https://ijmsphr.com
DOI: - 10.37547/ijmsphr/Volume07Issue06-04
Open Access Research Paper
INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND PUBLIC HEALTH RESEARCH
Vol. 07, No. 06, June 2026, 15-18
eISSN 2767-3774

Challenges in Improving the Diagnosis and Treatment of Skeletal Open Bite Anomalies in Children

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Article Received: 28/04/2026, Article Accepted: 24/05/2026, Article Published: 17/06/2026

Abstract
This article is dedicated to a literature review on the problems of improving the diagnosis and treatment of skeletal open bite anomalies in children. According to various authors, the frequency of this condition is approximately 13.5%. The prevalence of vertical incisor disocclusion is 11.3-16.9% in European countries and 12.1% in Latin America. The prevalence of open bite in patients seeking orthodontic care was 2.66%. The frequency of occurrence in patients with neutral, distal, and mesial dental arch relationships was 1.8%, 2.7%, and 13.0%, respectively. In children with Class III vertical disocclusion of the dental arches, speech function is impaired, which manifests as the incorrect pronunciation of affricate (c, ch), sibilant (sh, zh), and whistling (s, s', z, z') sounds. The formation of an open bite is associated with many etiological factors: impaired respiratory, swallowing, and speech functions, endocrinopathies, macroglossia, postural disorders, genetic predisposition, the presence of harmful habits, and neurological pathology. Childhood is the most favorable period for the prevention and treatment of an open bite. At this age, the child's jaws are still growing and developing.

Keywords: Open bite, anomaly, cross-occlusion.

Introduction

According to local researchers, the prevalence of skeletal open bite anomalies in children is approximately 13.5%. The prevalence of vertical incisor disocclusion is 11.3-16.9% in European countries and 12.1% in Latin America [2, 4, 9].

According to many authors, the prevalence of deep bite among patients seeking orthodontic care is 17.42%. In patients with neutral, distal, and mesial dental arch relationships, the frequency of deep bite was 30.5%, 67.9%, and 1.9%, respectively. The study made it possible to determine the proportionality of the anterior and posterior facial height in patients with a deep bite. In most cases, a decrease in the posterior and anterior facial height was noted (66.5%) [1, 3]. A decrease in the anterior height was identified in 13.5% of the subjects while maintaining normal posterior height indicators. In most patients with a deep bite, the size and position of the maxilla were normal (37%), while maxillary retrognathia was noted in 26.5% of cases. Mandibular retrognathia and micrognathia were identified in 55.5% of subjects, while mandibular micrognathia alone was identified in 25.5% of patients with a deep bite [1, 6, 8].

The prevalence of open bite in patients seeking orthodontic care was 2.66%. Its frequency of occurrence in patients with neutral, distal, and mesial dental arch relationships was 1.8%, 2.7%, and 13.0%, respectively. Deep bite was observed in 17.42% of the subjects, and its frequency in patients with neutral, distal, and mesial dental arch relationships was 9.5%, 29.5%, and 7.4%, respectively. In patients with an open bite, an increase in anterior facial height was most often found in conjunction with a decrease in posterior height (25%). In 25% of subjects, the anterior facial height was normal, while a decrease in the posterior height was found. In 66.5% of patients with a deep bite, a decrease in both the anterior and posterior facial height

was identified in the majority of cases. In 40.62% of patients with an open bite, the mandibular condyles were in an anterior position. In 38.8% of patients with a deep bite, the condyles were observed to be in an anterior-inferior position [5, 8].

Defects in sound pronunciation occur in every second child during childhood [4, 6, 8]. A direct correlation is observed between the nature and frequency of sound pronunciation disorders in childhood and dentoalveolar anomalies and deformities [1, 3]. In this regard, there is a need for a detailed study of the correlation between the severity of dentoalveolar system pathology and the incidence of defective sound pronunciation in children [2, 7, 9]. Children with speech function impairment due to Class III vertical disocclusion and a distance of 9 mm or more between antagonist teeth in the anterior segment are of particular interest [2, 6].

