Effectiveness of elastodontic appliances in the treatment of malocclusions: a review of the literature

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Abstract

This paper aims to verify the effectiveness of using elastodontic devices in the treatment of malocclusions in growing patients. An English-language literature search was conducted. The following electronic databases were selected for searching from 2020 to June 2023: PubMed, Web of Science, and Scopus. Eight articles were included based on the inclusion and exclusion criteria. The articles examined highlight the ability of elastodontic devices to act in cases of malocclusion in a safe, simple and more comfortable way for the young patient. However, there is a lack of knowledge about this technique, so this study aims to review the most recent literature to provide the scientific community with new knowledge.

KEYWORDS Elastodontic Appliances, Malocclusions, Overbite, Overjet.

Introduction

According to WHO, malocclusion is the third most common oral disorder after tooth decay and periodontal disease. According to a recent review of the literature, in the Caucasian population, Class I malocclusion is the most frequent, with a mean prevalence of 51.9 percent (SD 20.7). Class II and Class III malocclusions have a mean prevalence of 23.8 percent (SD 14.6) and 6.5 percent (SD 6.5), respectively [De Ridder L et al., 2022]. The Caucasian population has the highest prevalence of Class II malocclusion compared to the rest of the world [Alhammadi et al., 2018]; Class II malocclusion is characterised by an altered relationship of the maxillary bone bases, due to mandibular hypomandibulism or retrognathia [McNamara, 1981]. Subjects with Class II present retruded chin, labial incompetence, and respiratory problems [Kaur et al., 2022]. Compared to Class I and III subjects, these subjects exhibit a hypo-development of the upper airway. [Li et al., 2021]. Nowadays, orthodontists have a wide range of therapeutic devices to treat malocclusion. One of these new techniques is called "elastodontics". Elastodontics is an interceptive therapy that involves using removable silicone appliances of varying rigidity. These appliances can be used in children without requiring impressions, and the appropriate size of the appliance is chosen to fit the patient's mouth. Adjustments can easily be made according to the operator's needs [Ortu et al., 2021]. These devices are capable of both dental and orthopaedic action. In recent years, this technique has gained more acceptance as a simple technique with greater comfort and compliance by young patients. Elastodontic devices can be used in clinical practice to treat malocclusions, overjet and overbite, tooth crowding and anomalies of tooth position by giving a new direction of growth to the patient's stomatognathic apparatus. They can modify and eliminate functional disorders of the oral cavity, improving swallowing, posture and breathing problems. Elastodontic devices are valuable aids for guiding tooth eruption since they are constructed with the ideal position of the tongue and perioral muscles in mind. They can be used concurrently with other orthodontics therapy [Ortu et al., 2021]. However, few studies exist regarding the use of elastodontic devices in clinical practice. As such, this study aims to conduct a thorough survey of the scientific literature to give a clear view of the effectiveness and advantages of the still little-known elastodontic technique in the treatment of malocclusions.

Materials and methods

The inclusion and exclusion criteria of studies from the review were determined in patients under 14 years old by the PICOS methodology, the name of which is an acronym for the following (Table I). For each type of criteria, the inclusion was of paramount importance, and only after its fulfilment was the exclusion criteria verified. A literature search was performed by searching English-language articles. The following electronic databases were selected for search from January 2020 to June 2023: PubMed, Scopus, Web of Science. Two reviewers (EO and AM) performed the database queries independently according to the keywords listed in Table II. Animal studies, abstracts, letters, case reports, and reviews were excluded. Disagreement regarding inclusion was resolved by discussion.

Database	Search Strategy Keywords/MeSH
Pubmed *http://www.ncbi.nlm.nih.gov/pubmed/*	*Elastodontic device(s) OR Elastodontic treatment(s) OR Elastodontic appliance(s) OR*
Scopus *www.scopus.com/home.url*	*Elastodontics OR Elastodontic technique AND*
Web of Science *https://www.webofscience.com/wos/woscc/basic-search*	*Malocclusion(s) OR Dental malocclusion(s) OR Malocclusion, Angle I OR Malocclusion, Angle II OR Malocclusion, Angle III OR Overbite OR Overjet*

TABLE 2

Criteria	Inclusion criteria	Exclusion criteria
Population	Growing patients (<14 years)	Adult subjects
Intervention	Patients with Class II malocclusions, overbite, overjet	Previous orthodontic treatment, systemic problems and craniofacial syndrome
Control	Any o none	
Outcome	Improvements of malocclusions with EA	

TABLE 1 Criteria for including studies in the review.

