

Employment of Microimplants in Orthodontic Treatment of Open Bite with Speech Disturbance

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Abstract Purpose: Substantiation of the use of microimplants in the correction of open bite by intrusion of the chewing teeth. **Material and methods:** a mass dental examination was carried out in 735 patients (of which 342 boys and 393 girls) in the period of mixed dentition at the age of 6 to 14 years, of which 505 were children attending the school educational institution school No. 18 in Tashkent, as well as 230 adult patients who applied to the clinic of Orthodontics of the Tashkent State Institute at the age of 16-30 years. All examined patients were conditionally divided into 3 groups depending on the occlusion: 1st - milk and early removable dentition (6-9 years), 2nd - late removable dentition (10-14 years) and 3rd - permanent bite. **Results:** 41 patients with open bite and speech disorders underwent a complex of diagnostic and therapeutic measures. These patients were advised to wear the Infant and T4K trainers. Vestibular plates were also fabricated with an expanding screw, a vestibular arch, and a tongue grille. The use of the trainer "Infant" in the complex orthodontic and speech therapy practice gave good efficiency only in the milk occlusion. In children over 5 years of age, positive effects have been obtained from the use of the T4K trainer. The examined patients with permanent occlusion underwent orthodontic treatment using microimplants for intrusion of the posterior teeth. After treatment, the patient had a normal bite (1.5 mm) to overlap (2.5 mm) ratio, stable occlusion, class I canine to molar ratio, and a correct midline. **Conclusions:** in order to achieve a good result with the help of trainers and orthodontic plates, a great cooperation with the patient is necessary, which is expressed in conscientious wearing of the devices in compliance with personal oral hygiene. In permanent occlusion patients, appliances do not need to be attached to the anterior segment during intrusion, allowing for more esthetic treatment. Although micro-implant molar intrusion is an effective method for correcting open bite, it is not a universal method for all types of open bite.

Keywords Teeth, Dentition, Open bite, Orthodontic apparatus, Trainers, Orthodontic plate, Microimplant, Intrusion, Speech disorder, Speech correction

1. Introduction

Open bite is considered one of the most difficult disorders to treat in orthodontics. Over the past 10-15 years, the number of children in whom the habitual open position of the mouth has been fixed has increased, resulting in a restructuring of the type of breathing: the child switches from the physiological nasal type of breathing to the pathological oral type of breathing, as a result, a pathological open bite is formed.

This non-physiological open position of the mouth may be facilitated by the pathology of the ENT organs. (ear, throat,

nose), causing the pathological process of nasal breathing. Children, the incidence of adenoids and chronic rhinitis, secondary disorders occur, are found in reduced phonemic hearing. Deterioration of auditory perception and auditory differentiations slows down the process of formation of language means and entails speech disorders. The consequence of a violation of phonemic hearing may be a general underdevelopment of speech, a violation of the intonational expressiveness of speech, etc.

Due to the constantly open mouth, the labial muscles become flaccid. Low tone of the circular muscle of the mouth makes it difficult for the lips to close normally, interfering with the normal development of the lower jaw. In speech, there is insufficient labialization (active participation of the lips in pronouncing sounds), especially vowels. Later, at school age, insufficient labialization of vowels can lead to

specific (speech) errors in writing.

Based on the foregoing, the incorrect structure of the articulatory apparatus and malocclusion is one of the most common causes of deficiencies in sound pronunciation. Anomalies and deformities of the maxillofacial region prevent the normal articulation of sounds, contribute to the consolidation of the habits of incorrect articulation and make it difficult to correct them (Ayupova F. S. Voskanyan A. R., 2016).

The literature describes dentoalveolar anomalies resulting from mesial displacement of the posterior teeth and methods for their treatment (Korkhaus, 1939; Oppenheim, 1934; Schwarz, 1962; Mejer, 1968, etc.). However, the biomechanical principles of the distal movement of the lateral teeth (molars and premolars) and the indications for the use of one or another design of the orthodontic appliance have not been studied enough.

To prevent complications and increase the effectiveness of treatment, it is proposed to strengthen the support by means of various variants of skeletal anchorage. Various anterior open bite treatments have been proposed to traditional orthodontic treatment, such as extrusion of anterior teeth using intermaxillary elastics; straightening molars with multi-loop edge archwire (MEAW) and inhibiting molars eruption during growth. However, none of these methods is satisfactory due to adverse effects on the skeletal, aesthetic structure and a strong tendency to relapse.

