

Advantages of Interceptive Orthodontic Treatment; Rapid Maxillary Expansion in Children with Malocclusion Resulting from Mouth Breathing Habits

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Abstract

Background: One of the causes of malocclusion in developing children is the practice of mouth breathing. Morphological disturbances may occur during the growth phase in children with chronic mouth breathing. This resulting in the unfavorable development of dentofacial and craniofacial complexes.

Mouth breathing in children as a condition has come to the attention of health care professionals. Malocclusion incidence will be decreased and eventually eliminated with the early identification and treatment of these poor oral habits.

Purpose: The study determines the benefits of interceptive orthodontics Rapid Maxillary Expansion treatment in children with malocclusion caused by the habit of mouth breathing. Methods: Data were gathered by searching and analyzing literature from electronic databases PubMed, Wiley, and Science Direct in the 2012 and 2022 publication period. Interceptive orthodontics; rapid maxillary expansion; mouth breathing; malocclusion and children keywords were used to conduct the systematic search of the data.

Results: One of the most frequent malocclusions is caused by the practice of mouth breathing which narrows the maxillary arch. Some of the characteristic features are decreased distance between nasal cavity's lateral walls, bilateral or unilateral posterior crossbite, crowding of the anterior teeth, and deep palate.

Keywords: Interceptive orthodontic; Rapid maxillary expansion; Mouth breathing; Malocclusion; Children.

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Receiving Date: 08-05-2022

Accepted Date: 08-18-2022

Published Date: 08-29-2022

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Background

Malocclusion is prevalent in all the age groups within the range of 20% to 93% with common occurrence among children. The factors responsible for malocclusion include local factors such as oral bad habits, environmental factors and genetics and, or both together. One of the causes of malocclusion in developing children is oral poor habits [1]. Oral bad habits during childhood and adolescence interfere with the muscles and jawbones' normal growth and development [1]. Health practitioners all around the world are now aware of a number of comorbid conditions that are linked to children's mouth breathing as a condition [2]. Breathing through the mouth due to pathological condition is usually cause by upper respiratory tract obstruction due to several mechanical factors, including tonsillar hyperplasia, nasal polyps, septal deviation, palatine and pharyngeal hypertrophy, allergic rhinitis, tumors, infectious or inflammatory diseases [2,3]. Snoring and sleep disruption are among the symptoms, with sleep breathing disturbances being a sign of severe cases. The spectrum of respiratory disorders during sleep includes OSA i.e., Obstructive Sleep Apnea and UARS i.e., Upper Airway Resistance Syndrome. Lyra et al. in the 2020 survey, reported that 33.3% children with malocclusion suffers from sleep-disordered breathing [2]. The habit of mouth breathing is known to cause several functional transformations such as changes in the position of the tongue and imbalance of the perioral muscles which in turn affects facial development [2].

Morphological disturbances may occur during the growth phase in children with chronic mouth breathing. This resulting in the unfavorable development of dentofacial

and craniofacial complexes [3]. One of the most typical malocclusions is called maxillary constrictions, which is a narrowing of the maxillary arch. Some of the characteristic features are decreased distance between nasal cavity's lateral walls, crowding of the anterior teeth, bilateral or unilateral posterior crossbite and deep palate [4]. Apart from aesthetic problems, facial development also has a significant impact on the psychology and lifestyle of patient. Early detection and therapy of these bad oral habits will help reduce and eliminate the incidence of malocclusion [1]. For long term and short-term benefits early detection followed by timely treatment for malocclusion is essential in the mixed dentition period. Interceptive orthodontic treatment, is typically done during mixed dentition stage, corrects mild malocclusions involving one to four teeth.

