

Review Article

Clenching exercise as additional orthodontic treatment in anterior open bite patients

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ABSTRACT

Background: Anterior open bite is a complex case of malocclusion that needs complex treatment. This malocclusion has a tendency to relapse, so the difficulty level of treatment is high. Clenching exercise began to be applied as an additional myofunctional therapy that can help correct anterior open bite and stabilize treatment results.

Purpose: This narrative review aims to explain clenching exercise as an additional orthodontic treatment in anterior open bite patients.

Review(s): The most essential step in open bite treatment is the retention period because the tendency for relapse is strong and difficult to predict. Surgical treatment can be used to achieve an anterior open bite, but this treatment does not guarantee the stability of the treatment outcome. To achieve retention in anterior open bite correction, it is essential to improve muscle function after treatment.

Conclusion: Clenching exercise can be an additional therapy in anterior open bite patients to shorten the treatment duration and maintain the stability of the treatment outcome.

Keywords: Clenching exercise, Anterior open bite, Muscle exercise, Malocclusions, Human and health

INTRODUCTION

Open bite is an anomaly with easily recognized characteristics. The absence of vertical contact between the maxillary and mandibular teeth characterizes an anterior open bite. There is no contact between the maxillary and mandibular incisor edges in the anterior open bite, indicating a negative overbite with occlusion of posterior teeth.^[1-3]

The prevalence of anterior open bite varies by age and race, ranging from 3.5% to 11%. An open bite is found in approximately 17% of orthodontic patients.^[3,4] Despite its low prevalence, An anterior open bite is a complicated malocclusion with a challenging course of treatment. In general, stability is an essential criterion in determining the open bite treatment because this type of malocclusion has a tendency to relapse.^[5] It is commonly found that the anterior open bite is due to a combination of skeletal and dental factors, even habit. Several etiological factors of open bite include facial growth patterns, mouth breathing, tongue thrusting, finger-sucking habits, ankylosis, certain syndromes, occlusal pressure and tooth eruption, mandibular posture imbalance, also adenoid hypertrophy. Other factors such as severity and initiation

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time of treatment can also make open bite correction and stabilization difficult to achieve.^[5]

In some cases, open bites can be reduced or corrected spontaneously without treatment (75–80%), especially in cases of transitional dentition. If treatment is required, mechanical orthodontic treatments that can be performed are: Palatal crib, camouflage treatment with premolars or first molars extraction, mini-plates, mini-implants, magnets, and orthognathic surgery. In fact, in some cases, myofunctional therapy is needed as additional therapy.^[1-3] However, a proper diagnosis and treatment plan are required before deciding on a course of action.^[5]

The success and stability of treatment depend not only on the balance of the teeth, but also on the pressure between the tongue, cheeks, and lips.^[6] Because of this, myofunctional therapy was presented to The American Society of Orthodontists in 1918 by Canadian Alfred Paul Rogers, a student of Angle, who attempted to apply the effects of functional stimuli to orthodontics, which had undergone surgical and orthopedic treatment. The use of muscle exercise in orthodontics has been considered a therapeutic agent for the prevention and correction of malocclusion and as an agent for maintaining occlusion through enhancing function.

Clenching exercise is a myofunctional therapy that is used as adjunctive therapy in anterior open bite patients. The masticatory muscles (musculus temporalis, masseter, medial, and lateral pterygoid) are used in clenching exercises, which can assist correct an anterior open bite and stabilize treatment results. This narrative review aims to describe clenching exercise as an adjunctive orthodontic treatment in anterior open bite patients.

REVIEW(S)

Anterior open bite definition

Vertical facial dysplasia can be caused by any changes in the vertical dimension. A more pronounced vertical dimension may result in an open bite. Caravelli created the term “open bite” in 1842 as a different classification of malocclusion, and it has a variety of definitions.^[7] Anterior open bite, also known as negative incisor overlapping, is the absence of vertical contact during centric occlusion between the upper and lower anterior teeth.^[1-3] Open bites can be divided into dental and skeletal types.^[2]

