



## Reduction of the severity of malocclusion by eliminating oral habits with the application of prefabricated myofunctional appliances in children aged 6 -14 years- A systematic review.

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### ABSTRACT

**Purpose:** To assess the efficiency of prefabricated myofunctional appliances (PMA) in the correction of oral habits and reduction of malocclusion associated with these habits.

**Methodology:** A literature search was confined to the English language using MeSH terms conferring to PICO format in PubMed, Cochrane Library, and Ovid<sup>SP</sup> covering September 1985 to December 2020. Search in Google Scholar, Grey literature, and Hand search on references was performed to find additional data. Suitable studies were selected based on the predefined inclusion and exclusion criteria. The selected studies' quality analysis was performed using a "5 component scheme for quality assessment of case reports".

**Results:** A total of 8733 articles were retrieved from all three databases (PubMed, Cochrane library, Ovid<sup>SP</sup>) and other sources. After screening all the titles, eliminating the duplicates, animal studies, adult studies, irrelevant articles, non-availability of abstracts, unrelated studies, narrative reviews, systematic reviews, and letters to editors, only five studies were included for the final analysis. Quality analysis of these 5 case reports showed two case reports with insufficient quality for publication; one case report was suggested with caution about the report's validity and clinical value, and two were presented as a worthwhile contribution to the literature.

**Conclusion:** There is an average quality of evidence indicating that the PMAs were effective myofunctional appliances in correcting oral habits and reducing malocclusion associated with the habits in the short-term. The main advantage of PMAs seems to be related to their favorable patient acceptance and reduced cost. Further well-designed and long-term RCTs are needed to confirm these effects.

**Keywords:** Malocclusion; Myobrace; Oral habits; Prefabricated Myofunctional appliances; Trainer.

### I. INTRODUCTION

Evidence suggests that malocclusion poses a significant burden worldwide, with its prevalence in India ranging from 20% to 41%.<sup>1,2</sup> Orofacial muscles work in harmony during any oral function such as deglutition, speech, mastication and affect the shape of the dental arches and position.<sup>3</sup> Any alteration in these muscles' activity can compromise the orofacial morphology, functioning, well-being, and oral health-related quality of life (OHR-QL) from childhood. This was based on the theory of craniofacial growth proposed by Moss in his "functional matrix theory."<sup>4</sup> One of the main functional factors of orofacial dysfunction is the presence of oral habits that influence the development of malocclusion.<sup>3,5,6</sup> Oral habits are repetitive behaviors in the oral cavity that leads to malformation in dentofacial structures, depending on the nature, onset, and duration of these habits.<sup>6,7</sup>

Orthodontic treatment is required to correct malocclusion along with aberrant oral habits, but relapse occurs if any unusual muscle activity is ignored. Retraining the abnormal muscle tone and function along with correction of the dentoalveolar system is necessary to avoid the risk of relapse and attain stable orthodontic results. Functional appliances offer many benefits as they help in eliminating oral dysfunction by establishing muscular balance and allowing proper growth and development of the jaws.<sup>8</sup> Since in early times, to produce skeletal and dentoalveolar changes, functional appliances have been used. Two-phase orthodontic treatments, where functional problems are treated by functional appliance, and also to improve the frequently occurring relapse after orthodontic treatment, brackets were used to align the teeth. During the last decades, enhanced



functional appliances have been produced, which made a significant change in oral function as well as stimulated mandibular growth.<sup>9</sup>

Over the last 20 years, myofunctional research has developed orthodontic appliances to promote children's dental and facial development from 5 to 15 years, using myofunctional orthodontic techniques instead of traditional orthodontics.<sup>10</sup> These appliances are known to produce neuromuscular changes, which lead to morphological alterations in the craniofacial complex. A treatment centered on only moving teeth is like treating only part of the problem, and relapse could be expected. Thus, the treatment plan intending to correct a malocclusion must include appliances that eliminate soft tissue dysfunction acting on the cheeks, lips, and tongue muscles while correcting teeth and jaw position.<sup>11</sup> Orofacial myofunctional therapy is a growing field in orthodontic treatment, including the treatment of facial muscle imbalances, the teaching of tongue posture, and establishing equilibrium between the tongue, cheek, and lip musculature. Specific orofacial dysfunctions have been considered to be the vital indicators for the early identification of functional abnormalities, producing deviations from normal dentition development.<sup>12</sup> Furthermore, it has been shown that changes in dentofacial formation can be influenced by myofunctional therapy even in non-growing patients. Prefabricated functional appliances have been developed to produce beneficial outcomes in children mainly with Class II, division 1 malocclusion.<sup>13</sup>