Rapid Maxillary Expansion (RME) is a dentofacial treatment used for oral breathing treatments, reshaping the hard and soft tissues of the maxillofacial region, improving airway and ventilation, and other dentofacial disorders. The technique is to expand the maxillary bone by separating the mid-palatal suture, thereby correcting the narrowed maxillary arch, and reducing the palatal depth [2]. Given that the maxillary bone accounts for around 50% of the nasal cavity's anatomical structure and existence of strong relationship between the maxilla and nasal cavity, changes in the maxillary bone can also cause changes in the nose such as lateralization of the turbinate and an increase in nasal volume that can lead to improved nasal breathing [5].

This systematic review evaluates the advantages of Rapid Maxillary Expansion (RME) for the treatment of malocclusion in children caused by mouth-breathing habits.

Methods

Information sources

Data is gathered through electronic search. PubMed, Cochrane, Wiley, Science Direct, and Google Scholar were used as the sources for the data searches, and the data were collected using a publication time range of 2012-2022. The following keywords were used to gather the data: interceptive orthodontic; rapid maxillary expansion; mouth breathing; malocclusion, children.

Search criteria

A. Inclusion criteria

- Articles published from 2012-2022
- Articles published online
- Articles in the form of research journals and those related to interceptive orthodontic; rapid maxillary expansion; mouth breathing; malocclusion; children

- Articles in English

B. Exclusion criteria

- Articles under 2012
- Articles cannot be accessed
- The articles discussed the effects of adherence to the use of other types of appliances in the treatment of malocclusion due to breathing habits
- Articles in Indonesian or other language than English
- Articles in the form of books, literature reviews, case reports, and systematic reviews

Data collection

Secondary data were used in this literature review. Data were obtained from articles which were then reviewed based on the criteria made by the author. The screening stages can be seen in the diagram below (Figure 1) (Table 1).

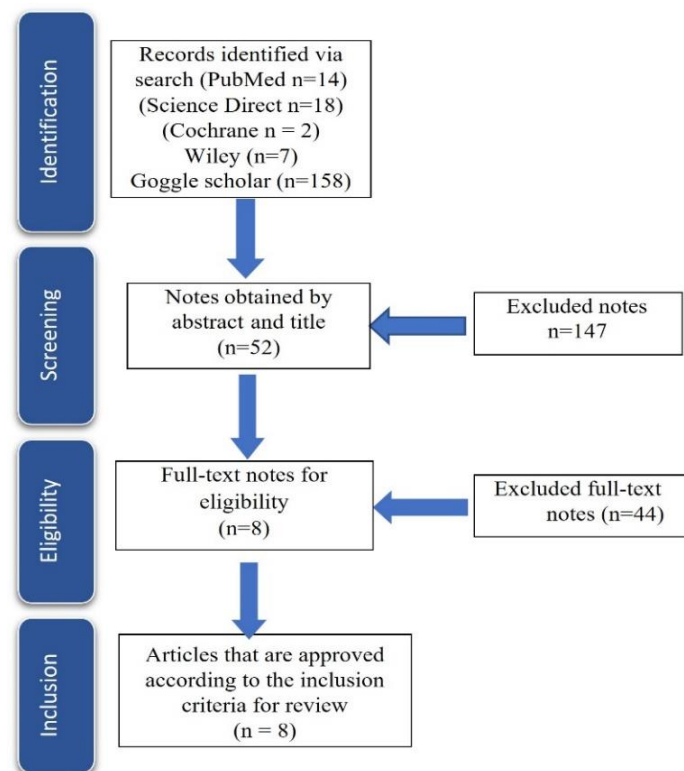


Figure 1: Flow diagram for searching journal articles.

