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Review article

Orofacial Myofunctional Therapy Effectivity in Child's Anterior Open Bite

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Abstract

Background: Anterior Open Bite (AOB) is a malocclusion condition characterized by the absence of contact between the upper and lower anterior teeth, resulting from oral bad habits for a long time or abnormalities in skeletal patterns. AOB leads a lack of confidence in children because of the difficulty for lip sealing and the unclear pronunciation function. AOB occurs in children and continues into adulthood so it needs to be treated early on at the age of growth and development. One method of treating AOB is Orofacial Myofunctional Therapy (OMT) which is a method to improve the stability of the stomatognatic system by involving the exercise of the facial and neck muscles.

Aim: Literature Review (LR) writing aims to find out the effectiveness of OMT in the case of AOB children, how the treatment is carried out and the problems that occur during OMT.

Mini-Review: OMT increases the activity of the masseter and buccinator muscles, and decreases the contraction of the lip muscles that the lips may seal. OMT is able to increase the ability to hold the tongue to stay in contact with the palate so there is no obstacle to the eruption of the lower insisivus tooth and AOB can be corrected. Results: Orofacial Myofunctional Therapy (OMT) is effective for the correction of a child's Anterior Open Bite (AOB) as a combination therapy with the use of orthodontic tools or myofunctional equipment, especially in children older than 12 years of age and craniofacial deformity has occurred.

Keywords: Orofacial myofunctional; Child; Growth and development; Anterior open bite.

Introduction

In the era of globalization, the demands and services of orthodontic care for children continue to increase over time. Initially, they focused more on orthodontic curative action against malocclusion in children, but today more demand and services have shifted to prevention and early orthodontic care [1-4]. In the case of orthodontic services for children, it indicates different service

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patterns; both at the stages of preventive, interceptive and orthodontic curative services [4]. In fact, the development of orthodontic in children, especially in preventive orthodontics and interception has been in line with government programs in the dental and oral health services in a tiered and integrated manner; however, its implemetation is still a complex problem, [4-6] The current orthodontic care system has delivered satisfactory results, but there are still difficult cases that are proven to be treated. There are still some bad habits that accompany myofunctional in a child, such as finger sucking, posture problems and tongue placement when swallowing, and abnormal breathing patterns [7] included in the treatment of anterior open bite in children.

Anterior Open Bite is a malocclusion condition that often occurs in children. The prevalence of AOB is 16.52% in children and adolescents aged 2-16 years [8]. The prevalence of primary dentition AOB is 16.9% and mixed dentition is 11.3%. The habits of sucking, tongue thrusting, and oral breathing are the main risk of AOB in the firstborn teeth, in mixed dentition, the habits that often cause AOB are sucking pacifiers, sucking lips, tongue thrusting, and breathing with the mouth [9].

Treatment for AOB correction includes the use of removable, fixed and functional appliance, which the aims are inhibiting mechanical factors (such as thumb sucking or sticking out the tongue) that cause open bites to continue to exist and limiting excessive vertical growth of the craniofacial skeleton [10-12]. The principle of the use of oral myofunctional therapy devices is highly recommended for use in the growth and development of children. Treatment that begins at the mixed dental stage can increase effectiveness, minimizing the need for orthodontic treatment with permanent tooth extraction or orthognatic surgery has been widely reported [13]. Some publications state that early interceptive treatment in AOB patients with a deviated and persistent swallowing pattern may use Orofacial Myofunctional Therapy (OMT) [14-17] Other authors also state that the normal oral function is re-established after OMT in patients with myofunctional disorders such as tongue thrusting [18,19].

Although the use of tools is effective in making AOB corrections, including can eliminate oral bad habits, OMT remains a treatment option. This is based on cost efficiency considerations and gives a sense of comfort because it does not use tools in the mouth [20]. OMT can also provide effective results when done during desidui teeth and teeth mixed and become an adjunctive treatment [21,22].

