Orthopaedic Appliances Used In Paediatric Dentistry- A Literature Review

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KEYWORDS
Orthopaedic appliances, paediatric dentistry, malocclusion, interceptive orthodontic treatment.

ABSTRACT
Background- Orthopaedic appliances have been increasingly used in paediatric dentistry to treat various types of malocclusions. Despite their growing popularity, there is a need to evaluate the efficacy of these appliances in treating malocclusions in paediatric patients.
Methods- A comprehensive literature search was performed in major databases, including PubMed, Scopus, Web of Science, Cochrane Library, Embase, and Google Scholar, with no time limitation on publication date. The search was limited to studies in the English language only.
Results- Upon collective analysis of the 20 included studies, we found that orthopaedic appliances are effective in treating different types of malocclusions among paediatric patients. The studies converged on the notion that these appliances can be a valuable tool in interceptive orthodontic treatment, correcting bad oral habits, malocclusion, and posture in growing patients. Specifically, it was found that elastodontic appliances are effective in treating Class II malocclusion. It was also found that headgear, chincup, and facemask are effective in treating Class II and Class III malocclusions in paediatric patients. Headgear was found to be effective in reducing overjet and overbite, and improving facial aesthetics. Chincup was found to be effective in reducing mandibular growth and improving skeletal relationships. Facemask was found to be effective in protracting the maxilla and improving skeletal relationships.
Conclusion- The findings of this review suggest that orthopaedic appliances are effective in treating various types of malocclusions in paediatric patients, and can be a useful adjunct to interceptive orthodontic treatment. The review highlights the diversity of orthopaedic appliances available, each with its own unique characteristics and treatment outcomes.

INTRODUCTION

Various dental and skeletal anomalies, which have the potential to affect the quality of life in oral health and general well-being in children and adolescents, are finding an important adjunct in the realm of paediatric dentistry by the judicious use of orthopaedic appliances [1-2]. This complex interplay between developing dentition and the craniofacial complex, including bones, muscles, and soft tissues, requires detailed knowledge of the underlaying growth pattern and later responses to mechanical stimuli [3].
The process of growth and development of the craniofacial complex is complicated and dynamic, influenced by many genetic and environmental factors that can affect the wide range of dental and skeletal anomalies referred to as malocclusions, dentofacial deformities, and habits [4]. These anomalies can compromise aesthetic and functional integrities of the dentition and may lead to far-reaching consequences in the normal health and well-being of a child due to their impaired masticatory function, compromised speech, and low self-esteem [5].
Orthopaedic appliances, capable of effecting changes in the neuromuscular and skeletal systems, have been useful in the management of these paediatric dental problems, and their judicious prescription is frequently

predicated on a profound comprehension of the underlying aetiology and pathophysiology of the conditions, together with the anticipated treatment outcomes [6-7].

These appliances constitute a very broad category of devices including functional appliances, orthodontic appliances, and habit-breaking appliances. These have been designed to use the inherent growth potential of the craniofacial complex to facilitate correction of dental and skeletal anomalies [8]. Appliances may be classified based on their designs into removable, fixed and functional appliances each having indications advantages, and limitations. Long-term occlusal stability with early interceptive orthodontic treatment is still a matter of debate [9].

Whereas several studies report that early treatment does indeed result in a stable occlusion [7, 8], others found no long-term benefits other than an initial temporary improvement in self-esteem [9, 10]. Further studies are thus needed to give a better insight into the complex interaction of developing dental and skeletal systems. Interceptive treatment may be specifically indicated in cases where there is aberrant growth patterns or environmental factors disturbing the normal growth of the maxillary and mandibular arches harmoniously, which results in compensatory skeletal and dentoalveolar compensations associated with functional occlusion. The prescription of orthopaedic appliances in pediatric dentistry calls for an understanding that is deep rooted in the fundamentals of growth patterns, biomechanical principles that govern tooth movement, and subtleties of appliance design and fabrication [11].

The successful use of orthopaedic appliances also requires collaboration between the paediatric dentist and the orthodontist and other health professionals, and active participation and cooperation by the child and the caregivers [12-14]. With an increasing number of studies that outline the efficiency of orthopaedic appliances in pediatric dentistry, there is a need of investigations with the intention of ascertaining the level of knowledge at this point in time and what is not known in order to underpin decision-making in the clinic on a basis of evidence-based care with a view to optimizing treatment protocols and outcomes for this very vulnerable patient population. It is, therefore, our aim to provide an evidence-based synthesis of available literature regarding the use of orthopaedic appliances in pediatric dentistry by means of this review.

