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Modern Treatment Methods for Distal Pricus

Khollieva Gulnoza Sodik kizi
Clinical resident of the Department of Pediatric Stomatology Samarkand State Medical University

Murotova Dilnoza Dilshod kizi
Clinical resident of the Department of Pediatric Stomatology Samarkand State Medical University

Ahrorova Malika Shavkatovna
Candidate of Medical Sciences, Associate Professor of the Department of Stomatology, Samarkand State Medical University

Abstract: Distal occlusion (Engle's skeletal class II) is one of the most common dentoalveolar anomalies, occurring in 30-50% of the population of various ethnic groups and characterized by the distal position of the lower jaw relative to the upper or proximal position of the upper jaw. Distal pricking can be caused by both skeletal factors (underdevelopment of the lower jaw, excessive development of the upper jaw, or their combination) and dentoalveolar factors (medial position of the upper molars, distal position of the lower molars), making it a multifactorial problem requiring a comprehensive approach to diagnosis and treatment.

Keywords: Distal prick; skeletal class II; ortodontic treatment; functional apparatuses; multibonded systems; lingual ortodontics; extraoral traction; orthopedic treatment; orthognathic surgery; dentofacial anomalies; jaw growth; mesiodistal correction; facial aesthetics; cephalometric analysis; growth management.

The purpose of this review is to systematize modern methods of treating distal occlusion, including their mechanisms of action, effectiveness, indications, and contraindications, as well as to discuss the role of new technologies (3D-planning, digital applications) in optimizing the treatment process and achieving predictable results.

Introduction. The aesthetic, functional, and psychosocial consequences of distal occlusion are significant: patients with distal occlusion often suffer from chewing, breathing, and speech disorders, and experience psychological discomfort due to characteristic changes in the facial profile ("bird's beak" or convex profile) [1, 2, 5]. Early diagnosis and timely initiation of treatment for distal occlusion during the period of active jaw growth are crucial for achieving optimal treatment outcomes and preventing the development of more severe forms of the anomaly [2, 3, 6]. Over the past two decades, a revolution has occurred in the methods of treating distal occlusion due to the development of new orthopedic and orthopedic technologies, as well as the emergence of innovative devices for managing jaw growth [3, 4, 7]. The modern arsenal of treatment methods includes non-removable devices (multibonded systems, lingual braces), removable growth-stimulating devices (functional devices, extraoral traction devices), combined ortodontic and orthopedic treatment, and, if necessary, orthognathic surgery combined with ortodontics [1, 4, 6, 8].

Distal prikus is a complex dentoalveolar anomaly based on multiple etiological factors, including genetic predisposition, impaired jaw growth and development, muscle dysfunction, and abnormal position of the tongue [1, 2, 3]. By etiological characteristic, the distal bite is classified as skeletal, dentoalveolar, and functional, with the skeletal component predominating in most cases (up to 60-70% of patients have skeletal disorders) [2, 4, 6]. Skeletal distal pricking can be caused by: (1) underdevelopment of the lower jaw (micromandibulia) due to impaired growth or abnormal growth direction, (2) excessive development or mesial position of the upper jaw (maxillary protrusion), or (3) combination of both factors [1, 3, 5]. Dentoalveolar distal occlusion is characterized by the mesial position of the upper molars, the distal position of the lower molars, or both simultaneously, with normal skeletal relationships between the jaws [2, 6].

Functional distal pricking develops as a result of an abnormal position of the lower jaw forward or backward due to a disruption of muscle balance, an abnormal position of the tongue, or harmful habits (biting the lower lip, mouth breathing) [1, 3, 4]. Understanding the etiology and mechanisms of distal bite development is crucial for choosing adequate treatment tactics and predicting its effectiveness.

Removable functional devices remain one of the main methods of treating distal occlusion during the period of active jaw growth and are based on the principle of gradually transitioning the lower jaw to the protrusion position, which stimulates its growth and promotes the repositioning of the upper molars [2, 3, 6, 8]. The most effective and widely used functional devices include: Andrezen activator, Frenkel functional regulator (FR), Herbst apparatus, Twin Block (double block) apparatus, and others [1, 4, 6].

Andrezen's activator is a removable two-jaw ortodontic device that works through constant contact with the muscles of the maxillofacial region, restructuring the reflex patterns of muscle activity and causing adaptive changes in the mandibular position [2, 3, 6]. The effectiveness of Andrezen activator in correcting distal occlusion is 60-75%, with better results achieved when treatment is initiated early (8-10 years old) and the patient is well-compliant [1, 4, 8].

The Frenkel Functional Regulator (FR) is a growth-stimulating apparatus that works by creating space for lower jaw growth through stimulation of surrounding muscles and thanks to cheek and tongue shields [2, 3, 6, 9]. FR shows good results in correcting skeletal distal prikus, especially in micromandibulitis, with 2-4 mm improvement in mandibular sagittal dimensions and normalization of the molar ratio [1, 4, 10].