The purpose of writing this literature review is to find out the effectiveness of OMT in the case of AOB children, how the treatment is carried out, and the problems that occur during OMT.

Literature review

Anterior Open Bite (AOB) is a condition in the oral cavity, characterized by no contact or deficit of normal vertical contact between antagonistic teeth in the arch of the anterior tooth [23-25]. AOB causes a variety of aesthetic and functional changes that interfere with the grip and cutting of food. It also causes problems in articulating certain phonemes. These changes can lead to poor psychosocial conditions. Some clinical problems due to malocclusion are permanent insisivus tooth injury of the upper jaw during growth, periodontal damage, difficulty closing the lips normally,

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and social influences such as lack of confidence in the child.

Open bites are classified into skeletal open bites and dental open bites. Dental open bites are localized to the anterior teeth and the surrounding soft and hard tissues without showing bone defects in cephalometric radiography, while skeletal open bites exhibit vertical disharmony in cephalometric radiography [27,28].

A number of habits may lead to AOB [29,30] but if the habit is performed only until the period of primary or mixed dentition will not have a negative effect [31,32]. AOB can develop in permanent dental periods [33-35]. In the age range between 6-8 years, AOB is the dominant type of malocclusion [36]. In the early days of mixed dentition, 39.1% of children did not have either contact between the upper and lower insisivus teeth or palatal gingiva, while 4.6% had no incisal overlap [37].

The habit of sucking fingers, nipple milk bottles, and tongue including the habit of tongue thrusting, as well as upper airway obstruction are the main cause of AOB [38-40]. All habits involving obstruction mechanisms can inhibit tooth eruption or allow continuous dental supra-eruption that causes less incisal contact, affect the tongue reducing pressure on the maxillary and can dilate the mandible. An imbalance between the tongue and perioral muscle pressure can lead to a cusp-to-cusp relationship, the mandible is in a clockwise rotational position and contact of the incisive tooth is obstructed. The habit of sucking fingers can cause negative pressure and worsen unwanted forces. However, muscles are thought to have a stronger influence. The habit of placing the tongue by pushing forward when swallowing also plays a role in causing AOB. When AOB is present, the habit of sucking produces proalveolus that blocks the closure of the lips when swallowing and the placement of the tongue in an abnormal position, especially at rest. Dental shifts in AOB often occur due to a lack of balance between the strength of the tongue muscle (centrifuge) and the lip and cheek muscles (centripetal). As the balance of muscle strength deteriorates, the shift of the tooth and the alveolus of the tooth causes anterior injury. The loss of balance is caused by a decrease or increase in the strength of muscle components or the result of reduced closure and increased overhang due to poor sucking habits. In Skeletal Anterior Open Bites (SAOB), when the vertical component of facial growth is disproportionately larger than the horizontal component, there is an increase in the angle of the Frankfurt-Mandibular Plane (FMPA). AOB arises from an eruption of labial teeth that cannot compensate for the increase in interoclusal distance. The resulting open bite will usually be symmetrical and, in most extreme situations, only the posterior molars will be in occlusion [43,44].

Orofacial Myofunctional Therapy (OMT) is re-education of muscle function to improve the function of suffocation, tongue, habit of breathing through the mouth and posture of lips, tongue and cheeks at rest [45]. OMT includes cervical and facial muscle exercises for proprioceptive, tone and movement enhancement, [46-50] including exercises that support the tightening and endurance of the mouth muscles [51,52]. OMT re-education trains normal and strong sucking skills, good sanctification using both sides of the jaw, normal swallowing, tongue in a normal position, and nasal breathing with lips in good contact at rest [53].

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Method

Journal samples are determined by inclusion criteria, namely children in primary and mixed dentition, with Anterior Open Bite (AOB) or incompetence of the lips closure. Exclusion criterias are review articles and case reports**.**

Search method

Journal searching uses electronic databases through Pubmed, Science Direct, Wiley Online Library portal and manual searching.