Prefabricated myofunctional appliances (PMAs) present a popular choice in correcting various types of malocclusions in children and young adolescents, being available in multiple designs and sizes. The Trainer (Trainer For Kids T4K®; Myofunctional Research Co., Queensland, Australia) is a popular single-sized PMA consisting of tooth channels, labial bows, tongue tags, and lip bumpers incorporating myofunctional and tooth positioning functions.<sup>14</sup> On the other hand, the Myobrace (Myobrace®; Myofunctional Research Co.) is available in various sizes incorporating myofunctional, arch development, and tooth positioning functions.<sup>15</sup>

They aid in the correction of muscular dysfunction, reposition the mandible in the forward direction, improve the tongue's position, align the teeth, stimulate transverse development, and improve the vertical facial pattern. By commencing treatment at the mixed dentition stage, more treatment options are available, and the need for complex orthodontic treatment involving

permanent tooth extraction or orthognathic surgery is also minimized. They are also economical and straightforward. These specifically designed PMAs would address the aetiological factors behind the developing malocclusion by correcting the tongue posture, soft tissue dysfunction, and improving the airway volume.<sup>16</sup>

The present study aims to illuminate all aspects and identify evidence-based information provided by contemporary scientific literature to answer the following question: Are prefabricated myofunctional appliances effective in correcting pernicious oral habits and reducing malocclusion associated with habits in children?

In the literature, most of the publications regarding this topic are demonstrated as case reports but not as controlled studies. Since higher privilege was given to case reports regarding this topic in the literature, authors decided to include only case reports in this systematic review.

## II. METHODOLOGY

This systematic review was designed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist.<sup>17</sup> The authors have also followed the PRISMA recommendations statement to report this systematic review.

### Research protocol:

A detailed database search was conducted using MeSH terms conferring to PICO format in MEDLINE, Cochrane Central Database, and Ovid SP covering the period from September 1985 to December 2020, limiting to the English language. The MeSH terms used were "Child" "preschool" "primary dentition" "mixed dentition" "oral habits" "Prefabricated Myofunctional therapeutics" "Trainer" "Myobrace" "No brace system" "molar relation" and "Malocclusion." The details of the search strategy were provided in table 1. An additional search was performed in Google scholar, Grey literature, and Hand search on cross-references of the included and relevant studies to find additional citations. Two researchers independently verified the studies which met the inclusion criteria, and they assessed the titles and abstracts of the searched articles. The 'AND' and 'OR' Boolean operators were used to combine keywords. The details of the search strategy were provided in annexure 1.

### Eligibility criteria:

#### Inclusion criteria:

1. Articles published in the English language from September 1985 to December 2020
2. Case reports in human beings



3. Children in the age range of 6-14 years
4. Correction of oral habits associated with malocclusion using PMAs

**Exclusion criteria:**

1. Articles published in languages other than English
2. Review articles
3. Systematic reviews
4. Animal studies, letters to the editor, comments, personal opinions, book chapters, and Randomized Controlled Trials (RCTs), Non randomized Studies (NRS)

**Data extraction:**

Studies that satisfied the inclusion criteria were critically appraised by two researchers independently. All electronically identified records were scanned by title and abstract. The included studies were determined by reading titles and abstracts of the studies identified from the databases and hand search. The full-text review was retrieved and examined when their title and abstract didn't provide enough information for a decision. A standardized form comprising the variables of interest was used for data extraction. In case of discrepancy, the paper was discussed by the authors until consensus was reached. Articles appearing in more than one database search were considered only once.

**Quality appraisal:**

For the systematic review, the quality of included studies was evaluated independently using a "5 component scheme for quality assessment of case reports" to classify the papers as: being likely to be a worthwhile contribution to the literature (9-10), the reader should be cautious about the clinical value of the report, and its validity (6-8) and report is of insufficient quality for publication (5 or less).<sup>18</sup>

### III. RESULTS

A total of 8729 articles were retrieved from all three databases (PubMed, Cochrane library, Ovid SP) and other sources. After screening the titles of retrieved articles, 8,699 records were excluded due to various reasons such as duplicates, animal studies, adult studies, without abstracts, unrelated studies, narrative reviews, systematic reviews, syndromes, and letters to the editor. After screening the abstracts, six were selected for full-text assessment. Finally, five articles were included for quality assessment. A flow diagram of studies included in the review is presented in figure 1.