Another treatment option is to reposition both the maxilla and mandible through surgical correction. Although satisfactory results can be achieved with orthognathic surgery, the complexity, risks, and cost of the operation have initiated a search for alternative treatments.

With absolute intrusion of the posterior teeth, autorotation of the lower jaw in the closing direction counterclockwise, closure of the open bite and reduction in the height of the anterior face without surgical intervention is possible. Intrusion has been reported to provide a more consistent treatment outcome than extrusion. Because the propensity to relapse is higher in adults, it is important to choose both a stable and predictable treatment.

This can be achieved with temporary anchoring devices such as osseointegrated implants, miniplates, and microimplants. Microimplants have many advantages over various other temporary fixators (Jae-Hyun Sung, 2006).

2. Purpose of the Study

Rationale for the use of microimplants in orthodontic treatment of open bite with speech impairment.

3. Material and Methods

We conducted a mass dental examination of 735 patients (including 342 boys and 393 girls) in the period of mixed dentition at the age of 6 to 14 years, including 505 children attending school educational institution school No. 18 in Tashkent, as well as 230 adult patients who applied to the clinic of Orthodontics of the Tashkent State Institute at the age of 16-30 years. All examined patients were conditionally divided into 3 groups depending on the occlusion: 1st - deciduous and early removable dentition (6-9 years), 2nd - late removable dentition (10-14 years) and 3rd - permanent bite.

Diagnosis of anomalies of teeth, dentition and occlusion was carried out on the basis of an anamnesis, the results of a clinical examination, an anthropometric study of the dentoalveolar system (DAS), TRG and orthopantomography of the jaws, and a biometric study of diagnostic models of the jaws.

All examined, depending on the state of hard and soft tissues of the oral cavity and the presence of speech defects, the degree of nasal breathing disorders, were referred for consultation and treatment to the relevant specialists.

4. Research Results

As a result of clinical and additional studies, out of 735 examined, malocclusion was detected in 428 (58.2%). Prognathic occlusion was diagnosed in 123 (16.7%) examined patients, of which 24 (3.26%) of the 1st, 53 (7.21%) of the 2nd and 46 (6.25%) of the 3rd group. Deep bite was observed in 65 (8.84%) examined, that is, respectively, in 14 (1.90%), 24 (3.26%) and 27 (3.67%) patients. Progenic occlusion occurred in 60 (8.16%) examined patients, including 19 (2.58%), 24 (3.26%) and 17 (2.31%) 1st, 2nd and 3rd group. Open bite was detected in 41 (5.57%) examined patients, of which 10 (1.36%), 13 (1.76%) and 18 (2.44%), respectively, from the 1st, 2nd and 3rd groups (Table 1).

Table 1. Distribution of examined patients depending on the type of malocclusion

Bite anomalies	1 st group			2 nd group			3 rd group			Total, abso. (%)
	N	b	g	N	b	g	N	b	g	
Superior prognathia	24	10	14	53	28	25	46	25	21	123 (16,7)
Prognathic ratio	10	4	6	12	7	5	27	13	14	49 (6,6)
Progenia	19	9	10	24	11	13	17	9	8	60 (8,4)
Progenic ratio	20	9	11	25	11	14	10	5	5	55 (7,4)
Deep bite	14	6	8	24	13	11	27	12	15	65 (8,8)
Open bite	10	4	6	13	7	6	18	10	8	41 (5,5)
Cross bite	8	3	5	16	7	9	11	6	5	35 (4,7)
Total	105	45	60	167	84	83	156	80	76	428 (58,2)

Note. b - boys; g - girls.

Out of 428 children (209 boys and 219 girls) with identified anomalies of the DAS, we selected 41 (5.5%) patients (main group), including 21 (51.22%) boys and 20 (48.78%) girls, with a diagnosis of open bite and speech disorders, who underwent a complex of diagnostic and therapeutic measures. According to the degree of severity, anomalies of the open bite were divided into three subgroups (according to L.S. Persin):

- 1) I degree - easy, in which the size of the vertical gap is up to 3 mm,
- 2) II degree - medium, the size of the vertical gap is from 3 to 5 mm,
- 3) III degree - severe, the size of the vertical gap is over 5 mm.

The main reason for the open bite was bad habits - in 7 children, laying the tongue between the teeth - in 3, sucking and protruding the tongue simultaneously with a short frenulum of the tongue - in 5, pathology of ENT organs - in 8.

After an in-depth clinical and functional, anthropometric and cephalometric study of this group of patients, methods of complex treatment were chosen - orthodontic, speech therapy, otorhinolaryngological and surgical intervention.