Search details

Journal search using keywords: "anterior open bite" AND "myofunctional therapy" AND children.

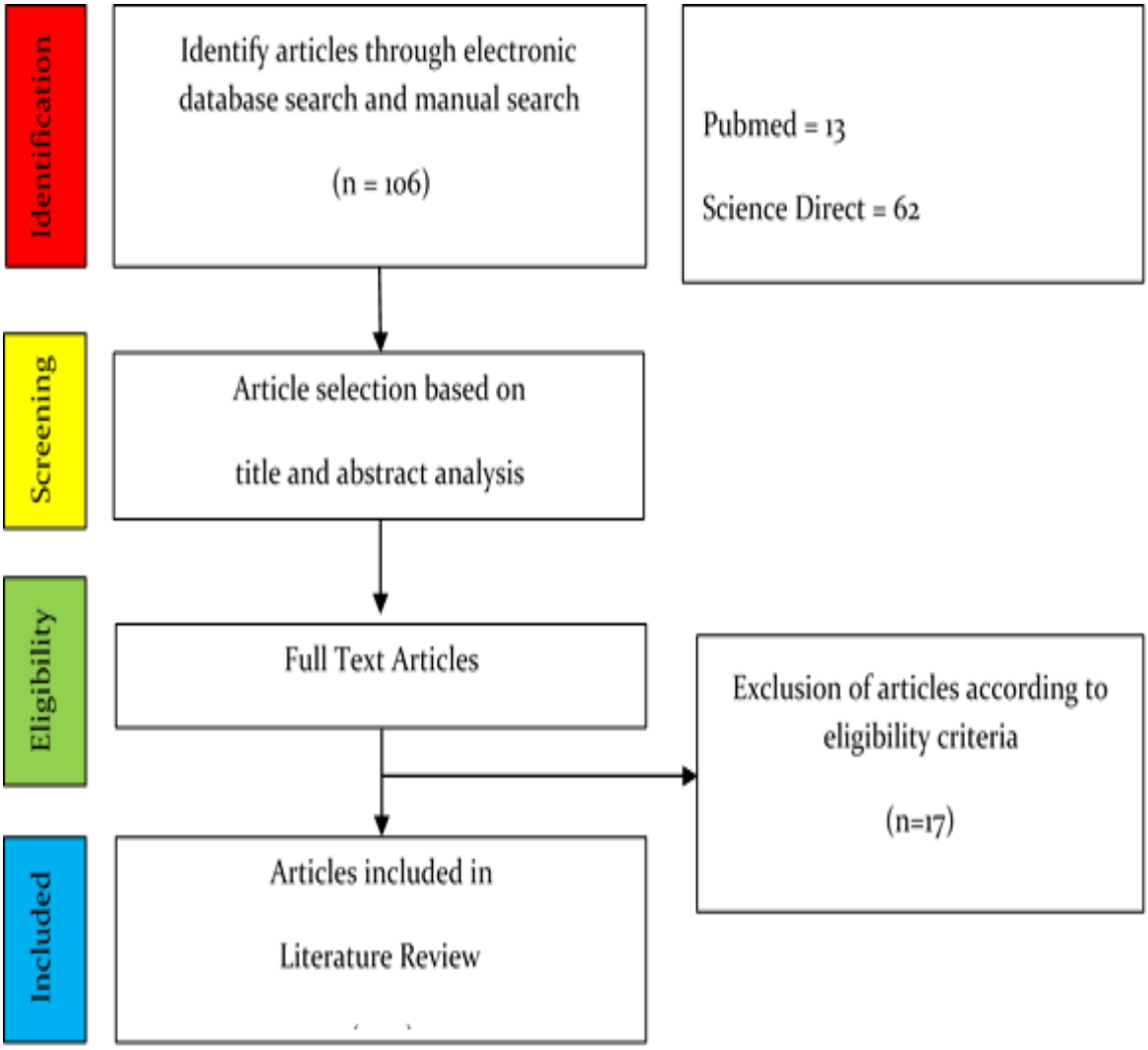

Figure 1: Complete data search process flow chart.