To avoid inappropriate exclusions, adjectives, nouns, and plural and singular forms of all terms were used. Disagreement regarding inclusion was resolved by discussion. To avoid inappropriate exclusions, adjectives, nouns, plural and singular forms of all terms were used.

The search resulted in a total of 19 articles, and a final eligibility screening was conducted to verify the agreement with the inclusion and exclusion criteria listed in Table II. A total of 8 articles were included according to both inclusion and exclusion criteria, as shown in the PRISMA flow chart (Fig.1).

Results

Eight studies were identified for the aim of this paper (Table III). Ortu et al. [2021] analysed the different results obtained after treating overjet and overbite cases using two different types of elastodontic devices. The test group included 30 patients (14 males, 16 females; mean age, 10.66 ±2.12 years) and it was treated with the EQ (Equilibrator) Eptamed Series II, while the control group was composed of 30 patients (15 males, 15 females; mean age, 10.76 ± 2.52 years) and was treated with the Occlus-o-Guide ®.In both groups, the subjects had dental Class II malocclusion, overjet, and overbite. Treatment was divided into two times: T0 corresponded to the start of therapy, and then each patient was reassessed at T1 after 1 year. At the end of the treatment, there was a reduction in overbite and overjet in both groups, with an overall improvement in patients' occlusion. In particular, subjects who used the Eptamed device experienced a more significant reduction in overjet and overbite than those in the control group, with a p-value of 0.0019.

Lo Giudice et al. [2022] conducted a prospective study evaluating the use of elastodontic devices in mixed dentition subjects with a Class II sagittal discrepancy. In addition, the growth pattern of the palate during treatment was assessed using 3-D imaging technology. The study included young patients After treatment (T1), the study group showed a reduction in overjet and improvement in overbite compared with the control group, in which both parameters worsened slightly. Moreover, the use of the elastodontic device reduced the extent of anterior tooth crowding, which was slightly increased in patients in the untreated group. At the beginning of treatment, both groups had asymmetric palate development on 3D analysis, probably due to asymmetry of the perioral muscles. After 1 year of treatment, 3D analysis showed an improvement in palate asymmetry in the group undergoing treatment, compared with controls. In a further study, Lo Giudice et al. [2023] analysed changes in palate size in children with cross-bite after 1 year of treatment with EA, compared to an untreated control group. A 3D imaging technique was used to superimpose intraoral scans

First Author	Publication Year	EA protocol	Results
Ortu	2021	Equilibrator Eptamed Series II during the night for 1 year	EQ caused a more significant reduction of the overjet and the overbite than the Occlus-o-Guide®
Lo Giudice	2022	Class II AMCOP® SC bio-activator during the night and 1 hour a day for 1 year	AMCOP® caused a reduction of the overjet and overbite and an improvement of anterior dental crowding
Lo Giudice	2023	AMCOP® Integral/Basic activator at night and 2 hours per day for 1 year	In children with crossbite AMCOP® caused an increase in the size of the palate and a reduction of palate asymmetry
Fichera	2021	AMCOP® second class (SC) at night and 1 hour a day for 1 year. During the day, patients had to bite the device while keeping their lips in contact	AMCOP® caused a reduction of crowding, overjet and overbite. There was an increase in Class I relationships
Inchingolo	2022	AMCOP® in hyperdivergent children for 16-18 months. AMCOP® was used during the night and for 1 hour a day for 6-8 months, then only at night.	The device caused a reduction of hyperdivergence and overbite. Moreover, there was an improvement in the width of the upper ways
Patano	2023	AMCOP® for 3 years	AMCOP® yielded to an improvement of the upper ways dimensions.
Ortu	2020	EMG analysis after 6 months of treatment with EQ OSA Eptamec (cases) and Occlus-o-Guide® (controls).	No significant difference
Ravera	2020	EF appliances for 12 months in 40 subjects with Class II malocclusion	EF appliances made an elongation of mandibular length and an improvement of the central upper incisors' position