The Twin Block (double block) apparatus consists of upper and lower plates with inclined occlusal surfaces, which, when the jaws are closed, generate a force that transfers the lower jaw to the protrusion and stimulates its growth [3, 6, 8, 11]. Twin Block demonstrates high effectiveness in correcting distal occlusion (70-85% of successful results), especially in the skeletal type of anomaly, and is characterized by good patient compliance due to ease of use [2, 4, 6, 11].

The Herbst apparatus belongs to the semi-removable functional apparatus and contains a mechanical element (screw or tape) that constantly maintains the lower jaw in the protrusion position, providing a more stable effect on the growth of the lower jaw [1, 3, 8, 11]. The Herbst apparatus is particularly effective in patients with poor compliance, as its use does not depend on muscle interaction and the patient's maintenance of the apparatus [2, 4, 6, 12].

The results of using functional devices show that the main mechanism for correcting distal occlusion is to stimulate the growth of the lower jaw (by an average of 3-5 mm in the sagittal direction), while the contribution to the distillation of the upper molars is 20-30%, and the inclination of the lower frontal teeth is 10-20% [1, 3, 6, 8]. The effectiveness of functional devices significantly depends on whether they are used during the period of active jaw growth (maximum at 8-14 years old) and on the patient's degree of compliance [2, 4, 6, 9, 10].

Non-removable multibonded orthodontic systems (bracket systems) are a universal tool for correcting distal occlusion in the final stages of treatment or as a primary method when precise correction of individual teeth is required [2, 3, 4, 6, 8]. Multibonded systems allow for controlling not only the sagittal position of the teeth (mediodistal), but also the transverse and vertical positions, achieving three-dimensional control of the position of each tooth [1, 3, 7, 8].

In the correction of distal occlusion using non-removable devices, various mechanisms of dental movement are used: distillation of the upper molars through extraoral traction or the use of distillating springs, protraction of the lower frontal teeth, or combined action [2, 4, 6, 8]. Modern direct and indirect bracket systems, such as the Roth system, MBT (McLaughlin-Bennett-Trevisi), Damon, and others, contain embedded information (angulation, torque, inclination) for optimal correction of skeletal and dentoalveolar disorders [1, 3, 6, 8].

Lingual orthodontics (internal orthodontics) is an alternative method for correcting distal occlusion using braces fixed on the inner (lingual) surface of the teeth, which ensures complete treatment aesthetics and allows for precise three-dimensional control of the dental position [4, 7, 11, 12]. Lingual orthodontics is especially indicated for adult patients who require full aesthetics during orthodontic treatment, but require special training and experience from an orthodontist [3, 6, 7, 12].

Cervical pull headgear is used when there is a normal or low gonadal angle and is characterized by a force directed upward and backward, which ensures the distillation of the upper molars with minimal effect on vertical development [1, 3, 6, 8]. The effectiveness of cervical traction in the distillation of the upper molars is 3-5 mm, while the associated posterior inclination of the upper frontal teeth can be compensated by subsequent orthodontic treatment [2, 4, 6, 8].

High extraoral traction (high pull headgear) is used in cases of high gonadal angle and vertical growth type of the mandible and is characterized by directing force upward and backward to avoid additional opening of the bite [1, 3, 6, 8]. High traction shows good results in controlling the vertical development of the face while simultaneously distillating the upper molars [2, 4, 6, 11].

The effectiveness of extraoral traction depends on many factors: the correct choice of headgear type depending on the patient's vertical height type, the adequacy of the applied force (with intermittent traction, 250-350 g), the duration of the device's use (minimum 12-14 hours per day), and the patient's good compliance [1, 2, 3, 6, 8]. The results show that with proper application, extraoral traction can ensure the distillation of the upper molars by 3-6 mm and the transition of the molar ratio from class II to class I [2, 4, 6, 8, 11].

In recent years, intraoral distillation systems have become widespread, which do not require the use of extraoral equipment and allow patients to avoid aesthetic problems associated with the use of headgear [3, 4, 6, 7, 8]. The most well-known systems include: Pendulum (pendulum), Distal Jet, Jones Jig, Forsus EZ, and others [1, 2, 3, 6, 8].

The Pendulum system is a pallatinum apparatus with an intraoral power source that ensures the distillation of the upper molars through inclination and lateral displacement [2, 3, 6, 8]. The Pendulum system shows the effectiveness of 4-6 mm distillation of the upper molars with less side effect (slope of the upper frontal teeth) compared to extraoral traction, especially when used during the period of mixed occlusion [1, 4, 6, 11].

The Distal Jet system utilizes closer contact with the upper molars and provides more vertical molar distillation, which reduces tooth inclination during movement [3, 6, 8, 11]. The distillation efficiency when using Distal Jet is 3-5 mm, while the system shows good results when used in conjunction with non-removable equipment [2, 4, 6, 8].

Jones Jig and Forsus EZ are non-removable systems that provide constant distal force on the upper molars and can be used as an alternative to extraoral traction [1, 3, 6, 7, 8]. These systems show good results in distillation and minimization of side effects due to better control over the direction of tooth movement [2, 4, 6, 11]. One of the advantages of intraoral distallizing systems is their non-removable nature, which ensures constant exposure and does not depend on patient compliance, however, they require more careful monitoring of the distallization process and may have limitations when certain morphological features of the upper jaw are present [1, 3, 4, 6, 8, 12].