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NO	AUTHOR	TITLE	INTERVENTION	RESULT	CONCLUSION
1	Daglio, S., et. al., (1993)	Orthodontic Changes in Oral Dyskinesia and Malocclusion under The Influence of Myofunctional Therapy	Group A=undergoing Myofunctional Therapy (MT)=13 children Group B=undergoing treatment with orthodonthic appliance and Myofunctional Therapy (MT)=15 children	Group A: Reduction of overjet from 3.5 to 2.6 mm; the base angle of the mandible decreased from 30° to 28.31°; The angle of ANB decreased from 4.4° to 2.7°; statistically significant changes; better results with overbite correction, an average of -2.46 to 3.06 mm Group B: Reduction of overjet from 6.6 to 2.6 mm; overbite increased from an average of -1.2 to +2.9 mm; the base angle of the mandible decreased from 31.2° to 27.8°; ANB angle reduced from 7.3° to 3.7°	Orofacial dyskinesia can effectively be treated with a combination of orthodontic use and myofunctional therapy rather than only being treated using myofunctional therapy.
2	Erbay E, et. al., (1995)	The Effects of Frankel's Function Regulator (FR-4) Therapy on the treatment of Angle Class I Skeletal Anterior Open bite Malocclusion	Group 1: control (without treatment)=20 children Group 2: lip-seal training and use of FR-4 appliance=20 children	AOB closure in group 1(control)=from -3.5 mm to -2.1 mm (average increase of 1.4 mm) AOB closure in group 2=from -3.95 mm to 1.1 mm (average increase of 5 mm)	AOB correction significantly occurs in the use of FR-4 and lip training through rotation of the mandible up and forward.

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3	Lembrechts D, et. al., (1999)	Effect of a Logopedic Instruction Program after Adenoidectomy on Open Mouth Posture: A Single-Blind Study	Control group: only undergoing adenoidectomy treatment=87 children Case group: undergoing adenoidectomy treatment and logopedic instruction program=72 children	In the control group, spontaneous lip closure after adenoidectomy of 2 months by 14% and after 1 year by 25% In the case group, lip closure occurred after adenoidectomy and logopedic instruction program by 2 months by 37% and after 1 year by 38%.	There was a significant change in lip closure after 2 months of adenoidectomy and logopedic instruction program. Children who can blow with their nose, do not have a habit of dripping saliva, do not have the habit of sucking thumbs or fingers, have a normal lower lip, are able to lift the tongue and are able to perform tongue control in good condition to start a logopedic instruction program and give better results than children who have bad mouth habits.

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	Schievano D, et. al., (1999)	The 13 children were divided into 4 groups, based on morphological evaluation of the lower lip, chin, evaluation of respiration function, chewing and swallowing. Each group is scored according to 4 levels of alteration (0-4 alteration=no alteration–severe alteration) Furthermore, Myofunctional Therapy (MT) is carried out by training the lips, tongue, chin area and chewer muscles, especially isometric procedures, facial massage especially in the chin area, and re-education of feeding (at least 30 minutes every week for 9 months)	There is a significant RMS comparison between the position of the resting lip and the closed lip before therapy (rate=1%), indicating an increase in the value of muscle electrical activity (RMS). There was a statistically significant difference in electrical activity in the lips at rest and lips closed at a rate of 5%, suggesting that it required a decrease in muscle activity to close the lips before and after therapy. RMS values were similar in both situations analyzed, even when the muscles were not rehabilitated. There was a difference in electrical activity (significant at 5%) in the lips at rest and the lips closed earlier and after myofunctional therapy. Myofunctional therapy affects these muscles due to a decrease in muscle activity that is required to hold the lips together.	There is a significant RMS comparison between the position of the resting lip and the closed lip before therapy (rate=1%), indicating an increase in the value of muscle electrical activity (RMS). There was a statistically significant difference in electrical activity in the lips at rest and lips closed at a rate of 5%, suggesting that it required a decrease in muscle activity to close the lips before and after therapy. RMS values were similar in both situations analyzed, even when the muscles were not rehabilitated. There was a difference in electrical activity (significant at 5%) in the lips at rest and the lips closed earlier and after myofunctional therapy. Myofunctional therapy affects these muscles due to a decrease in muscle activity that is required to hold the lips together.	MT improves clinical and electromyographic outcomes significantly and shows a positive influence of myofunctional therapy on the perioral muscles. This therapy reduces the activity of the perioral muscles resulting in a lip closure posture.