No	Writer	Title	Purpose	Result
1	Dr.Mahesh RamaKrishna n, arthikeyan.S, (2021)	Association of mouth breathing, dental malocclusion and oral habits among preschoolers.	Following are the risk factors for the development of malocclusion: Mouth breathing, Tongue thrust swallowing and Thumb sucking. The study aimed to evaluate the association between malocclusion and oral Habits.	The analysis showed that the most prevalent gender is Male common age group is 5-10 years and common oral habits is lip biting. The study shows no significant correlation age habits $p=0.800$
2	X. Zhang, J.-M. He, W.-Y. Zheng (2021)	Comparison of rapid maxillary expansion and pre-fabricated myofunctional appliance for the management of mouth breathers with Class II malocclusion	Rapid maxillary expansion (RME) and Prefabricated myofunctional appliances have been used for the treatment of mouth-breathers with Class- II malocclusion. Aim of the research was to aimed to compare the treatment effects of pre-fabricated myofunctional appliance and hyrax used in mouth breathers with Class II Malocclusion in mixed dentition stage.	Data of 28 patients (14 in each group) were compared. Significant advancement of maxilla was seen in both groups while mandibular length improved only with the T4K appliance. Molar relationship improved in both groups. Molar correction was obtained by 55.6% skeletal change and 44.4% dental change with RME. In the T4K group the corresponding values were 48.1% and 51.9% respectively
3	Xiaowen Niua, Melih Motrob, Leslie A Willc, Marie A Cornelisd, Paolo M Cattaneo (2021)	Does rapid maxillary expansion enlarge the nasal cavity and pharyngeal airway?-A three dimensional assessment based on validated analyses.	To evaluate the three-dimensional changes following rapid maxillary expansion (RME) of the nasal cavity (NC) and pharyngeal airway (PA) in growing patients, using innovative and validated evaluation methods. To investigate whether a correlation between skeletal expansion and increase in airway volume exists	The PA, skeletal, NC parameters were significantly enlarged after RME. The NC volume and inter-molar distance in the RME were significantly larger compared to the control group.
4	Dr. Abhik Sinha, Dr. Lipika Mali, Dr. Swati Saraswata Acharya, Dr. Smruti Bhusan Nanda (2018)	Effect of Naso-respiratory Obstruction with Mouth Breathing on Dentofacial and Craniofacial Development	To evaluate the effects of mouth breathing on craniofacial and dentofacial development during childhood in comparison to nasal breathing in malocclusion patients	The mouth breathers had downward and a backward rotation of mandible with higher palatal plane, increased mandibular plane angle, increased overjet, and constriction of upper and lower arches. The prevalence of posterior cross bite and Abnormal lip-to-tongue anterior oral seal was observed greater in mouth breathers group than the nose breathers group.

5	Mario Cappellette Jr., Fabio Eduardo Maiello Monteiro Alves, Reginaldo R. Fujita, Fauze Ramez Badreddine, (2018)	Rapid maxillary expansion (RME) in mouth breathers: a short-term skeletal and soft-tissue effect on the nose	The retrospective study aimed to evaluate the short-term effects of RME on skeletal and soft-tissue effect on the nose with the use of CT Scan.	As compared to control, experimental group showed a change in the width of pyriform aperture with a significant increase in all the skeletal and soft tissue variables.
6	Raimundo Fujita, Oliveira, Keiko Yuki, Aparecida Shirley Shizue Nagata Pignatari, Ana Mario Cappellette Jr., Raquel Mori Gonçalves, Lucia Hatsue Yamamoto Nagai, Reginaldo -2017	Skeletal effects of RME in the transverse and vertical dimensions of the nasal cavity in mouth-breathing growing children	A total of 61 mouth breathers' patients with skeletal maxillary constriction participated. Data was obtained using Posteroanterior (PA) radiographs. PA before and 3-month post-expansion was taken to evaluate the Skeleton effects. Student t test and Kolmogorov-Smirnov were used for statistical analysis.	There was a significant increase in the linear measurements of nasal transverse and maxillary dimensions produced by RME.
7	Siby Gopinath, N.K Sapna varma, Navya Ashok, V.V Ajith, (2014)	Effect of rapid maxillary expansion on sleep characteristics in children	The study aimed to describe how Rapid maxillary expansion effect the sleep in children.	After expansion, all children showed a significant increase in inter-molar distance and sleep efficiency.

Table 1: Literature Review.