The substantial inter-examiner agreement corresponding to kappa statistics for the

methodological quality assessments was 0.89 for all the categories. The information regarding authors' details, Patient's age, treatment duration, treatment outcomes, and follow-ups of the five evaluated studies were given in table 2. A version of the 5 component scheme for quality assessment of case reports was used for checking the quality of articles. All reports submitted were appropriate for the aim of the study.

The scale assessed the articles under mainly five domains: Documentation, Uniqueness, Educational value, Objectivity, and Interpretation. Whether it documents new scientific knowledge or provides an educational resource on a previously known entity, the potential validity and value of a case report are determined by the following characteristics: a) How well the case is documented b) Its uniqueness and/or educational value, c) The objectivity with which it is described and how the information is interpreted for broader principles and applicability to other patients.<sup>18</sup> These five characteristics, or domains, help to assess a case report, and illustrates how they relate to one another. They are provided with a scoring system for rating the report on a scale of 0 to 10. A score between 0 and 2 is given for each of the domains, such that a case report meeting all the criteria for valid data and appropriate presentation would score 10 points, implying that it was a valuable contribution to the literature, whose contents could be relied on upon by the reader.<sup>18</sup>

Reports by Boucher et al.,(2008)<sup>19</sup> scored 9 points and Ramirez et al.,(2007)<sup>20</sup> scored 10 points, implying that it is a valuable contribution to the literature, Deepika et al.,(2016)<sup>21</sup> scored 6 points implying that the reader should be cautious about the clinical value of the report and its validity whereas Landau et al.,(2010)<sup>22</sup> and Wijjey et al., (2017)<sup>23</sup> scored 5 points respectively indicating that the report is of insufficient quality for publication which is mentioned in table 3.

### IV. DISCUSSION

This systematic review was intended to collect and analyze case reports to assess prefabricated myofunctional appliance's efficiency in reducing malocclusion along with correction of oral habits. It was found that a total of 5 studies qualified to be included in the systematic review based on the inclusion criteria. According to the 5 component scheme adapted for quality assessment of case reports, the quality assessment of the included case reports was done.

A case report from Belgium in 2008 presented a girl with Class II malocclusion and upper and lower tooth size and arch length



discrepancy associated with a narrow maxillary arch, infantile swallowing, and nasal breathing. The treatment plan to correct this malformation included rapid maxillary expansion, followed by transpalatal arch and complementary treatment delivered by wearing a T4K® at night and for two hours during the day. The post-treatment analysis of lateral cephalograms revealed that some mandibular growth had taken place along with improvement of class II, a significant decrease in overjet that accompanied the palatal expansion as well a clear improvement in tooth positioning, which finally improved deglutition and breathing capabilities, similar to those derived from conventional orthopedic re-education.<sup>19</sup>

A case report from Milwaukee in 2007 presented 8 years, 10 months old girl having thumb sucking habit with an open bite in mixed dentition. She also had Class II, division 1 malocclusion associated with the forward position of the maxilla and incisors tipped buccally and unilateral posterior crossbite. A modified quad helix was initially used to correct the crossbite and discourage thumb sucking. However, due to lack of Patient compliance, the treatment plan was modified, and the T4K was proposed as phase I treatment followed by fixed orthodontics. Thumb sucking habit was corrected by using the T4K appliance. Finally, by combining both functional and fixed appliances, the case was finished in a Class I occlusion with a normal overbite and overjet along, with good muscular activity. Therefore, this case report supports the idea of including myofunctional treatment when an open bite is treated at an early age.<sup>20</sup>

Another Indian case report in 2016 presented a seven-year-old girl with a toe-sucking habit since her infancy. Her upper incisor showed an abnormal pathway of eruption due to the toe's abnormal pressure during the sucking event, leading to the deflection of the developing tooth to an irregular path. This developing crossbite was intervened by tongue blade therapy. They noticed that the upper incisors showed distoangular rotation in the subsequent follow-up visit as they erupted into occlusion. The Patient was given a pre-orthodontic trainer (T4K Phase I, Preorthodontic Trainer for Kids, MRC, Australia). The pre-orthodontic Trainer was advocated to realign the incisors as well for myofunctional retraining of the oral musculature. Authors stated that identification and intervention of toe sucking habit at the right time by using Trainer have helped in limiting the extent of malocclusion.<sup>21</sup>

