Efficacy of elastodontic devices vs clear aligners in lower dental arch crowding reduction assessed by computer-aid evaluation.

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Abstract

Background: this pilot study aim to verify the efficacy of two orthodontic appliances in the treatment of the lower arch crowding in the growing patients. Methods: twenty patients aged 7–15 years were enrolled in the study, and separated into test and control groups. The test group included 10 patients (5 males, 5 females; mean age, 10.4 ± 1.57 years), who were treated with an elastodontic device. The control group included 10 patients (5 males, 5 females; mean age 10.8 ±1.53 years), who were treated with clear aligners. Dental lower crowding were evaluated at two timepoints with intraorla scans: T0 (before starting therapy) and T1 (after 1 year). Results**:** there was not statistically significant difference between the two groups at T0 and T1 ($p<0.005$). Conclusion: elastodontic devices and clear aligners can help succesfully the orthodontist in the treatment of the lower crowding. This appliances are comfortably to wear, simply to clean everyday and reduce the number of dentist appointments. Finally, but not in order of importance, these devices have allowed to dentists to continue the orthodontic treatments during the lockdown during the covid 19 pandemic.

Keywords

Orthodontics, Elastodontic device, clear aligners, dental crowding

Introduction

One of the most frequent malocclusion in Caucasian subjects seems to be dental lower crowding. The Third National Health and Nutrition Examination Survey of 1988–1994 (NHANES III) reported in its data, based on occlusal examinations performed on more than 7000 individuals between 8 and 50 years of age collected during the first half of the survey, that 21.9% of the population in the United States had a zero mandibular incisor irregularity index (II); approximately 30% had clinically significant irregularity, and 15% had severe irregularity. Finally, the NHANES III showed that the mandibular II increased with age, from 1.6 mm between 8 and 11 years to 2.5 mm between 12 and 17 years, and then to 3.0 mm between 18 and 50 years. Longitudinal studies have also shown that the incisors become more crowded after the permanent dentition is totally erupted (1-4). These orthodontic defects can be associated or not associated with skeletal malocclusions, causing aesthetic and periodontal issues to patients . The etiological causes remain uncertain; however, early treatment of mixed dentition is strongly recommended. There are many devices on the market aimed to treating this type of defect, even though nowadays more and more patients and dentists prefer to use elastodontic devices and clear aligners. The term Elastodontic refers to a specific type of interceptive orthodontic treatment based on the use of removable elastomeric devices (5). These devices are characterized by an extreme simplicity in terms of use by the patient, by safety and by construction. Elastodontic devices allow the dentist to finalize the treatment and create a harmonious and natural smile, obtained with comfortable and non-invasive appliances. The aim is to achieve balance in the oral cavity, without creating problems in other areas of the body. All of this can be obtained by stimulating the patient by using his own strengths (tongue and chewing muscles) , his own growth and his natural remodeling potential to solve the problem of malocclusion (6). On the other hand, the clear aligners allow to reach the maximum clinical results while maintaining the aesthetics of the single subject. The aligner grants the control of 3D movements by holding teeth on all the surfaces (vestibular, palatal-lingual and occlusal) and by applying proper forces thanks to attachments of different size and shape and other specific features. One of the limitations of the technique is the impossibility of evaluating the neuromuscular approach in the diagnostic phase and also during the orthodontic therapy(7). This study's purpose is to verify the clinical effect in reducing lower arch crowding with these devices (EQ Series CP [Eptamed] versus Invisalign).

The authors of this pilot study compared dental records before treatment and 12 months after treatment. The results are expected to provide guidelines on the most suitable devices for use in orthodontic practice.

Material and methods

Study sample

This study was carried out in accordance with the fundamental principles of the Declaration of Helsinki. It was approved before commencement by the Ethics Committee of the University of L'Aquila, Italy . Sixty patients aged between 6–16 years were clinically examined at the Dental Clinic of the University of L'Aquila, Italy. The same clinician performed all examinations. Examinations included the acquisition of dental panoramic radiographs according to European guidelines on radiation protection in dental radiology, extraoral and intraoral photographs, and alginate impressions of both dental arches. Based on these data, the orthodontist created a treatment plan personalized to each patient, following the Index of Orthodontic Treatment Needs (IOTN) described by Brook and Shaw (8). The following exclusion criteria were applied: IOTN index > 4; presence of epilepsy, systemic disease, TMD, or periodontal disease; and lack of written informed consent from a parent or legal guardian. Inclusion criteria were: skeletal and dental class I malocclusion; and the presence of lower crowding.

Ultimately, 20 patients aged 7–15 years were enrolled in the study, and separated into test and control groups. The test group included 10 patients (5 males, 5 females; mean age, 10.4 ± 1.57 years), who were treated with the EQ Series CP. The control group included 10 patients (5 males, 5 females; mean age 10.8 ±1.53 years), who were treated with clear aligners. The two groups exhibited the same orthodontic features. Dental lower crowding were evaluated at two timepoints: T0 (before starting therapy) and T1 (after 1 year). Scans of the dental arches of the two groups were taken by the same orthodontist (AM) at T0 and T1. Variables of the study were the distance between the lower canines, which were evaluated using this virtual digital technique.