Discussion

Many authors have discussed the relationship between malocclusion and oral habits. Mouth breathing is the habit that most often causes abnormalities in facial structures and occlusion of the teeth. The habit of mouth breathing during the time of growth and development may have an impact on the development of the dento-craniofacial region. Chronic mouth breathing causes abnormalities in the muscles around the mouth, which can stimulate the development of malocclusion [4,16] (Figure 2) Changes in head posture,

lower jaw position and lowered tongue are early adaptations that occur due to mouth breathing.

The rotation of mandible to posteroinferior causes a deviation in the mandibular growth direction, which results in the craniofacial growth deviation. The mandible, which normally grows in a horizontal dimension toward the back, experiences an overgrowth in a vertical downward dimension. The great pressure of the buccinator muscle on the lateral side especially in the maxillary premolar and molar regions, coupled with the absence of tongue pressure, causes the

maxillary arch to become narrow. Both jaws look retrognathic because the maxilla is

narrow, and the mandible is underdeveloped [12].



Figure 2: Left: A. 6-year-old patient with a severe mouth breather. Right: The same patient at age 9, with dental malocclusion and abnormal facial growth.

This is supported by the study of Faria et al. (2002) who found retrognathic maxillary and mandibular tendencies in mouth breathing patients. Inadequate air flow through the nose also interferes with the resorption of periosteal tissue that is located next to the palatal wall of the nose [6]. This process causes the palate to become high and V-shaped due to lack of downward growth, and the size of the nasal cavity and nasopharyngeal space is small.

Mouth breathing, apart from causing craniofacial growth irregularities, also affects the teeth. Following a healthy jaw development, teeth will also erupt in a regular arch. Malocclusion of the teeth will occur as a result of the short maxillary arch caused by excessive pressure on the lateral side and an underdeveloped maxillary sinus [10]. The tendency for posterior crossbite to occur is due to excessive maxillary dental arch contractions, and less maxillary growth. The eruption of the teeth is not matched by the development of dental arch size, causing the teeth to lack space to grow and tend to crowd. According to the study's

findings, mouth breathing increases the likelihood that Angle's Class II Division 1 Malocclusion to occur [9,14]. As the mandibular posterior teeth shift distally, a Class II Angle molar relationship is produced. Mouth breathing pattern causes fewer active lips, reduced tone and shortened. Protruding teeth are caused by a forceful downward thrust from the lower lip without any opposition from the anterior side of the upper lip. The above mechanism causes an Angle Class II division 1 malocclusion. The large lower lip pressure on the mandibular anterior teeth causes it to retrocline. This is consistent with the findings of Koski and Behlfelt et al., who discovered a tendency for the mandibular anterior teeth in mouth breathing individuals to retrocline. The condition of protrusive maxillary anterior teeth with retrusive mandibular anterior teeth causes an increase in overjet and open bite [24].

Children with mouth breathing tend to have a facial shape called long faces syndrome characterized by a depressed jaw, increase in the lower third of the anterior face, an

open mouth, a small and undeveloped nostril, a gummy smile, and a face that seems foolish. The severity of the

malocclusion is strongly influenced by the duration of doing these bad habits intensity and frequency [3,24].