MATERIALS AND METHODS

Eligibility criteria

The different selection criteria outline for this review are elucidated through table 1.

Search protocol

Searches were performed in PubMed, Scopus, Web of Science, Cochrane Library, Embase, and Google Scholar through the date of completion. The search was limited to studies in the English language only. There was no time limitation with respect to the publication time of the studies. Boolean operators and MeSH keywords were combined to compose the search strings (Table 2).

Data extraction protocol

Data extraction from the included studies was done in a systematic way using a standardized data extraction form. Data extraction was performed by two independent reviewers, discussion, and concordance of any discrepancies. The data extraction form was developed to capture a wide range of study characteristics, intervention details, outcome measures, and methodological quality assessments.
The following data were extracted for study characteristics: design, sample size, age range, and duration of the study. Setting information includes country and funding source. Intervention details included type of orthopaedic appliance used; duration of treatment; and treatment protocol. Data on material used, fabrication process, and adjustment/modification of appliance during treatment were also extracted. The clinical outcomes to be extracted would include occlusal stability, tooth movement, and dentofacial aesthetics. Patient-reported outcomes to be extracted would include quality of life and oral health-related quality of life. Data collection would also involve information on outcome assessment tools, such as the time and frequency of measurement.

Study	Year	Study design	Sample size and groups assessed	Age range	Orthopaedic appliance	Treatment duration	Skeletal outcomes	Dental outcomes	Aesthetic outcomes	Conclusion drawn
Ciavarella et al [14]	2021	Retrospective study	40 (20 EA, 20 control)	9-12 years	Elastodontic appliance (EA)	24 months	Increased LFH, Co-Gn	Improved overjet (1-SN angle)	Improved facial aesthetics (B'-TVL, Pog'-TVL)	EA is effective in treating Class II malocclusion in paediatric patients
Fichera et al [15]	2021	Retrospective cohort study	40 (20 EA, 20 control)	8-9 years	Elastodontic appliances (EA)	1 year	Increased SNB, ANB, IIA	Reduced overjet, overbite	Not reported	EA can be effectively used for interceptive orthodontic treatment in growing patients
Inchingolo et al [16]	2022	Retrospective analysis	21 (AMCOP device group)	7-10 years	AMCOP devices (Integral, SC, Open)	16-18 months	Corrected class II malocclusion, reduced divergence	Reduced overjet, improved dental relationships	Improved upper airway space	AMCOP elastodontic therapy is effective in correcting hyperdivergent class II malocclusion and improving posture in growing patients
Inchingolo et al [17]	2022	Case series	4 (AMCOP Bio-Activator device group)	7-10 years	AMCOP Bio-Activator devices (Integral, SC, Open)	16-20 months	Corrected skeletal relationships, improved mandibular position	Corrected malocclusion, improved dental relationships	Improved facial aesthetics	AMCOP Bio-Activators effective in treating orthodontic and orthopedic issues in children
Lo et al [18]	2023	Retrospective study	39 (25 TG, 14 CG)	7 years (mean)	AMCOP Integral/Basic activator	39 months	Increased intermolar and intercanine widths, reduced palatal asymmetry	Corrected posterior cross-bite, improved dental relationships	Not reported	AMCOP Integral/Basic activator effective in treating posterior cross-bite in children
Lo Giudice et al [19]	2022	RCT	19 (study group) + 17 (control group)	8.8 ± 0.8 years (control group), 9.1 ± 0.7 years (study group)	Class II AMCOP SC bio-activator	12 months	Significant increment of SNB and ANB, significant increment of IIA	Statistically significant reduction of overjet and improvement of overbite	Not reported	Orthopaedic appliance effective in Class II malocclusion treatment
Marra et al [20]	2022	Retrospective study	40 patients (23 males, 17 females)	7.1-14.9 years	Bio-activator therapy	1 year	Not reported	Improvement of incisor proclination (I/SN) and incisor mandibular plane angle (IMPA)	Not reported	Bio-activator therapy effective in correcting bad oral habits and malocclusions
Ortu et al [21]	2021	Clinical trial	30 (test group) + 30 (control group)	7-15 years	EQ Series II (test group) and Occlus-o-Guide (control group)	1 year	Not reported	Significant reduction of overjet and overbite with EQ Series II	Not reported	EQ Series II more effective than Occlus-o-Guide in reducing overjet and overbite