Clinical features and cephalometric

The anterior open bite patients have typical facial features that are seen in the longer 1/3 of the lower face, which is often referred to as the long-face syndrome. In addition, characteristics of anterior open bite patients are the downward and backward rotation of the mandible and

maxilla [Figure 1], superposition of posterior teeth, a steep mandibular plane (MP), incompetent lips, and normal eruption (or sometimes excessive) of the anterior teeth.^[1,3] Anterior open bite can occur in Class I, II, or III malocclusion.^[1-3]

Antegonial notching is common and the mandibular base is generally normal. The mandibular symphysis is long and narrow, the growth pattern is vertical, the ramus is short, and the gonial angle is large. David and Richard Smith in Munjal *et al.*, describe the diagnosis of an open bite based on cephalometrics and clinical diagnosis as follows: (1) MP angle (MPA) is steep; (2) Sella-Nasion-MPA of 40° or more; (3) Occlusal Plane (OP)-MPA of 22° or more; (4) Palatal Plane (PP)-MPA of 32° or more; (5) posterior facial height [Articulare (Ar) - Gonion (Go)] and anteroinferior facial height [Anterior Nasal Spine (ANS) - Menton (Me)] ratio of 58% or less; and (6) lower face height (ANS-Me) or a UFH/LFH ratio of 0.70 or less.^[7]

Sassouni in Munjal *et al.* refer to the horizontal anatomical plane as follows [Figure 2]: (1) anterior cranial base inclination; (2) Frankfort plane; (3) PP; (4) OP; and (5) MP. These planes' inclination toward one another identifies the face's vertical proportions. The incidence of open bite malocclusion is impacted if these planes diverge as they continue anteriorly so that the portion of the anterior face is long, and the posterior is short (skeletal open bite).

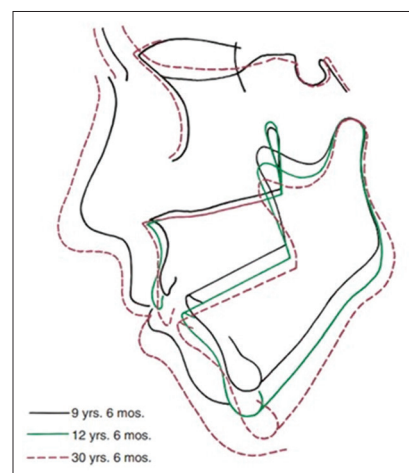


Figure 1: Superimposition of the cranial bases showing the mandibular rotation pattern in an individual with the long-face syndrome. When the mandible rotates downward, the anterior facial height increases so there is a tendency for an open bite. The incisor teeth will advance anteriorly relative to the mandible.^[3] Proffit WR, Fields HW, Sarver DM, Ackerman JL. Contemporary Orthodontics. 6th ed. USA: Mosby; 2019

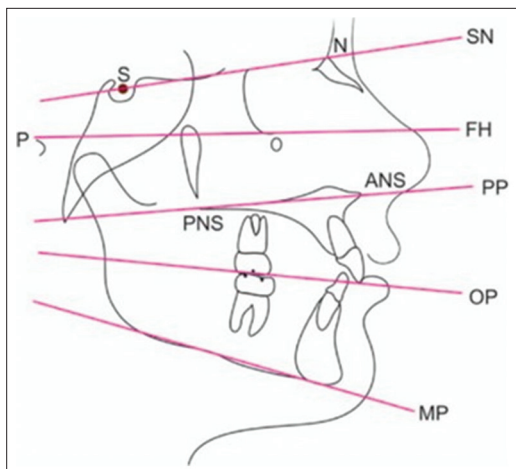


Figure 2: The horizontal plane according to Sassouni.^[7] Munjal A, Alo A, Abraham SA, Jini B. A review of an open bite. *Indian J Orthod Dentofac Res* 2021;7:277-85.

There is a tendency for an anterior deep bite if the lines are almost parallel, meet far back on the face, and then slightly diverge as they continue anteriorly (skeletal deep bite).^[7]

Cephalometric measurements as described above are very important to do in patients with open bites or with open bite tendencies in order to prevent treatment mechanics from actually causing the bite to open and or exacerbate the situation.