Patients of the 1st group received complex orthodontic and speech therapy treatment for 6 months, they were recommended to wear "Infant" trainers and vestibular plates (Fig. 1). The use of the trainer contributed to the fixation of the upper position of the tongue with an emphasis on the anterior third of the hard palate, which provided support for the arch of the upper jaw from the inside and normalization of its shape, width and height. The occlusion of the teeth improved, the closing function of the lips was trained, nasal breathing was restored. Thus, the trainer "Infant" acted as a simulator for the correction of myofunctional disorders.



Figure 1. Trainer "Infant" for milk bite (a); trainer T4K - for mixed dentition (b)

The program of speech therapy classes for all children was the same. Classes were held 3 times a week for six months. At each lesson, tasks were offered for the development of

phonemic hearing, prosody, articulation and breathing exercises. Each lesson included tasks for clarifying the sounds corresponding to ontogenesis. All children performed breathing exercises, silent articulation of vowels, some articulation exercises, exercises for the development of phonemic hearing, a few minutes of exercise with the trainer "Infant".

For children of the 1st group at the age of 6 to 9 years (early mixed bite), T4K trainers were recommended and individually made plates with a vestibular arch, an expanding screw, with a lattice for the tongue and occlusal pads in the area of chewing teeth were installed (Fig. 2).

After 12 months, a positive result was obtained in 8 (61.5%) of 13 children, their severity of open bite decreased, speech normalized. The remaining 5 children continue complex treatment.

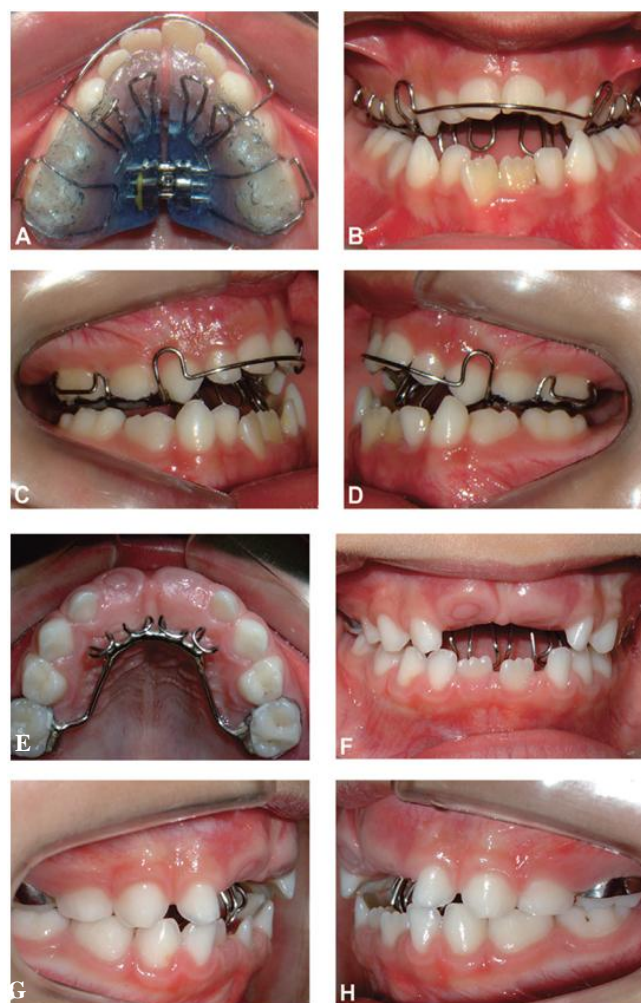


Figure 2. Plates with an expansion screw, with a lattice for the tongue and occlusal linings in the area of the chewing teeth

The examined 41 patients of the 3rd group with an open bite underwent orthodontic treatment for an open bite using microimplants for the intrusion of the chewing teeth.

Clinical example: A 28-year-old woman addressed the clinic of the Tashkent State Dental Institute (TSDI) with complaints of anterior open bite. In the past, she had a habit

of sucking her thumb, which could affect the opening situation and speech impairment. In the lateral profile, retrusion of the mandible was observed (Fig. 3).

The woman underwent intrusion of the posterior teeth of the upper jaw using microimplants. The posterior teeth were palatally splinted with rapid maxillary expansion (RME) and then an intrusive force was applied to the buccal microimplants. An anterior open bite of 3.5 mm was corrected 5 months after intrusion. As a result, a harmonious facial profile was achieved due to the closing mandibular rotation.