The occurrence of vertical occlusal anomalies is significantly influenced by infantile swallowing patterns, harmful habits, acute respiratory diseases, and concomitant chronic diseases. Patients with vertical occlusal anomalies exhibit incoordination of masticatory movements and deviations in the dynamic and static potentials of the masticatory muscles. The application of statistical research methods and the development of medical and social measures for the prevention of dentoalveolar anomalies based on them will make it possible to significantly reduce the incidence of vertical occlusal anomalies [8].

The articulatory apparatus plays an important role in every person's life, as it is precisely what enables speech activity. Various congenital and acquired defects of the speech organs in children can cause difficulties with eating and sound pronunciation, thereby affecting their development [5]. A study of the etiological factors in the formation of vertical disocclusion in preschool children concludes that harmful habits—such as prolonged pacifier use, sucking on fingers, pencils, or pens, and sucking the upper and lower lips—can lead to dental arch deformation in the form of vertical disocclusion [7].

It has been found that children with grade III vertical disocclusion of the dental arches exhibit speech disorders, specifically the incorrect pronunciation of affricate (ts, ch), sibilant (sh, j, shch), and whistling (s, s', z, z') sounds. These sounds are pronounced interdentally. In this process, labial-labial sounds are replaced by prelingual sounds. For this category of patients, correcting pronunciation defects is only possible through orthodontic treatment [8].

It has been determined that in children with grade III vertical disocclusion of the dental arches, speech function is impaired, manifesting as the incorrect pronunciation of affricate (ts, ch), sibilant (sh, j, shch), and whistling (s, s', z, z') sounds. These are pronounced as interdental sounds. In this case, labial-labial sounds are replaced by prelingual sounds. For this category of children with grade III vertical disocclusion of the dental arches, pronunciation disorders can only be corrected through orthodontic treatment [7].

Considering the etiology of the most common dentoalveolar anomalies, as well as the structure of comorbid pathologies, it can be concluded that the majority of patients begin orthodontic treatment during the early mixed dentition period. The following anomalies are predominant: distal occlusion (up to 47%), crossbite (up to 44%), dental crowding (up to 83%), and mesial occlusion (up to 20%), as well as combinations thereof. Risk factors include the presence of harmful habits (pacifier use, sucking fingers or the tongue, sleeping on one side, etc.) and the early removal of primary teeth without subsequent prosthetics [6].

The formation of an open bite is associated with numerous etiological factors: impaired respiratory, swallowing, and speech functions, endocrinopathies, macroglossia, postural disorders, genetic predisposition, harmful habits, and neurological pathologies. An increase in the incidence of open bite was noted in proportion to the age of the patients examined. The diversity of etiological factors explains the complexity of diagnosing and treating vertical incisal disocclusion, which necessitates a thorough approach to the rehabilitation plan [94]. The results of recent epidemiological studies on dentoalveolar anomalies have shown that the prevalence of open bite ranges from 0.9% to 7.5%, reaching up to 10.5% among all anomalies [4, 6].

An open bite is classified by location as follows: 1. open bite in the frontal region; 2. open bite in the lateral group of teeth: a) unilateral; b) bilateral. In 1980, K. Jebreii identified a bilateral posterior open bite resulting from macroglossia. In addition to this classification, it is necessary to differentiate between symmetrical and asymmetrical vertical disocclusion [9].

D.A. Kalvelis, based on etiological and pathogenetic factors, distinguished two forms of this malocclusion: • true (rachitic); • false (traumatic). V.A. Bogatsky assessed the size of the gap formed between the teeth when they are in occlusion [6].

Thus, he identified three degrees of manifestation for vertical disocclusion. According to this classification, the following are distinguished: • Grade I - vertical gap up to 5 mm; • Grade II - vertical gap from 5 to 9 mm; • Grade III - vertical gap greater than 9 mm [4, 7].

Z.F. Vasilevskaya classified open bite by severity, without taking the causative factor into account. As a result, she identified the following three degrees: Grade I - only the anterior group of teeth (incisors and canines) do not meet; Grade II - the anterior group of teeth (incisors, canines, and premolars) do not meet; Grade III — only the posterior teeth (last molars) occlude. In an open bite, there is dentoalveolar shortening (anterior region), dentoalveolar elongation (lateral group of teeth), and the mandibular angle is greater than 135° [1].