Anterior open bite etiology

The anterior open bite causes are multifaceted which can occur from a combination effect of dental, skeletal, and soft tissue. Anterior open bite results from the interaction of many causes, including genetic and environmental factors see Table 1 for various etiologies and explanation.^[8]

Anterior open bite management

Treatment for an open bite is closely related to the age of the patient, so the treatment of patients who are still in their growth period is aimed at modifying the vertical direction of growth through vertical molar control.^[9] Anterior open bite treatment will be easier in the primary dentition period because 95% only involve dental and very few involve the skeletal. Anterior open bite with a proportionate facial profile in children usually does not require treatment during the primary dentition phase. It is hoped that spontaneous correction will occur with the eruption of the incisors, especially the anterior open bite resulting from bad thumb-sucking habits.^[3] In the dental type, anterior open bite can be screened. Habitual control to minimize severity can be performed in primary dentition patients with skeletal-type anterior open bite. Besides, extraoral orthopedic appliances such as chin caps can also be used to direct growth.^[7]

Anterior open bite that occurs during the replacement dentition period is usually more difficult than with the primary teeth because there is a history of etiological bad habits that persist from the primary dentition period.^[1,2] In the replacement dentition phase, the treatments for anterior open bite that can be done are screening, using habit-breaking appliances, and myotherapy. Some anterior open bite cases can be corrected by adjusting the growth pattern. The aim of this treatment is to rotate the mandible clockwise to close the open bite, especially when the mandibular ramus is growing, which aims to achieve occlusion and a balanced profile and control the increase in anterior facial height. The goal of treatment is directed at controlling posterior tooth intrusion and/or vertical facial growth.^[7]

In the permanent dentition phase, functional devices, fixed mechanotherapy, and surgery can be performed for the correction of the anterior open bite.^[7] Orthognathic surgery in combination with fixed appliances is the standard treatment plan for skeletal-type anterior open bite. The temporary anchorage devices (TAD) were developed in recent years to correct anterior open bite. The development of TAD as an effective treatment allowed for the potential avoidance of orthognathic surgery in certain cases.^[10]

The retention period is the most essential step in an open bite treatment, both surgical and non-surgical, because the tendency for relapse is strong and difficult to predict. Anterior open bite can be reached through surgical treatment, but this treatment does not guarantee the stability of the treatment outcome. To achieve retention in anterior open bite, it is important to improve muscle function after treatment. Tongue thrust during swallowing must be controlled to increase stability.^[11] Orthodontic treatment aims not only at ideal tooth positioning but also at ensuring synchrony between the condylar position and occlusion, often assisting in re-establishing the lost equilibrium of the joint and muscles, which is frequently associated with malocclusion.^[12] Management of problems related to temporomandibular joint function and masticatory muscles is also important for stability. The mandible can rotate posteroinferior in the presence of temporomandibular disease, night teeth clenching, or bruxism disorders, and consequently relapse can occur after the treatment of an open anterior bite.^[11]

DISCUSSION

Anterior open bite has a multifactorial etiology. Some of them are the result of environmental factors or habits.^[3] In anterior open bite cases, control of mandibular rotation and molar extrusion is important to correct vertical dysmorphology. The key to treating open bite malocclusion is controlling of the vertical dimension by the molars intrusion of both maxillary and mandibular, and facilitating counter clockwise

mandible rotation. In anterior open bite, surgical therapy is necessary, especially if growth manipulation can no longer be done.^[13] In adult patients, orthognathic surgery is performed to rotate the mandible up and forward to correct anterior open bite and reduce anterior facial height. At present, the use of TAD together with miniscrews and miniplates has been used for the intrusion of maxillary posterior teeth.^[14] Several alternative therapies for anterior open bite cases provide a challenge for orthodontists to determine the appropriate therapy.

Patients who refuse orthognathic surgical procedures can be given non-surgical options such as habit control devices, anterior vertical elastics, vertical chin cups, high pull headgear, posterior bite blocks, and myofunctional therapy, such as clenching exercises.^[14] Myofunctional therapy, especially clenching exercise, began to be used as adjunctive therapy in addition to other therapies. Clenching exercise can be used as a control for molar extrusion. In anterior open bite cases, molar extrusion is something that must be prevented to avoid aggravating the patient's vertical dimension and downward and backward rotation of the mandible.