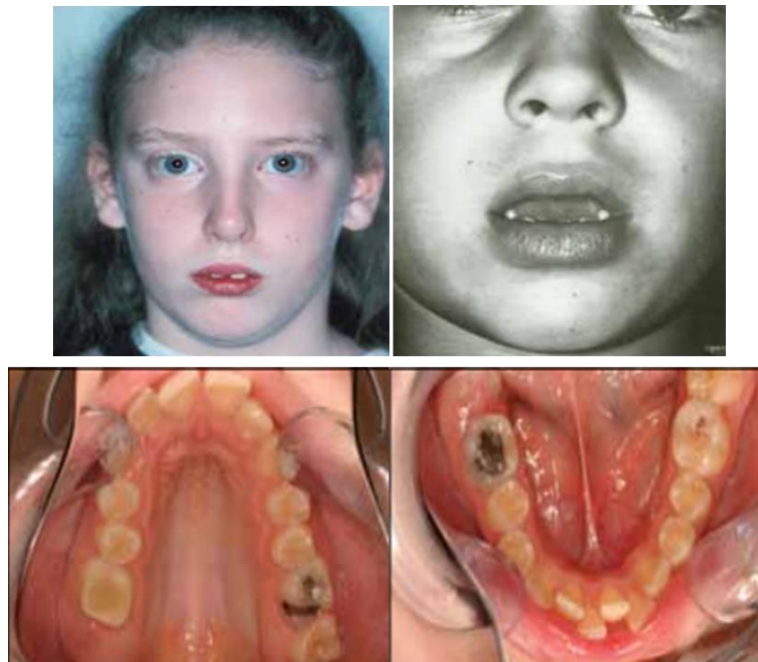


Figure3: An example of a child with a narrow palate, high palatal vault, and dental crowding due to mouth breathing.

For long term and short-term benefits early detection followed by timely treatment for malocclusion is essential in the mixed dentition period. Interceptive orthodontic treatment, is typically done during mixed dentition stage, corrects mild malocclusions involving one to four teeth. Rapid Maxillary Expansion (RME) is used for treating oral breathing problems, reshaping the hard and soft tissues of the maxillofacial region, improving airway and ventilation, and other dentofacial disorders [2]. This appliance is fixed, produces lateral, parallel, and symmetrical widening, used to widen the basal arch in the mixed dentition period [17].

The RME is made up of stainless rings that are bonded to the right and left first permanent molars or deciduous molars, connected by expansion screws which have

high widening power. With this appliance, the median palatine suture is widened laterally, and the dental arch moves bodily [2] (Figure 4,5). The effects of using RME on Class II division 1 Malocclusion include:

1. Orthopedic effects. This effect occurs in the transverse dimension with the opening of the intermaxillary suture. The maxilla is divided into two sections in a “V-shape” pattern. Furthermore, the opening of these sutures will cause diastema in the incisor region and an increase in intercanines and intermolar width due to the palatine sutures being widened.

The length of the arch will be increased by 0,7 mm with a 1 mm expansion of the transverse direction.

2. Orthodontic effect. The RME use with the orthodontic effect causes the buccal movement of alveolar

processes and the posterior teeth [7].



Figure 4: Rapid Maxillary Expansion.



Figure 5: Tooth-anchored device (RME appliance).

According to Haas, this transverse expansion will result in an increase in arch length, allowing for the retraction of proclining upper incisors without extraction in the available space.

Additionally, this expansion will permit the mandible to move spontaneously forward, thereby creating an atmosphere for the mandible to expand and assisting its Class II

correction. According to Bacceti et al., treatment with RME will affect patients both before and after the peak growth period. In comparison to patients treated after the growth peak, those treated before the growth peak would have a greater long-term effect. Due to the replacement of primary teeth during the period of mixed dentition, treatment with RME resulted in a mean treatment time that was shortened by

about 6,5 months [8]. Treatment for rapid maxillary expansion can affect both the skeletal and dentoalveolar levels. This appliance can treat crowding because it can widen the maxillary basal arch and widen the dental arch (Baratieri et al., 2010).

Conclusion

Breathing through the mouth due to pathological condition is usually caused by upper respiratory tract obstruction due to several mechanical factors, including septal deviation, tonsillar hyperplasia, pharyngeal

hypertrophy and palatine, nasal polyps, allergic rhinitis, tumors, infectious or inflammatory diseases. Oral habit of mouth breathing is the major cause of malocclusion in developing children. Interceptive orthodontic treatment uses the Rapid Maxillary Expansion (RME) technique which works by opening the intermaxillary sutures and resulting in an increase in the maxilla transverse dimensions which increases airflow by increasing the volume of the airway passageways in addition to correcting the malocclusion.

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