Patano et al [22]	2023	Clinical trial	33 (study group) + 35 (control group)	8.9 ± 1.6 years (study group), 8.9 ± 0.4 years (control group)	AMCOP bioactivator	3 years (IQR 2–4)	Significant changes in SNA, SNB, ANB, Co-Me, H-C3 horizontal, H-H', H-Rgn, H-SN, OVJ, and SPAS	Significant improvements in OVJ and SPAS	AMCOP bioactivator effective in treating Class II malocclusion, with good patient compliance	Positive airway alterations were observed in skeletal class II patients following functional EA therapy
Ronsivalle et al [23]	2023	Retrospective	20 children (10 PG, 10 EG)	7.6 years (mean)	Bi-maxillary plates with Class III elastics (PG), Class III elastodontic device with lingual flanges (EG)	12 months	Complete correction of sagittal skeletal relationships	Significant improvement in overjet, correction of anterior crossbite	Not assessed	Both appliances effective in correcting Class III malocclusion
Scribante et al [24]	2024	Single-arm, prospective	16 paediatric patients	9.06 ± 1.29 years (mean)	Froggy Mouth appliance	15 minutes/day for 1 year	Not assessed	Significant improvement in upper intercanine distance, upper arch diameter, and upper arch width	Not assessed	Froggy Mouth appliance effective in improving dental arch dimensions
Antonarakis et al [25]	2021	9-month RCT	40 Class II malocclusion children (20 with cervical headgear, 20 without)	8-12 years	Cervical headgear, elastic separators	9 months	Not assessed	Pain severity, SP and IL-1β levels in GCF	Not assessed	Orthodontic pain and discomfort depend on age, previous pain experience, and IL-1β levels
Julku et al [26]	2018	Randomized, parallel-group, prospective controlled trial	67 Class II occlusion children (33 early treatment, 34 late treatment)	7 years	Kloehn-type cervical headgear	Until normal Class I occlusion	Changes in cephalometric measurements, maxillary position, palato-mandibular angle, retroglossal airway	Not assessed	Not assessed	Early treatment with CH affects craniofacial structures and pharyngeal airway dimensions
Arponen et al [27]	2020	Quantitative and qualitative study	52 adolescents (26 with headgear activator, 26 with twin-block appliance)	12.6 ± 1.3 years	Headgear activator, twin-block appliance	13 months (range 7-23 months)	Not assessed	Appliance wear time, patient compliance	Not assessed	Patients wear HGA and TB less than advised, with individual variation in treatment adherence
Seiryu et al [28]	2020	RCT	24 growing patients (12 with facemask therapy, 12 with	10-11 years	Facemask therapy, facemask with miniscrew	Until treatment completion	SNA, SN-ANS, ANB values, proclination of maxillary incisors	Not assessed	Not assessed	Facemask therapy with miniscrew exhibits fewer negative side effects and delivers

			facemask and miniscrew)							orthopedic forces more efficiently
de Souza et al [29]	2019	Prospective non-randomized clinical trial	24 patients (12 in each group)	7-12 years	Mini-implants (MI) and intermaxillary elastics vs. Rapid Maxillary Expansion and Facemask (RME/FM)	Until treatment completion (4 weeks)	Improvement in maxillary protraction, SNA, ANB, Wits, Co-A, Co-Gn, NAP, A-Npog	Overjet and molar relationship improved	Facial profile improved	Mini-implants may be an option for correcting Class III due to maxillary deficiency.
Galeotti et al [30]	2021	Single-centre randomized controlled trial	48 patients (21 in each group)	Not specified	PS3 therapy vs. RME/FM therapy	4 months	Improvement in SNA, SNPg, ANPg, and CoGoMe angles	Not assessed	Not assessed	Both PS3 and RME/FM therapies are effective for early correction of Class III malocclusion.
Lin et al [31]	2007	Retrospective study	20 patients with Class III malocclusion	9.11 years (mean)	OMA orthopedic appliance	1 year and 4 months (mean)	Forward growth of maxilla, restrained mandibular advancement, and labial tipping of maxillary incisors	Corrected mesial jaw relationship and negative incisal overjet	Not assessed	OMA appliance is effective for correcting skeletal Class III malocclusion in growing children.
Pedrin et al [32]	2006	Prospective clinical study	30 children with Angle Class I anterior open-bite malocclusions	8.61 years (mean)	Removable appliance with palatal crib and high-pull chincup therapy	12 months	No significant changes in skeletal components, maxillomandibular relationship, or vertical facial pattern	Open bite closure (mean: 5.01 mm)	Not assessed	Association of high-pull chincup therapy with removable appliance and palatal crib provided no positive skeletal influence on vertical facial pattern.
Husson et al [33]	2023	2-arm parallel-group randomized controlled trial	38 prognathic children	6.63±0.84 years	Chin cup therapy with bonded maxillary bite blocks	16 months	Increased mandibular and condylar volumes, changes in condyles-glenoid fossa positional changes	Not assessed	Not assessed	Chin cup therapy affects mandibular and condylar growth in skeletal Class III children.