Park *et al.* in their study compared 50 patients were divided into: The group with orthodontic treatment only (group one), the group with orthodontic treatment and clenching exercise as an additional therapy (Group 2), and the group with no treatment (group three). The second group of patients were instructed to perform a clenching exercise (maximum intercuspation) as tightly as they could for 15 s, then repeat the procedure 4 times (total of 1 min). The orthodontist also instructed the patients in the second group to chew sugar-free gum as often as possible. Orthodontic treatment accompanied by clenching exercise resulted in a greater increase in overbite than orthodontic treatment without clenching exercise. However, in this study, there were no significant differences in gonial angle, MPA, the ratio of the posterior to the anterior face height, or the ratio of the lower face to the total face height.^[15]

Gross and Frech also submitted a case report on a similar topic in 2021. Gross and Frech performed a combination of miniscrews and clenching exercises in patients with Class II malocclusions. After 24 months, anterior open bite was corrected through a combination of anterior tooth extrusion and vertical holding of the posterior teeth (relative molar intrusion), miniscrew-supported transpalatal arch, and clenching exercise. Miniscrews are used to keep the upper molars in a stable position, and clenching exercises minimize the possibility of extrusion of the lower molars. Gross and Frech apply myofunctional therapy as follows:

1. Isometric clenching: 5 s isometric clenching (80% full pressure), 5 s rest. This takes 1 min/session, 3–4 times/day
2. Swallowing: retract the lips while looking in the mirror, swallow, and make sure the tongue touches the top of the

mouth and the posterior teeth are in occlusion, then rest for 5 s. This takes 1 min/session, 3–4 times/day

3. Active clenching: Looking in the mirror and placing the hands on the masseter and temporalis muscles, biting 5 times quickly without moving your lips, then resting for 5 s. This takes 1 min/session, 3–4 times/day.^[15]

Besides being used to control molar extrusion, clenching exercise is also used as an adjunctive therapy because anterior open bite is closely related to the orofacial muscles. The masticatory muscles (musculus temporalis, masseter, medial, and lateral pterygoid) are used in clenching exercises. These muscles are not only involved in mastication but also in speech and breathing processes.^[16,17] However, these muscles work at different percentages in different activities. Farella *et al.* wrote that based on the electromyography % max value, the temporalis muscle activity is higher than the masseter muscle in the intercuspation position, such as in clenching exercise. This is the opposite of static activities such as incisal biting (protrusion and laterotrusion of the contralateral jaw). In chewing activities, almost all of these muscles work at high intensity.^[17]

In patients with hyperdivergent or long face syndrome, the ability to achieve maximal masticatory strength is lower than in individuals with normal vertical dimensions or individuals with hypodivergent or short-faced individuals. Differences in occlusal strength between the long and normal faces were statistically significant during maximal swallowing, chewing, and biting.^[3] In addition, patients with long-face syndrome have masticatory muscles that are smaller and weaker than normal. Weak masticatory muscles result in low occlusal forces and are directly related to craniofacial skeletal dysmorphology. The low occlusal forces especially in the posterior create a favorable environment for the molars to supraeruption as the mandible rotates downward and backward.^[15]

Patients with dolichofacial pattern and anterior open bite have poor masticatory function because their high mandibular angle is associated with weak masticator muscles. The cross-sectional area of the masticatory muscles decreases as a result of downward and backward mandibular rotation, increased vertical bone growth, and posterior dentoalveolar tissue, which results in a decreased maximum bite force.^[18] Several findings also show that forces originating from the masticatory muscles are not a major etiology affecting tooth eruption and are not an etiological factor in the occurrence of an open bite or deep bite. Low chewing strength is considered an effect and not a cause of an open bite.^[3]

Corrêa *et al.* conducted a study using the colorimetric capsule method to evaluate masticatory muscle strength in anterior open bite patients. Children aged 7–11 years were instructed to chew one capsule for 20 s. Children with anterior open bites presented specimens which had lower

Table 1: The etiologies of an open bite.