TABLE 3 Characteristics of the selected studies

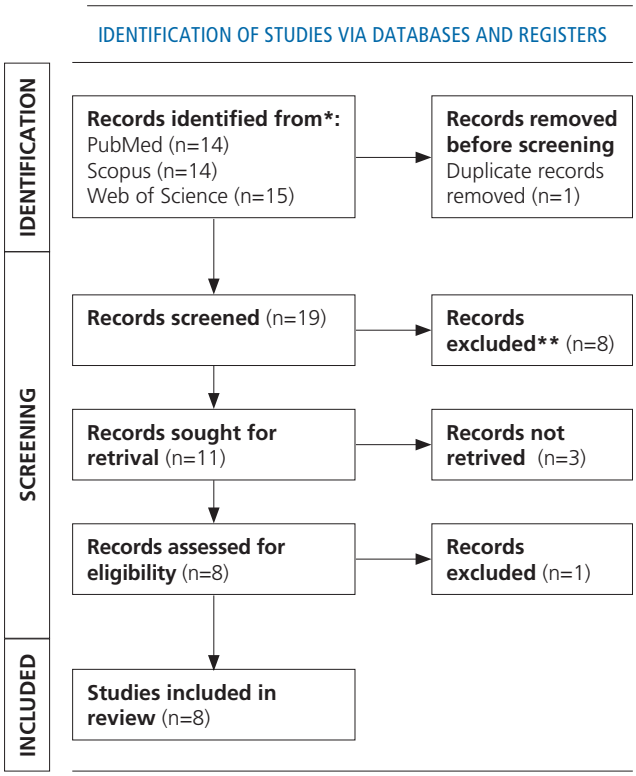

FIG. 1 PRISMA flow diagram showing the stages of study selection.

on T0 and T1. Four indices were used to assess changes between T0 and T1: the inter-canine (ICW) and inter-molar widths (IMW) and the corresponding emi-lateral measurements (eICW and eIMW) using the median palatine plane as reference. Before treatment, in both groups, eICW and eIMW parameters were reduced on the cross-bite side compared to the side without cross-bite. After treatment with EA, the case group showed an increase of ICW and IMW, a reduction of the differences of eICW and eIMW between the two sides and a more significant overlap of the palate images. This means a decrease of palate asymmetries. Fichera et al. [2021] conducted a retrospective study of children with malocclusion. The study aimed to evaluate possible dental and bone changes after 1 year of EA treatment [AMCOP® second class (SC)]. Forty children were recruited, divided equally into cases (8 males, 12 females, mean age 8.4 ± 0.6 years) and controls (9 males, 11 females, mean age 8.1 ±0.8 years). Patients in both groups underwent lateral cephalograms before treatment (T0) and after 1 year (T1). The test group had to wear the device at night and for 1 hour a day; during the day, patients had to bite the appliance while keeping their lips in contact. In the case group, following EA treatment, there was a reduction in tooth crowding and a Class I molar relationship, and overjet and overbite improved. On cephalometric analysis, SNBˆ, ANBˆ, and IIAˆ increased, while angle SNAˆ showed no significant changes. In the untreated group, there was an increase in subjects who developed tooth crowding and a worsening of the Class II molar relation. The overjet and overbite worsened slightly, especially the overbite. According to Inchingolo et al. [2022] the elastodontic device, in addition to acting on overjet, overbite and molar Class II, can be a valuable therapeutic tool in cases of hyperdivergent growth pattern. 21 patients were recruited (10 males and 11 females, mean age 8.22 ±1.17 years), and they underwent therapy with the AMCOP® (Armonizzatori Multifunzionali Cranio-Occluso Posturali) device for 16–18 months. In the first 6–8 months, the device had to be worn 1 hour per day, throughout the night, and for the following months, only at night. Intraoral photos, extraoral photos, orthopanoramics and lateral cephalograms were requested for each patient before and after treatment. The results can be summarised as follows: on the vertical plane, there was an increase in PFH/AFH and a reduction in Sna-Snpˆ Go-Gn and S-Nˆ Go-Gn. In the sagittal plane, there was a significant mandibular advancement with a reduction of the ANB angle. At the dental level, the overjet and Sna-Snpˆ Go-Gn, S-Nˆ Go-Gn, and Ar-Go-Me were reduced. Moreover, significant positive changes in upper airway width were found following treatment. Thanks to the results achieved, it can be said that the proposed protocol effectively treated hyperdivergent patients with skeletal Class II malocclusion. However, one of the limitations of this study is the lack of evaluation of the maintenance of results in the long term. The AMCOP® device was also used in the study of Patano et al. [2023]. In this case, the research aimed to evaluate the efficacy of elastodontic devices to increase the upper airway and hyoid bone position size in subjects with molar Class II, who generally may manifest respiratory problems. 68 patients were recruited divided into two groups: the test group, which underwent Class II treatment with AMCOP®, consisted of 33 patients (19 females and 14 males, mean age: 8.9 ±1.6 years), while the control group did not undergo treatment and consisted of 35 patients (17 females and 18 males, mean age: 8.9 ± 0.4 years. Cephalometric tracings were requested from both groups at the beginning and end of treatment after 3 years. At the end of treatment, the study group showed statistically significant differences from T0 in both the hyoid bone position parameters (IAS, SPAS and MAS) and the airway parameters (H-C3 horizontal, H-C3 vertical, H-H0, H-Rgn, H-SN). In particular, the SPAS value increased, improving upper airway dimensions. Moreover, there was a reduction in the ANB angle; this presupposes a rebalancing of normal sagittal plane relationships of the maxillary bone bases. The present study confirms the ability of elastodontic devices to act on children with Class II by expanding the upper airway, leading to improvements in swallowing, phonatory, and masticatory levels. Finally, the article by Ortu et al. [2020] gives a different view on the use of elastodontics in the dental setting: the study aimed to confirm that elastic devices were more comfortable for patients. To verify their clinical validity, electromyographic examinations were performed on two different devices (EQ OSA: Eptamed and Occlus-o-Guide ®: Sweden and Martina, Via Veneto, 10, 35020 Due Carrare, Padova, Italy) at the beginning of treatment and after 6 months. 66 patients were enrolled for the study and divided into two groups: the test group was composed of 36 patients (18 males and 18 females, mean age: 9.19 ± 1.43 years) treated with EQ OSA device, the control group was composed of 30 patients (15 males, 15 females, mean age: 9.19 ± 1.41 years) and they were subjected to treatment with Occlus-o-Guide®. Each patient underwent sEMG analysis at baseline (T0) and after 6 months of treatment (T1). EMG activity was recorded using an eight-channel Myotronics K7 Evaluation System, and the registration of Scan9 was completed for each patient at T0 and T1 to assess the muscle tone during the rest position. The electromyographic values of patients treated with EQ OSA and Occlus-o-Guide® after 6 months did not show a statistically significant difference, even though the subjects who wore EQ OSA displayed a greater relaxation of muscle tone. This study shows that elastodontic devices, in addition to their already-known abilities, are much more comfortable for the patient.

