account the force of pressure of the bracket slot cover on the arch, in passive systems it makes sense to take into account only the force directly applied by the arch to the brackets.

Among passive self-ligating braces, the brace system created by Dr. Dwight Damon in 2000 stands out, which was named the Damon System . This system is essentially a fundamentally new approach to orthodontic treatment using non-removable equipment. It is an ecosystem of braces, arches, locks and other elements developed in a complex and ideally suited to each other to ensure the specified treatment results, subject to the integrity of the system and general treatment algorithms on this equipment.

Individualized braces

Modern CAD/CAM technology allows creating orthodontic equipment (brackets and arches) that is completely individualized for each patient. Thanks to computer precision, it reduces the number of errors, opens up new possibilities in planning and managing the treatment process, and provides accurate, predictable results in less time (up to 25%). Individual torque values and an individual arch shape with applied first-order bends, calculated by a computer program, allow achieving high-quality results with less effort. Brackets are placed on the teeth in such a way as to move them to the position prescribed by the doctor in the shortest possible time. Application of an individual preventive program scheme in treatment with bracket technology.

Brief description of the technology

The orthodontist makes silicone impressions (casts) of the patient's teeth and sends them to the laboratory, where the impressions are scanned. This creates a three-dimensional computer model of the teeth. The program processes the image so that each tooth is transformed into a separate geometric object with the ability to move and change position in all planes. In accordance with the doctor's wishes, technicians in a special program set the teeth in the position they will occupy as a result of treatment, and also calculate and draw the ideal shape of the dental arches. The program creates a "virtual setup" - places the braces selected by the doctor on the teeth. After this, the file with the setup is sent to the doctor for approval. The doctor has the opportunity to change the setup using a special program and send it for rework. This continues until the doctor approves the setup. After this, the order goes into production. The doctor receives 2 sets of portable templates for fixing the braces on the teeth, made in full accordance with his order, containing braces made individually for the patient. The doctor receives his order by mail and fixes the braces directly to the patient's teeth using templates (a plaster model and a mouth guard are not needed).

Examples of existing technologies for the production of individualized braces are the Insignia (Ormco) and Orapix systems.

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