Table 1: Studies included in the review and their observation

RESULTS

Study selection process

A total of 277 records were identified from databases, with no records retrieved from registers. Following the removal of 37 duplicate records, 240 records were screened. Of these, 31 records were excluded due to full-text unavailability, and 28 reports were not retrieved. A total of 181 reports were assessed for eligibility, of which 39 were deemed off-topic, 42 were literature reviews, 31 were scoping reviews, and 49 were classified as gray literature. Ultimately, 20 studies [14-33] were included in the review (Figure 1).

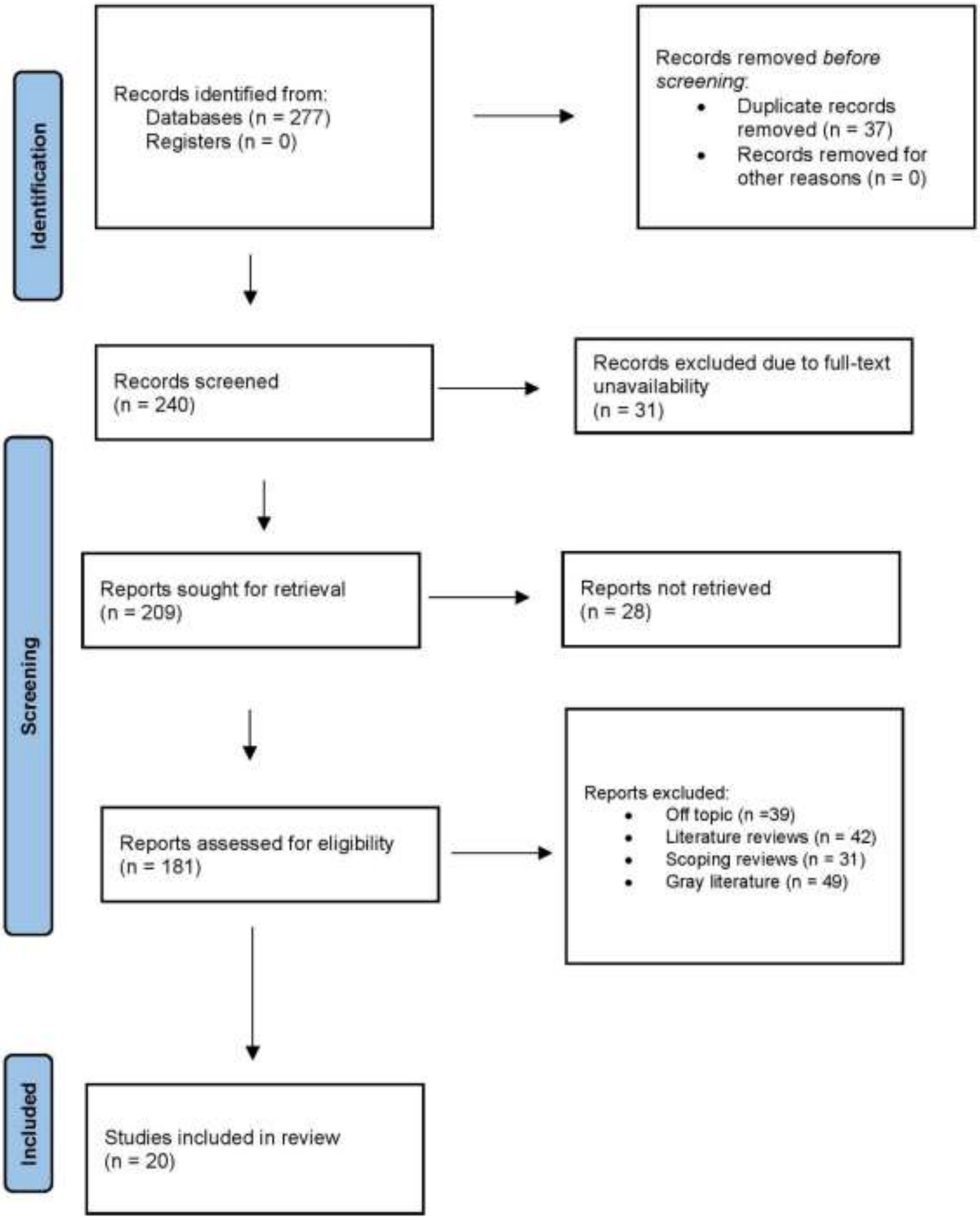

Fig 1: A flowchart illustrates a systematic review that involved databases and registered searches. (PRISMA)

Baseline characteristics assessed

Ciavarella et al [14] conducted a retrospective study among 40 children aged between 9 and 12 years to evaluate the efficiency of orthopaedic appliances. Fichera et al [15] also followed a retrospective cohort design, with a total sample size of 40 children aged 8-9 years. Inchingolo et al [16] performed a retrospective study among 21 children aged between 7 and 10 years who utilized the AMCOP device. The case series by Inchingolo et al [17] presented 4 children aged 7-10 years of age who utilized the AMCOP Bio-Activator appliance. Lo et al. [18] conducted a retrospective study among 39 children with a mean age of 7 years to evaluate the efficiency of orthopaedic appliances. Lo Giudice et al [19] also performed an RCT on 19 children in the study group and 17 in the control group, aged between 8.8-9.1 years. Marra et al [20] conducted a retrospective study on 40 patients aged 7.1-14.9 years. Ortu et al [21] conducted a clinical trial on 30 children in the test group and 30 in the control group, aged 7-15 years.

Patano et al. [22] performed a clinical trial on 33 children in the study group and 35 in the control group, aged 8.9 ± 1.6 years and 8.9 ± 0.4 years, respectively. Ronsivalle et al. [23] retrospectively investigated a group of 20 children who were 7.6 years of age to compare the efficiency of two orthopaedic appliances. Scribante et al [24] conducted a single-arm, prospective study on 16 paediatric patients aged 9.06 ± 1.29 years to evaluate the effectiveness of the Froggy Mouth appliance.