This is an essential prerequisite for maximum cooperation from the small patient during treatment. Ravera et al. [2020] evaluated the effectiveness of some functional devices in pre-pubertal subjects with skeletal Class II, particularly at the CVM2 and CMV3 stages of cervical vertebral growth. Eighty subjects were recruited; half were part of the study group (including 20 pre-pubertal age, CVM2, and 20 pubertal age, CMV3) treated with EF devices, and the other half was part of the control group, untreated subjects. At both T0 and T1, all patients underwent laterolateral cephalogram. Notably, at the comparison of the study group with the control group of stage CVM2, there were significant changes at the dental level regarding the upper central incisors: 11^SpP decreased by 8.28° (-11.77/-4.80, 95% CI, p=3.8 e-5), 11^41 increased by 5.37° (1.01/9.73, 95% CI, p=0.021). With regard to the CMV3 stage, there were important differences at both dental and skeletal levels; in particular, the efficacy of EF appliance in stimulating mandibular elongation in patients with retruded mandible at CVM3 when compared to untreated subjects was seen. Although the main limitations of this study were the retrospective design and, as many previous ones, the lack of consideration for effect variations due to compliance and individual biological responsiveness.

Conclusion

The purpose of this study is to evaluate the effectiveness of elastodontic devices in the treatment of malocclusions. Elastodontics is a branch of interceptive orthodontics that uses practical removable appliances that are easily tolerated by the patient. These devices can prevent early malocclusions, lingual malposition cases and respiratory problems [Fleming, 2017]. Furthermore, these devices can also be used to prevent or eliminate bad habits in the young patient, and thanks to their structure, they guarantee the correct eruption of the teeth.

According to Nisula et al. [2020], elastodontic devices are most effective in treating Class II malocclusions in subjects with early mixed dentition. In fact, following the use of these devices, none of the patients treated required a second phase of treatment. Therefore, the results obtained in early mixed dentition remained stable also in early permanent dentition. Moreover, a recent literature review [Migliaccio et al., 2014] has stated that elastodontic devices are most capable of acting in patients with Class II division 1. They can increase the mandibular length by restoring the dentoalveolar component, and they can correct overjet and overbite in mixed dentition. Furthermore, it has been seen that they can solve other cases of malocclusion, like crowding, rotations and little midline discrepancies. In conclusion, it can be deduced that elastodontic devices can be a valid therapeutic aid in children with malocclusion as they are easy to wear, removable and do not require dental impressions before use. However, a significant limitation is the presence of little scientific literature to support this method, so it is necessary to carry out further studies with a larger sample in the future.

Declaration Section

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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