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5	Cayley AS, et. al., (2000)	Electropalatographic and Chepalometric Assessment of Myofunctional Therapy in Open-Bite Subjects	Tongue Re-education Therapy in 4 sessions (each session=20 minutes)	5 children with Anterior Open Bite (AOB)=0-6 mm; 2 AOB children have no change; 1 AOB child=5.5 mm -->5 children with AOB are correct, 3 children need follow-up care	Treatment has successfully improving tongue function during swallowing and lowers anterior open bite (AOB).
6	Korbmacher HM, et. al., (2004)	Evaluation of A New Concept of Myofunctional Therapy in Children	MFT group = conventional myofunctional therapy (speaking practice)=13 children Face Former Therapy (FFT) group=Tongue and lip traning using Flexible Silicone Appliance=15 children	There was a very significant change in lip strength based on the length of therapy in each group. However, there was no significant difference in lip strength between the groups based on the duration of treatment. Within 6 months of observation, Face Former Therapy (FFT) showed success faster than Myofunctional Therapy (MFT).	Face Former Therapy (FFT) achieves an increase in lip closure strength in a shorter time than Myofunctional Therapy (MFT)
7	Degan VV, and Puppin-Rontani RM. (2005)	Removal of Sucking Habits and Myofunctional Therapy: Establishing Swallowing and Tongue Rest Position	Myofunctional Therapy Group and Counseling (TMF)=10 children Modified Counseling Group (REM)=10 children	60% of TMF samples showed better resting tongue position at 3rd evaluation (180 days) than REM samples by 0% 80% of TMF samples showed normal swallowing patterns at evaluation to -3(180 days) rather than REM samples by 50%	Myofunctional therapy (TMF) associated with eliminating the habit of sucking showed improved swallowing patterns and better and faster tongue resting positions

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8	Smithpeter J, and Covell D (2010)	Relapse of Anterior Open Bites Treated with Orthodontic Appliances with and without Orofacial Myofunctional Therapy	Experimental group: received Orofacial Myofunctional Therapy (OMT) and orthodontic treatment=27 children (before, during and after relapsing orthodontic treatment) Control group: history of orthodontic treatment with relaps anterior open bite (AOB)=49 children	There was a significant difference in anterior open bite (AOB) relapsing between the experimental group and the control group, where the experimental group occurred relaps AOB=0.5 mm, while the control group=3.4 mm	The combination of OMT and orthodontic treatment effectively maintains anterior open bite closure versus single orthodontic treatment.
9	Huang B, et. al., (2015)	Influence of Non-Orthodontic Intervention on Digit Sucking and Consequent Anterior Open Bite: A Preliminary Study	Experimental group=Non-Orthodontic Intervention (NOI)/Stomahesive Wafer Spot + tongue instruction=77 children Control group=14 children	From 77 children in the experimental group, the number of children with anterior open bites (AOB) decreased from 37 (51.4%) to 12 (16.7%) at the end of NOI treatment; Among 32 patients with a measured overjet, the average overjet decreased from 4.2 mm to 3.1 mm after NOI treatment; Children who received NOI were more likely to quit the habit of sucking fingers within a 4-month period and more likely to appear without an Anterior Open Bite (AOB) in a 4-month period.	There is clinical relevance to NOI in finger sucking habits, AOB closure and overjet reduction