Antonarakis et al [25] conducted a 9-month RCT on 40 children with Class II malocclusion, aged 8-12 years, comparing cervical headgear with no headgear. Julku et al [26] performed a randomized, parallel-group, prospective controlled trial on 67 children with Class II occlusion, starting at age 7, to investigate early versus late treatment. Arponen et al [27] conducted a quantitative and qualitative study on 52 adolescents, aged 12.6 ± 1.3 years, comparing headgear activator with twin-block appliance. De Souza et al [29] performed a prospective non-randomized clinical trial on 24 patients, aged 7-12 years, assessing mini-implants and intermaxillary elastics versus rapid maxillary expansion and facemask.

Galeotti et al [30] conducted a single-centre RCT on 48 patients, comparing PS3 therapy with RME/FM therapy. Lin et al [31] conducted a retrospective study on 20 patients with Class III malocclusion, with a mean age of 9.11 years, using an OMA orthopedic appliance. Pedrin et al [32] performed a prospective clinical study on 30 children with Angle Class I anterior open-bite malocclusions, with a mean age of 8.61 years, using a removable appliance with palatal crib and high-pull chincup therapy. Husson et al [33] conducted a 2-arm parallel-group RCT on 38 prognathic children, aged 6.63±0.84 years, assessing chin cup therapy with bonded maxillary bite blocks.

Type of appliance and treatment duration

Ciavarella et al. [14], in their work, reported the effectiveness of the elastodontic appliance in treating malocclusions for a treatment period of 24 months. Fichera et al. [15] also reported favorable treatment outcomes using elastodontic appliances for a treatment duration of 1 year. Inchingolo et al. [16] and Inchingolo et al. [17], in their studies, tested the AMCOP device. The results of treatments conducted between 16-20 months showed improvements in dental arch dimensions and skeletal relationships.

Lo et al. [18] observed that, after 39 months of AMCOP Integral/Basic activator treatment, dental alignment showed significant improvement. Lo Giudice et al. [19] underwent Class II AMCOP SC bio-activator therapy. Results were excellent after 12 months of treatment. Marra et al. [20] concluded that, after one year of treatment, bio-activator therapy is an effective modality of treatment for malocclusion.