Based on these facts, A.M. Schwarz proposed dividing open bite into gnathic and dentoalveolar forms. The gnathic form is characterized by a change in the shape of the mandibular body: a convex curvature in the area of the lateral teeth and a concavity in the frontal part. In this case, the mandibular angle is increased, and the mandibular rami are shortened. The dentoalveolar form is explained by the shortening of the tooth roots. It often develops due to harmful habits (where the gap between the teeth even

corresponds to the specific shape of an object) [2, 8].

According to E. Angle's classification, the relationship of the first molars is one of the primary criteria for clarifying a diagnosis. The presence of vertical incisor disocclusion and a normal relationship of the first molars allows for the diagnosis of "Open Bite." If the first molars of both jaws are not in a Class I relationship, an open bite will occur in conjunction with a distal bite (Class II according to Angle) and a mesial bite (Class III according to Angle), respectively [2, 9].

An open bite very rarely occurs as a primary, independent condition. More often, this malocclusion occurs in conjunction with other dento-jaw anomalies. The diagnosis of an open bite, like other occlusal pathologies, includes a comprehensive clinical and paraclinical examination. Clinical examination methods include: • interview (complaints, collection of life and medical history); • visual inspection; • palpation; • functional tests [1].

A person with an open bite has a characteristic appearance: a sloped chin and, as a result, an altered (convex) facial profile and proportions. The lower third of the face is enlarged. The nasolabial and mental (chin) folds of the face are flattened. In this occlusal pathology, the mouth is slightly open and does not close, the lips are also unclosed and in a state of constant tension. Wearing a chin strap 24 hours a day during midpalatal suture expansion is a key factor that helps keep the mouth closed and transition to nasal breathing. As a result, the maxilla (upper jaw) expands and moves forward, the tongue is prevented from positioning in the floor of the mouth, and the horizontal growth vector of the mandible (lower jaw) decreases [5, 6]. It has been determined that the posterior dentoalveolar height, which is fundamental for diagnosis and treatment planning, should be measured in patients with a vertical growth pattern. Early removal of permanent or deciduous posterior teeth in the upper jaw is an effective measure for patients with a hyperdivergent facial type and increased posterior dentoalveolar height [2, 4].

The treatment of an open bite primarily consists of eliminating its etiopathogenetic factors: • ceasing harmful habits; • restoring the normal function of the respiratory, articulatory, and swallowing organs. An open bite most often occurs at an early age, during the primary dentition period; therefore, the most effective solution to this problem is performing myogymnastic exercises. If all exercises are performed correctly, the functional capacity of the muscles is restored. In addition to exercises, a special Rogers' activator and vestibular plates can be used to prevent pressure on the frontal teeth. Among such appliances, the following are most effective: • Andresen-Häupl activator; • open Klammt activator; • Schwarz appliance; • Herbst appliance, and others [3, 7, 8].

In the mixed dentition period, myogymnastics is supplemented by the use of fixed appliances and the Angle appliance [1]. In a fully formed permanent occlusion, an open bite is often quite advanced. To correct this malocclusion, the following are prescribed: • plates; • bracket systems; • Fränkel appliances; • trainers (silicone mouthguards); • Andresen-Häupl appliances. Plates are actively used in children. Their construction includes a vestibular arch, orthodontic clasps, and springs. Currently, the preferred method for treating an open bite is the use of fixed orthodontic appliances with reverse curve archwires. The use of retention appliances after treatment is mandatory. Retention therapy should last twice as long as the treatment period. Treatment with orthodontic appliances alone does not always achieve successful results in adult patients, as the jaw growth and development processes are complete. In this case, it is necessary to resort to surgical intervention in addition to appliances. Surgical methods may include corticotomy as well as ostectomy (bone removal) [1, 5, 9].

Childhood is the most favorable period for the prevention and treatment of an open bite. At this age, the child's jaws are still growing and developing. The formation of the dento-jaw apparatus ceases after the permanent occlusion is established. In this case, treating an open bite takes longer. The success of the treatment depends not only on age but also on the form of the open bite (true or pseudo). A pseudo or traumatic open bite is easier to treat than a true rachitic open bite. Adherence to all the orthodontist's instructions during the treatment period directly affects the success of the outcome, helping to improve the facial profile, achieve proper jaw development, and also address the psychological aspect.

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