A French case report in 2010 presented a patient with a thumb-sucking habit until a late age;

as a result, she retained a primitive swallowing pattern, was a mouth breather, and kept her tongue in a low position. Because of this Patient's numerous functional problems, the myofunctional therapy was performed in three phases. In phase I, the Patient wore a "T4K® Position trainer for six months, and results showed regaining lip competence and the ridges around the nose diminished, indicating that nasal breathing had improved; in phase II Patient wore a "Multi P high 5" eruption guide for nine months and the results demonstrated the increase in width of both upper and lower arches and in phase III myo-functional therapy restored proper functioning, and mechano-therapy achieved good occlusion and decrease of the bi-maxillary protrusion.<sup>22</sup>

An Australian case report in 2017 presented a 13y 6m old girl having mouth breathing habit with subsequently lowered tongue posture and labio-mentalis activity on swallowing. She was treated with the Myobrace for Teens. Mouth breathing habit was corrected with a significant reduction in overbite and overjet, together with a precise translation of the mandible on viewing the facial profile.<sup>23</sup>

Two papers did not mention follow-up periods after completion of treatment to know the stability of results. The search was restricted to English full-text articles and children below 14 years of age. Further well-designed and long-term RCTs are needed to confirm these effects.

The current systematic review summarises evidence from five case reports with five patients on the clinical performance of PMAs for the treatment of children with malocclusion along with correction of oral habits. According to the evidence of moderate quality in this review, PMAs seem to be effective in alleviating Class II malocclusion, bimaxillary protrusion, mandibular crowding, which is mainly achieved through dentoalveolar effects, correcting overjet, overbite, assisting in myofunctional retraining of the oral musculature along with cessation of oral habits. By commencing treatment at the mixed dentition stage, more treatment options are available, and the need for complex orthodontic treatment involving permanent tooth extraction or orthognathic surgery is also minimized. PMAs combined with fixed appliances showed superior results and are also associated with significantly lower treatment costs with better Patient compliance.

## V. CONCLUSION

As per the findings of the present systematic review, it can be concluded that there is average quality of evidence indicating that the



PMA's were effective in reducing malocclusion along with correction of oral habits in the short-term. The main advantage of PMA's seems to be related to their favorable patient acceptance and reduced cost. These results should be viewed with caution, as a definitive need for high-quality long-term research into this area is required. Further well-designed and long-term RCTs are needed to confirm these effects.

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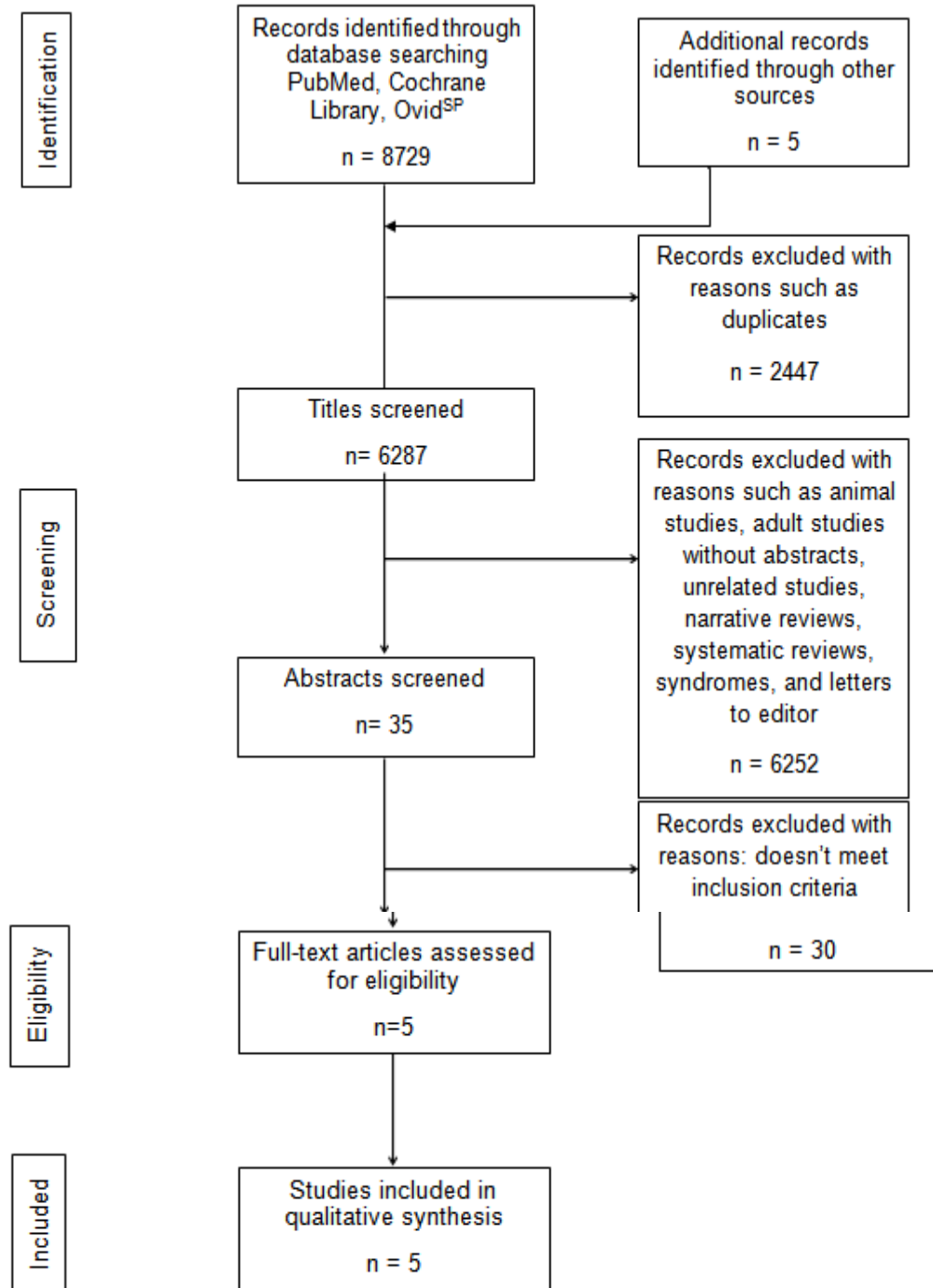
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Figure 1: PRISMA flow diagram