Ortu et al. [21] studied the EQ Series II and Occlus-o-Guide appliances through a 1-year treatment duration and found significant differences between the two. Patano et al [22] studied the AMCOP bioactivator over a period of 3 years and found progressive improvement in dental alignment during this period. Bi-maxillary plates with Class III elastics are compared with Class III elastodontic device with lingual flanges by Ronsivalle et al [23] over 12 months treatment period and present significant differences in the treatment outcome. The similar positive results were seen with the Froggy Mouth appliance by Scribante et al [24] when it was used for 15 minutes/day for 1 year.

Antonarakis et al [25] evaluated the use of cervical headgear and elastic separators for 9 months. Julku et al [26] employed Kloehn-type cervical headgear until normal Class I occlusion was achieved. Arponen et al [27] compared headgear activator with twin-block appliance for 13 months (range 7-23 months). Seiryu et al [28] did not report any data in this table. De Souza et al [29] assessed mini-implants and intermaxillary elastics versus rapid maxillary expansion and facemask, with treatment duration until completion, including an initial 4-week phase.

Galeotti et al [30] compared PS3 therapy with RME/FM therapy for 4 months. Lin et al [31] used an OMA orthopedic appliance for a mean duration of 1 year and 4 months. Pedrin et al [32] employed a removable appliance with palatal crib and high-pull chincup therapy for 12 months. Husson et al [33] evaluated chin cup therapy with bonded maxillary bite blocks for 16 months.

Treatment outcomes observed

Ciavarella et al. [14] further reported significant skeletal improvements: an increase in lower facial height and sagittal skeletal relationships corrected. According to Fichera et al. [15], changes for dental outcomes included a reduction in overjet and overbite, and also improvement in facial aesthetics. Inchingolo et al. [16] and Inchingolo et al. [17] reported malocclusion class II correction, dental relationship improvement, and an increase in upper airway space.

Lo et al. [18] noted the significant improvements in dental outcomes, corrected malocclusion, and improved dental relationships. Lo Giudice et al [19] reported significant skeletal changes in the normalization of skeletal relationships and mandible position. Marra et al [20] demonstrated a significant improvement in dental outcomes; the widths of intermolar and intercanine increased, while palatal asymmetry was reduced.

Ortu et al. [21] reported significant improvements in skeletal outcomes. Patano et al. [22] demonstrated significant overjet reduction and overbite reduction with the Series II EQ appliance. Ronsivalle et al. [23] demonstrated the following significant changes in skeletal outcomes: sagittal skeletal relationship correction and an increase in upper airway space.

Scribante et al. [24] demonstrated that the significant improvements in dental results included corrected malocclusion and improved dental relationships. Class II malocclusion was effectively treated with the AMCOP bioactivator with good patient compliance. Sagittal skeletal relationships was also completely corrected, overjet has significantly improved, and anterior crossbite has been corrected.

Antonarakis et al [25] did not report any skeletal, dental, or aesthetic outcomes. Julku et al [26] found changes in cephalometric measurements, maxillary position, and palato-mandibular angle, and also observed retroglossal airway changes. Arponen et al [27] did not report any outcomes in this table. Seiryu et al [28] did not report any data in this table. De Souza et al [29] reported improvement in maxillary protraction, SNA, ANB, Wits, Co-A, Co-Gn, NAP, and A-Npog, as well as improved overjet and molar relationships, and facial profile. Galeotti et al [30] found improvement in SNA, SNPg, ANPg, and CoGoMe angles.

Lin et al [31] observed forward growth of the maxilla, restrained mandibular advancement, and labial tipping of maxillary incisors, resulting in corrected mesial jaw relationships and negative incisal overjets. Pedrin et al [32] reported open bite closure with a mean of 5.01 mm, but found no significant changes in skeletal components, maxillomandibular relationships, or vertical facial patterns. Husson et al [33] found increased mandibular and condylar volumes, and changes in condyles-glenoid fossa positional changes.

DISCUSSION

From the conclusions derivable across the included investigations [14-24], upon collective analysis, it is crystal clear that most of the studies discussed in the chapter share a common understanding that orthopaedic appliances are very effective in treating different types of malocclusions among paediatric patients: Ciavarella et al [14], Fichera et al [15], Inchingolo et al [16], Inchingolo et al [17], Lo et al [18], Lo Giudice et al [19], Marra et al [20], Ortu et al [21], Patano et al [22], Ronsivalle et al [23], and Scribante et al [24]. In general, the inference from these studies is that an orthopaedic appliance can be a very useful adjunct to an interceptive orthodontic treatment in correcting various bad oral habits, malocclusion, and posture in growing patients.