S. No.	Etiologies	Explanation
1.	Dental open bite	According to Johnson and Larson in Agbaje <i>et al.</i> , Non-Nutritive Sucking such as prolonged sucking on fingers, pacifiers, and other objects (over 3 years of age) is one of the main factors in the occurrence of open bites. ^[8] If this habit continues until the permanent dentition begins to erupt, then malocclusion can occur, namely, proclination of the upper incisors, diastema, open bite, narrow upper arch, and retroclination of the lower incisors. The malocclusion that occurs is determined by which finger is sucked and how the patient places his finger when sucking. ^[3]
2.	Skeletal open bite	Open bite, which results from vertical overgrowth, usually has a more severe clinical presentation than dental open bite. Hellman in Agbaje <i>et al.</i> used anthropological measurements and found that subjects with open bites had shorter rami and greater total facial height. In another study by Schudy, clockwise mandibular rotation was found to be the result of vertical overgrowth associated with horizontal growth. Genetic and environmental influences that promote vertical growth in the molar area are not compensated for by the growth of the condyle or posterior ramus, resulting in a skeletal-type anterior open bite. Adverse functional habits such as mouth breathing can exacerbate open bites. ^[8]
3.	Habitual tongue and lip	Tulley based his classification of tongue thrusting largely on the facial morphology and swallowing activity as either an endogenous habit or an adaptive behavior. As an adaptive response to an anterior open bite, the tongue is pushed forward during swallowing to prevent food, liquids, or saliva from escaping the anterior part of the mouth. Several studies have found a correlation between a long face and weak facial muscles, and between an anterior open bite and tongue position. An open bite may be associated with neuromuscular imbalance or diverging growth patterns, but this is not known with certainty. ^[8]
4.	Airway obstruction	The respiratory pattern is a major determinant of jaw and tongue posture. Therefore, it makes sense that altered breathing patterns, such as mouth breathing, can change the posture of the tongue, jaw, and head. This can change the balance of pressure on the teeth and jaw and affect tooth position and jaw growth. ^[3] Several researchers have shown that mouth breathing can change facial characteristics due to an increase in vertical facial growth patterns, open bite, and crossbite. ^[8] The habit of breathing through the mouth can be caused by chronic airway obstruction, the result of long-term nasal mucosal inflammation induced by allergies or chronic infections. ^[3]
5.	Neurological disorder	Carmagmani in Agbaje <i>et al.</i> reported a 64% incidence of anterior open bite and increased overjet in patients with cerebral palsy. However, it is not clear whether the neurological injury can be the cause of changes in patterns of craniofacial growth and development that result in malocclusion in cerebral palsy patients. ^[8]
6.	Muscular dystrophy	Vertical dentofacial aberrations have been observed in patients with muscular dysfunction, such as that seen in myotonic dystrophy. Similarly, a high of anterior open bite prevalence has been noted in Duchenne Muscular Dystrophy patients, which is strongly associated with orofacial muscle involvement. ^[8]
7.	Iatrogenic open bite	Errors in deep bite treatment using fixed orthodontics can cause molar extrusion and incisor intrusion, resulting in anterior open bite. Failure to prevent second molar extrusion when using a bite plane or functional appliance can also result in anterior open bite. ^[8]
8.	Pathological open bite	Anterior open bite can be associated with cleft lip and palate, acromegaly, or facial skeleton trauma, such as disruption of the condyle fusion process and bilateral fractures of the mandible. ^[8]

fuchsin concentration values compared to the control group. These results suggest that children with anterior open bites have less efficient mastication than children with normal occlusion.^[18]

The success and stability of treatment depend not only on the teeth but also on the pressure balance between the tongue, cheeks, and lips.^[6] Myofunctional therapy is used to restore function and train the muscles around the face and oral cavity in resting positions, swallowing, and speaking. The result of anterior open bite treatment will be more stable if

the masticatory muscles are in a harmonious and balanced condition. Likewise, the masticatory muscles will improve if anterior open bite is corrected. Regarding the already-corrected anterior open bite case, it was found that the activity of the masticatory muscles was higher and more harmonious. This becomes the basis that routinely performing clenching exercises during anterior open bite treatment can increase the strength of the masticatory muscles so that their activities become more balanced, and correction of anterior open bite is achieved more quickly.

CONCLUSION

Harmonious and balanced conditions of the teeth and masticatory muscles are the keys to successful orthodontic treatment. Clenching exercise can be used as an important adjunct therapy in anterior open bite cases because it can be used to control molar extrusion and increase masticatory muscle strength, especially for patients with a high level of adherence. With clenching exercise, it is hoped that the anterior open bite will be corrected more quickly and the likelihood of relapse will be reduced.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

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Conflicts of interest

There are no conflicts of interest.

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