When treating distal occlusion, a combined approach is often used, which involves applying various methods in a specific sequence to achieve optimal results [2, 3, 4, 6, 8]. The typical treatment plan includes: (1) initial use of functional devices during active jaw growth to stimulate lower jaw growth, (2) subsequent use of extraoral traction to displace upper molars, and (3) final ortodontic treatment using multibonded systems to achieve precise occlusion correlation [1, 3, 4, 6, 8, 10].

The consistent application of various treatment methods allows for minimizing the side effects of each individual method, as the initial changes obtained in one stage can be corrected and refined in subsequent stages [2, 4, 6, 8]. Combined treatment shows better long-term results compared to isolated methods, especially in treating severe forms of skeletal distal occlusion. In severe forms of skeletal distal occlusion, especially with significant micromandibulitis (deficiency in the sagittal direction greater than 10 mm) or with pronounced maxillary protrusion, ortodontic and orthopedic treatment may be ineffective and require orthognathic surgery in combination with ortodontics. Orthognathic surgery involves various surgical procedures: bilateral sagittal split osteotomy (BSSO) to move the lower jaw forward, maxillary setback osteotomy to move the upper jaw backward, or combined procedures involving both jaws. Orthognathic surgery allows for significant correction of skeletal disorders (up to 15-20 mm in various directions) and provides stable long-term results [1, 3, 4, 6, 8, 11].

Orthognathic surgery is typically performed at ages 16-18 and older, when the growth of the facial skeleton is complete, in conjunction with orthoodontic treatment: preoperative orthoodontic treatment (1-2 years) to prepare the teeth for surgery, surgical intervention, and postoperative orthoodontic treatment (6-12 months) to achieve optimal occlusion [2, 4, 6, 8, 11, 12].

The development of digital technologies, including 3D computed tomography (CBCT), digital dental models, and computer planning, has revolutionized the approach to diagnosing and planning treatment of distal occlusion [3, 4, 6, 7, 8, 11, 12]. 3D planning allows for accurate assessment of skeletal and dentoalveolar components of the anomaly, visualization of expected treatment outcomes, and optimization of treatment method selection in each specific case [2, 3, 4, 6, 7, 8, 12].

Personalized braces (custom-made braces) developed using 3D modeling and 3D printing allow achieving optimal positioning of each brace on the tooth surface and minimizing the need for stamps and metal wires, which reduces treatment time [3, 6, 8, 12]. Computer applications for predicting jaw growth and ortodontic treatment outcomes help orthopedists choose the most effective treatment method and inform patients about expected outcomes [2, 4, 6, 8, 12].

The development of distal bite is closely related to functional disorders, including impaired position and function of the tongue, oral breathing, muscle balance abnormalities, and harmful habits (biting the lower lip, sucking the finger) [1, 2, 3, 5, 6]. Myofunctional therapy, aimed at correcting functional disorders and re-learning patterns of muscle activity, is an important addition to ortodontic treatment of distal occlusion [1, 3, 4, 6, 8].

Speech therapy exercises for correct tongue positioning, developing nasal breathing skills, and eliminating harmful habits contribute to improving ortodontic treatment results and reducing the risk of distal bite recurrence after active treatment completion [2, 3, 6, 8]. Studies show that patients who underwent myofunctional therapy in combination with ortodontic treatment show better functional results and more stable preservation of achieved results [1, 4, 6, 8, 11]. The recurrence of distal occlusion (returning to the initial or approximate values of the anomaly) remains one of the main problems of ortodontic treatment, with recurrence rates ranging from 25% to 60% depending on the treatment method and the duration of the observation period [2, 3, 4, 6, 8, 11]. The recurrence is related to the genetic program of facial skeletal growth, which does not completely change during orthoodontic treatment, especially in skeletal forms of distal occlusion [1, 3, 4, 6, 8].

Thorough retention (fixing of achieved results) after completing active ortodontic treatment is crucial for minimizing recurrence, and it is recommended to use fixed retiners (lingual retiners) in combination with removable devices (night drops or plates) for a long period [2, 4, 6, 8, 11, 12]. Long-term studies show that proper retention can preserve treatment results for 10-20 years and longer, although some recurrence can be observed even with thorough retention [1, 3, 4, 6, 8, 11]. Successful treatment of the distal bite leads to a significant improvement in facial aesthetics due to the normalization of the facial profile (transition from convex to normal), improvement of the lower jaw position to the profile, and normalization of the position of the upper and lower lips [1, 2, 3, 6, 8]. Aesthetic improvement is accompanied by functional improvements, including restoration of the correct occlusal relationship, improvement of chewing function, normalization of the swallowing process, and improvement of speech quality [2, 3, 4, 6, 8, 11].

The psychosocial results of treating distal occlusion are also quite significant: patients report improved self-esteem, increased self-confidence, improved social interaction, and overall quality of life. Research on quality of life shows that treating distal occlusion, especially in childhood and adolescence, has a positive impact on the psycho-emotional state of patients and can contribute to improved academic and social performance.

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