Ciavarella et al [14], Fichera et al [15], and Lo et al [18] were all able to conclude that elastodontic appliances are effective in treating Class II malocclusion. In fact, Fichera et al [15] reported this appliance as successful in interceptive orthodontic treatment in growing patients. This tends to suggest quite strongly that these three studies present a consensus on the efficacy of this appliance in treating Class II malocclusion.

Successive corrective treatments of hyperdivergent Class II malocclusion, with the improvement of posture by AMCOP EA therapy, were reported by Inchingolo et al. [16], and AMCOP Bio-Activators by Inchingolo et al. [17] in growing patients. Similar results were found by Marra et al. [20] and Lo Giudice et al. [19] about corrective treatment for bad oral habits and malocclusions by bioactivator therapy and orthopaedic appliances, respectively.

Ortu et al [21] and Patano et al [22], in similar studies, reported Occlus-o-Guide was less effective than the EQ Series II in overjet and overbite reduction and recorded an increase in the cross-sectional area of the airway after functional EA therapy in skeletal Class II patients.

Ronsivalle et al [23] and Scribante et al [24] performed complementary studies where the former concluded that both appliances have equal efficiency in correcting malocclusion Class III, whereas the results of a study by Scribante et al [24] pointed out the effectiveness of Froggy Mouth appliance by improving the dimension of dental arches.

Among the differences, the appliances studied are different; Ciavarella et al [14], Fichera et al [15], and Lo et al [18] investigated EA, while Inchingolo et al [16] and Inchingolo et al [17] studied AMCOP elastodontic therapy and AMCOP Bio-Activators, respectively; Marra et al [20] and Lo Giudice et al [19] investigated bioactivator therapy and orthopaedic appliances, respectively.

Moreover, the particular results reported to have been achieved as an outcome of the treatment were different in the various studies: Ortu et al [21], effectiveness of EQ Series II; Patano et al [22], effectiveness of functional EA therapy; Ronsivalle et al [23], effectiveness of appliances in the correction of Class III malocclusion; and Scribante et al [24], effectiveness of appliances in improving dental arch dimensions.

Antonarakis et al [25] concluded that age, previous pain experience, and levels of IL-1β are associated with orthodontic pain and discomfort; and Arponen et al [27] noted that headgear activator and twin-block appliances are used by patients less than recommended, although treatment compliance varies between individuals. Pedrin et al [32] concluded that high-pull chincup therapy using a removable appliance combined with a palatal crib had no favorable skeletal effect on the vertical facial pattern. Taken together, these studies suggest that comfort and adherence of the patient can be critical to orthodontic treatment outcomes.

Some of the studies [26, 29-31, 33] stressed their research work in different orthodontic treatments in relation to changes it creates on the craniofacial structure, particularly about the development of the skeletal tissues. Julku et al. [26] find early treatment with cervical headgear affects craniofacial structures and pharyngeal airway dimensions, while de Souza et al. [29] have reported mini-implants as an option in order to correct Class III malocclusion due to maxillary deficiency. Galeotti et al [30] and Lin et al [31], respectively, studied the effectiveness of various other therapies for early correction of Class III malocclusion.

Galeotti et al. [30] established the efficacy of both PS3 and RME/FM therapies while Lin et al. [31] reported that the OMA appliance was effective in the correction of skeletal Class III malocclusion in growing children. Husson et al [33] reported that chin cup therapy has influence on mandibular and condylar growth in skeletal Class III malocclusion children. These studies taken together show that many forms of orthodontic treatment influence craniofacial development and skeletal growth of children. The work carried out by Seiryu et al [28] is unique as it reports on the comparison of facemask therapy with mini screw and investigates that it has lesser undesirable side effects and also is able to apply the orthopedic force more effective.

The use of interceptive orthodontics significantly reduces the need for future fixed treatments, which simplifies the entire treatment process. Elastic appliances appear to be useful in the interceptive treatment of selected malocclusions, reducing the complexity of fixed therapy during later phases of treatment.