Figure 3. Photograph of patient M.K., 28 years old, before treatment

An intraoral examination showed the position of canines and class I molars on both sides with an anterior open bite of 3.5 mm. The midline of the upper jaw coincided with the midline of the face, while the midline of the lower jaw shifted 1.0 mm to the left. There were two different occlusal planes between the posterior and anterior teeth (Figure 4).



Figure 4. Two different occlusal planes

Analysis of the casts revealed crowding of 6.0 mm in the upper and 5.0 mm in the lower dentition. An anterior open bite of 3.5 mm was visible, and there was no occlusal contact from the first premolar on the left to the first premolar on the right.

Cephalometric analysis (Table 2) revealed a large ANB (5.6°) and a small APDI (79.33°), indicating an anteroposterior class II relationship. Steep mandibular plane angle (SN-GoMe) (51.3°), high sum (409.99°), small face height ratio (59.7°) and large FMA (40.6°) indicated posterior and downward rotation of the mandible, suggesting a greater anterior face height. The slope of the upper incisors was vertical (U1 to SN: 96.5°). The upper molars were significantly extruded compared to the normal range (U6 to PP: 31.0 mm). The rotation of the mandible suggested an anteroposterior class II relationship, but the patient's

condition was diagnosed as a skeletal class I with an anterior open bite.

Table 2. Cephalometric open bite analysis

Показатель	Before the treatment	After the treatment	Retention 1 year
SNA, °	76,9	76,7	76,1
SNB, °	71,3	72,7	72,8
ANB distinction, °	5,6	4,0	3,3
Anterior face height, mm	146,1	140,4	143,1
Face height ratio %	59,7	59,4	60,2
SN-GoMe, °	51,3	49,7	48,4
Sum, °	409,9	409,7	408,4
FMA, °	40,6	36,1	36,0
ODI	69,4	63,0	64,7
APDI	79,3	80,6	81,5
От U1 до SN, °	96,5	100,7	100,7
IMPA, °	89,0	85,9	92,4
Upper lip to E-line (mm)	-0,3	2,5	2,0
Lower lip to E-line, mm	0,5	2,9	3,6
WITS, mm	-4,4	-4,4	-3,7

5. Progress of Orthodontic Treatment

The patient required an extension of the upper jaw. Therefore, the rapid maxillary expansion apparatus (RME) was used for the first time. After sufficient expansion, microimplants 2 mm in diameter and 8 mm in length were placed on the buccal alveolar bone between the first and second premolars, between the second premolar and first molar, and between the first molar and second molar. The RME was kept as a palatal splint to prevent buccal tipping of the posterior teeth while an intrusive force was applied to the buccal side. Elastomeric chains were used to apply the intrusion force, the magnitude of the force was approximately 150-200 g per tooth (Fig. 5, 6). Molar intrusion was performed 5 months later and the anterior open bite was corrected.

After treatment, the patient had a normal bite (1.5 mm) to overlap (2.5 mm) ratio, stable occlusion, class I canine to molar ratio, and a correct midline. Cephalometric examination showed intrusion of the maxillary molars (2.0 mm) and simultaneous counterclockwise rotation of the mandible. As a result, the difference in ANB, APDI and Wits were corrected within the normal range, and FMA decreased from 41 to 36°. The patient's anterior face height was reduced from 146 to 140 mm, and the retracted chin significantly improved the harmonious facial profile. Dentally, U1 to SN was expanded labially and the IMPA tilted lingually to compensate for mandibular autorotation. After 1 year of retention, FMA, APDI and WITS were maintained. As IMPA approached the normal range, the malocclusion opened slightly and the patient was advised to pay close attention to tongue position.



Figure 5. Before and after open bite treatment



Figure 6. Posterior segmental intrusion

6. Conclusions

1. The use of the trainer "Infant" in complex orthodontic and speech therapy practice is effective only in patients in the period of milk occlusion. In children older than 5 years, a positive result was obtained from the use of the T4K trainer.
2. The younger the child with an open bite and speech impairment, the better it responds to treatment, and the results obtained are stable.
3. Microimplants are relatively simple and easy to insert, less traumatic, stable at optimal force, and allow force to be applied immediately after insertion. Other benefits include fewer restrictions at the implant site and lower costs.
The use of a posterior segmental intrusion has advantages in both efficiency and esthetics. If intrusion is performed using the continuous wire technique, undesirable tooth movement will occur as well as posterior intrusion. Splinting the posterior segment allows for a more direct and efficient force. Appliances do not need to be attached to the anterior segment during intrusion, allowing for more aesthetic treatment.
4. While micro-implant molar intrusion is an effective method for correcting open bite, it is not universal for all types of open bite.

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