**Table.1 MeSH terms and alternate terms used in databases**

PICO	Population	Intervention	Comparison	Outcome
<b>Characteristics</b>	Children, dentition, oral habits	Pre-orthodontic myofunctional appliance	-	Elimination of oral habits
<b>MeSH terms</b>	Child, preschool, primary, mixed, teeth, oral habits	Prefabricated, Myofunctional therapeutics, Trainer, Myobrace, No brace system,	-	Correction of Malocclusion ,
<b>Alternative terms</b>	young person, Minor, Teen, Teenagers, Paediatric.	Habit breaking appliances, Trainer for kids, habit correction appliance, Myobrace for teens	-	Efficiency of habit breaking appliance, Evidence, Effectiveness.

**Table 2. Characteristics of the included studies**

Intervention	Participants (age range)	PMA wear instructions	Reported outcomes	Follow-ups
Trainer for kids & Fixed functional appliances	8 year 10 months	1-2 hours at day time and overnight	Correction of thumb sucking habit, open bite correction	3 years
Trainer T4K	10 years 2 months	Every day; overnight and 2 h during day	Improved deglutition and breathing capabilities, overjet correction	One year
Trainer T4K	---	No	Improved nasal breathing and correction of lip competence	No
Trainer T4K	7 year old girl	Every day; overnight and 2 h during day	Elimination of toe sucking habit	One year
Myobrace for Teens	13y 6m old girl	No	Improved breathing & Reduction in overjet and overbite	No



S.no	1	2	3	4	5
Case report	Ramirez et al., (2007) <sup>19</sup>	Boucher et al., (2008) <sup>20</sup>	Landau et al., (2010) <sup>21</sup>	DeepikaPai et al., (2016) <sup>22</sup>	Wijey et al., (2017) <sup>23</sup>
Setting	Milwaukee	Belgium	France	Karnataka	Australia
Design	Case report	Case report	Case report	Case report	Case report

PMA: prefabricated myofunctional appliance

Table.3. Five component scheme adapted for quality assessment of case reports

Study	Document	Unique ness	Educational value	Object ivity	Interpre tation	Score
Ramirez et al.,(2007) <sup>19</sup>	2	2	2	2	2	10
Boucher et al.,(2008) <sup>20</sup>	2	1	2	2	2	9
Landau et al.,(2010) <sup>21</sup>	1	1	1	1	1	5
Deepika et al.,(2016) <sup>22</sup>	1	2	1	1	1	6
Wijey et al., (2017) <sup>23</sup>	1	1	1	1	1	5

Implications of total score:

9-10: report is likely to be worthwhile contribution to the literature

6-8: reader should to be cautious about validity and clinical value of report

5 or less: report is of insufficient quality for publication