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10	Van Dyck C, et. al., (2016)	The Effect of Orofacial Myofunctional Treatment in Children with Anterior Open Bite and Tongue Dysfunction: A Pilot Study	Orofacial Myofunctional Therapy (OMT)=10 children (Myo=6; Combi exp=4) Non OMT=12 (Con=6;Exp=6); Children with AOB are included in the OMT group- Myo=6 people and Non OMT - Con=6 people; Children with crossbites fall into the Myo group - Exp=4 people and Non-OMT-Exp=6 people	At the beginning of therapy (To), 31.8% of children did not have vertical overlap of the lower and upper insisivus teeth. Other individuals (68.2%) had non-anterior occlusion/AOB After 6 months (T1), 10% of OMT subjects and 8.3% of non-OMT subjects had lower insisivus tooth contact with their antagonists. This difference is not significant. After 12 months (T2), there is a significant difference in AOB correction between Both groups were 60.0% of THE OMT group and 8.3% in the non-OMT group.	OMT positively affects tongue behavior

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11	Hong H, et. al., (2021)	Electromyographic Features and Efficacy of Orofacial Myofunctional Treatment for Skeletal Anterior Open Bite in Adolescents: an Exploratory Study	Skeletal Anterior Open Bite (SAOB) group=18 children Normal occlusion group=18 children	Orofacial Myofunctional Status (OMS): SAOB morphological image shows more than normal facial height and greater degree of protrusive insisivus Orofacial Myiofunctional Therapy (OMT): mental muscle activity (MEA) at rest and anterior temporal activity (TAA), masseter muscle activity (MAA) and anterior gastrical activity (DAA) in the intercuspal position (ICP) increases, while upper orbicularis activity (UOA) and mental muscle activity (MEA) decreases.	SAOB subjects showed abnormal OMS images including distorted swallowing patterns and weak discharge muscles, which are interrelated to the picture of craniofacial dysmorphology including greater anterior facial height and insisivous protrusiveness. OMT as one of the orthodontic adjuvant therapies is beneficial for the treatment of SAOB.

Table 1: Synthesis Table.

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Data Collection and Data Analysis

The author collected 106 articles through an electronic data base and manual search according to the keywords. The author assessed the title and abstract of the journals resulting from the search. The relevant title and abstract were selected with the result that 28 articles were obtained. The author read the full-text article to determine that the study met the inclusion criteria. Studies that meet inclusion criteria then underwent quality assessment and data extraction. The author reviewed selecting 11 articles that included the synthesis table.

Discussion

This literature review discusses the effectiveness of Orofacial Myofunctional Therapy (OMT) in Anterior Open Bite (AOB) of children. From the 11 studies, 6 journals stated that correction of AOB can be performed through a combination of OMT with myofunctional appliance, orthodontic appliance and post adenoidectomy treatment. Four journals showed the effectiveness of OMT as a single therapy. One journal showed the use of myofunctional appliances was more effective than OMT in performing AOB corrections.

According to Daglio et. al., 1993[43] malocclusion (open bite, anterior slit position and cross bite) can occur in neuromuscular disorders. Maloclusion can be treated with a combination of orthodontic use and myofunctional therapy compared to myofunctional therapy alone, by affecting the activity of the tongue muscles compared to the lip muscles, buccinators and facial muscles.

In Skeletal Anterior Open Bite (SAOB), the mandible grows and develops downward and backward. Erbay et. al., 1994 [44] showed that by using FR-4 and lip-seal training tools, the rotation of the mandible forward and upwards resulted in SAOB correction. Lip-seal training can activate and increase muscle tone, that the lips are able to close and mandible is held in the right position. Hong et. al., 2021 [45] show SAOB has an abnormal Orofacial Myofunctional Status (OMS) including distorted swallowing patterns and weak involuntary muscles, related to more than normal facial height and the presence of protrusive insisivus.