A case report recently illustrated the effectiveness of EAs in treating a 13-year-old patient who presented with a Class I malocclusion exhibiting severe crowding of both arches and supported by a skeletal Class II base [34]. There was also the presence of an increased overjet of 4 mm and an overbite of 4.5 mm, with a deep curve of Spee and an upper midline that was shifted to the right. After 4 months of active treatment with EA and myofunctional therapy, the overbite had reduced and the anterior teeth were correctly aligned, while there was slight mesial tipping of the first molars.

Interceptive orthodontic treatment with the use of orthopedic appliances for growing patients is gaining much popularity among orthodontists and pediatric dentists alike [12-15, 35]. Despite the growing interest, however, substantial evidence to advocate the use of orthopedic therapy in mixed dentition is still lacking in the literature since only case reports and retrospective studies have been reported so far.

Our study suggested that orthopaedic appliances can be a useful adjunct to interceptive orthodontic treatment in correcting bad oral habits, malocclusion, and posture in growing patients. In contrast, the reviews by Marcílio et al [36], Carvalho et al [37], Ronsivalle et al [38], Chiquet et al [39], and Bariani et al [40] focused on specific aspects of orthopaedic appliances, such as their effects on anterior open bite, obstructive sleep apnoea, and mandibular deficiency.

Marcílio et al [36] found that orthopedic functional appliances improved overbite and the angulation of upper incisors to the palatal plane in children with anterior open bite. Carvalho et al [37] reported inconsistent results for the effects of oral appliances or functional orthopaedic appliances on obstructive sleep apnoea in children. Ronsivalle et al [38] highlighted the potential of elastodontic appliances in managing mild-to-moderate malocclusion in children as an adjuvant therapy to interrupt spoiled habits. Chiquet et al [39] emphasized the importance of presurgical infant orthopedic appliances in reducing the severity of cleft lip and/or cleft palate. Bariani et al [40] found that functional orthodontic appliances improved the apnea-hypopnea index score and enlarged the upper airway in children with obstructive sleep apnoea.

In terms of bite force, our study did not specifically investigate its relationship with orthopaedic appliances. However, the studies by Marcílio et al [36] and Bariani et al [40] indirectly touched upon bite force by assessing the effects of orthopaedic appliances on overbite and upper airway dimensions. Regarding aesthetic considerations, our study did not explicitly explore this aspect. However, the studies by Ronsivalle et al [38] and Chiquet et al [39] hinted at the potential aesthetic benefits of orthopaedic appliances in improving dental arch dimensions and facial appearance.

Limitations

The slight heterogeneity of the reviewed studies might have had an effect of biasing the outcome. The review was also limited to studies published in the English language, thus excluding relevant studies published in another language. A variety of outcomes and measurements had been used across the selected studies, which precluded the determination of more general results.

Clinical recommendations

Based on these results, the use of an orthopaedic appliance to treat malocclusions in children is recommended for the paediatric dentist and orthodontist. Further research will be required to standardize the outcomes that need to be measured when testing the appliance in various clinical situations. Additional studies are also warranted to examine the long-range effects that orthopaedic appliances could have on oral and general health among children. In particular, orthodontists and paediatric dentists should consider using headgear to treat Class II malocclusions, especially those with a high mandibular plane angle, as it has been shown to be effective in reducing overjet and overbite, and improving facial aesthetics.

Chincup, on the other hand, should be used to treat Class III malocclusions, particularly those with a low mandibular plane angle, as it has been found to be effective in reducing mandibular growth and improving skeletal relationships. Facemask, meanwhile, should be used to treat Class III malocclusions with maxillary deficiency, as it has been shown to be effective in protracting the maxilla and improving skeletal relationships. It is also crucial to prioritize patient comfort and adherence to ensure optimal treatment outcomes. This can be achieved by educating patients and their caregivers about the importance of consistent wear and proper use of the appliances, as well as by monitoring patient progress and making adjustments as needed.

CONCLUSION

Our review provides evidence to prove that the orthopaedic appliances are efficacious in treating various types of malocclusions in paediatric patients. The findings indicate that these appliances could form a useful adjunct to the interceptive orthodontic treatment which corrects bad oral habits and corrects malocclusion and posture in growing patients. Furthermore, headgear, chincup, and facemask are valuable orthopaedic appliances in treating malocclusions in paediatric patients. They can be used in conjunction with other orthodontic treatments to achieve optimal results. Orthodontists and paediatric dentists should consider the type of appliance and treatment protocol that best suits the individual patient's needs. However, further research is warranted so as to adequately explain the efficacy and optimum use of orthopaedic appliances within paediatric dentistry.

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