AOB may result from Obstructive Sleep Apnea (OSA). OSA causes children to tend for oral breathing that the lip posture is not able to close. The most common therapy is adenoidectomy. Lembrechts et. al., 1999 [46] stated that there was lip closure after 2 months of adenoidectomy and the administration of training instructions to close the lips and breathe with the nose (logopedic).

Smithpeter and Covell 2010 [47] stated that OMT is needed as an additional treatment after the use of orthodontic applaiance to prevent AOB relapsing. OMT is performed before, during and after using the appliance as an orofacial muscle therapy and eliminates oral bad habits.

OMT as a single therapy was performed by Cayley et. al., 2000 [48] and Van Dyck et. al., 2016 [49]. There is a downward trend of AOB and further eruption of upper and lower insisivus teeth after OMT is performed. Schievano et. al., 1999 [50] showed that OMT can decrease perioral muscle activity so that the lips are able to close. Decreased muscle activity is seen from the clinical picture through

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electromyography. While Degan and Puppin 2005 [51] stated that eliminating oral bad habits shows a pattern of thickening and posture of the tongue at rest is better. Huang et. al., 2015 [52] showed that eliminating oral bad habits using Non-Orthodontic Intervention (NOI) effectively decreased AOB and reduced overjet. Reduced overjet implies backward movement, or rotation, of upper incisors. Due to the sensation of a foreign body, a stomahesive wafer place attached to sharp papillae can cause the tip of the tongue to touch that spot, divert the subject from insertion of the thumb or other finger into the mouth, and stop oral bad habits.

Correction of AOB using combination treatments is indicated in neuromuscular disorders, SAOB, OSA and post-use stabilization of orthodontic devices. Effective combination treatment is performed in children up to the age of 18 years. Correction of AOB using a single OMT in children aged <10 years indicates early treatment of AOB in children of growing age is able to prevent maloclusion to reduce the need for orthodontic care in adolescence. The use of myofunctional equipment is considered effective in repairing AOB compared to OMT without tools because the use of appliance is carried out for a longer duration than OMT and works directly on the orofacial muscle.

OMT has the effectiveness of correction of AOB by increasing the activity of the masseter and buccinator muscles, as well as decreasing the contraction of the lip muscles so that the lips are able to close. OMT is able to increase the ability to hold the tongue to stay in contact with the palate so that there is no obstacle to the eruption of the lower insisvus tooth and AOB can be corrected. AOB children have a wider pattern of tongue surface contact with palate because it involves the posterior and lateral sides of the tongue. In a normal swallowing pattern, only the tip of the tongue touches the palate behind the insisal papillae, while in AOB children the tongue is pushed into the open bite area so that contact occurs to the posterior and lateral parts of the tongue. In addition to AOB correction, OMT also has an effect in eliminating oral bad habits.

Based on these researches, it can be said that Orofacial Myofunctional Therapy (OMT) is effective in correcting a child's Anterior Open Bite (AOB) as an adjunct therapy or combined with the use of orthodontic or myofunctional appliance, especially in children over 12 years of age and craniofacial deformities have occurred. OMT is used as a single therapy when the child is still in the stage of growth and development.

Conclusion

Based on the analysis of literature reviews in related journals, it can be concluded that:

1. Orofacial Myofunctional Therapy (OMT) is effective for increasing facial muscle activity, decreasing perioral muscle contractions and improving tongue posture
2. OMT effectively eliminates bad mouth habits especially in relation to correction of Anterior Open Bite (AOB)
3. The effectiveness of OMT is used as a single therapy to eliminate children's bad habits and correction of AOB, especially while still in the stage of growth and development and there has been no craniofacial deformity

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4. The effectiveness of OMT as an adjuvant therapy or combination with orthodontic treatment especially if there has been maloclusion or craniofacial deformity

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Conflict of interest

The author states that this manuscript has no conflict of interest.

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