Experimental settings

Each patient in the test group received a medium hardness orange Equilibrator, CP model ,that was suitable for their dentition phase (9). This device had a similar shape to a mouthguard, and embraced both dental arches, reaching distally to cover the last molars present in the arch. There are several measures, based on the distance between the palatal cusps of the first premolars or deciduous molars. The patient inserts the activator on the upper and lower splints over their teeth. The device is activated by biting down on it , activating the soft elastic forces generated by muscle

energy and is worn mostly overnight. This new type of orthodontic device is called Equilibrator . It is innovative in its structure because it stimulates the maxillary growth and as a consequence of the muscle movements, elicits tissue development in order to gain a suitable chewing function. The patient, biting down onto this elastomeric tray, balances the tension of the Sphenobasilar Synchondrosis compression , based on osteopathic medicine and philosophy (6, 9). Subjects enrolled in the control group were asked to change the preformed clear aligners that had been previously delivered to them on a weekly basis. These aligners should be worn as much as possible throughout the day and should be removed only to eat. The orthodontist has checked the patients every 30 days to evaluate eventual modifications to optimize the execution of the device.

Results

Due to small sample size, data were analyzed using the nonparametric approach trough Wilcoxon signed-rank test. Statistical significance was set at $p < 0.05$. There was not statistically significant difference between the two groups at T0 and T1.

	Stratified by treatment		
	Eptamed	Invisalign	p
n	10	10	
sex = M (%)	5 (50.0)	5 (50.0)	1.000
age (mean (SD))	10.40 (1.58)	10.80 (1.62)	0.583
T0 (mean (SD))	26.75 (1.58)	26.39 (1.47)	0.605
T1 (mean (SD))	27.14 (1.45)	27.19 (1.05)	0.931
T2 (mean (SD))	27.08 (1.44)	27.11 (1.04)	0.958

Table I: Results of the study between the two group. Statistical significance was set at p <0.05

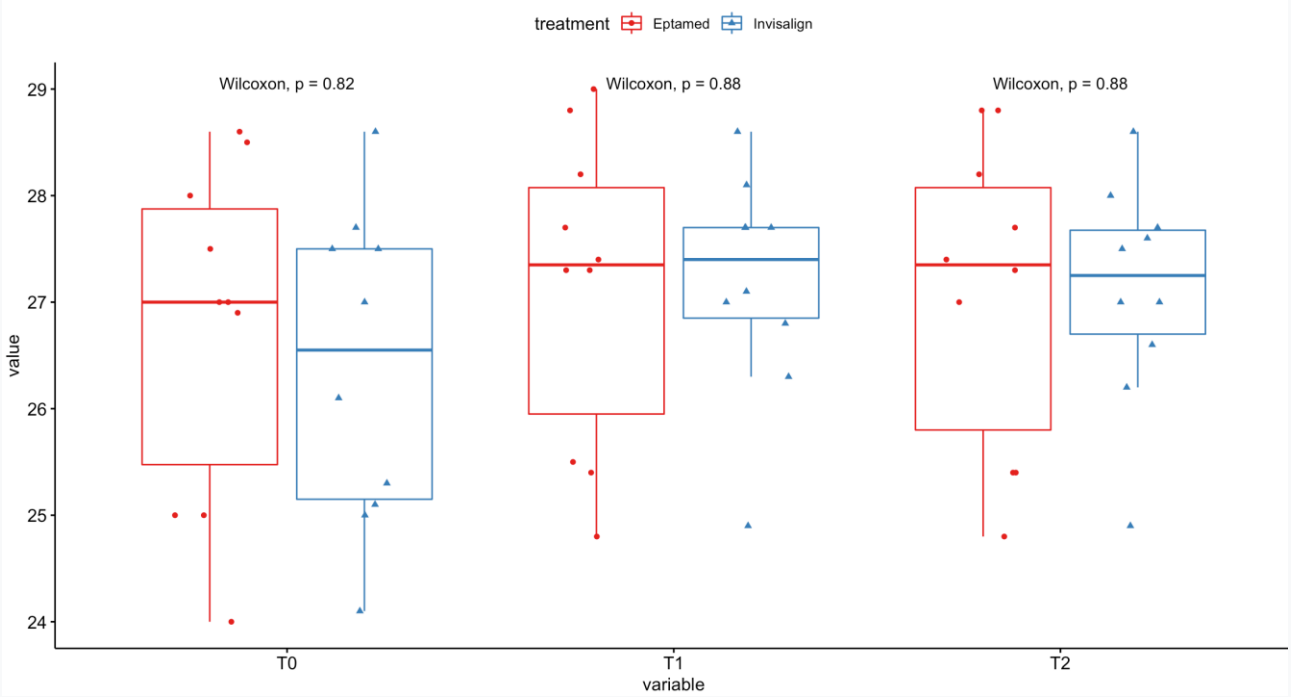

Fig.1: Bar plot of total lower crowding values stratified by timing according to group "Eptamed" and "Invisalign"

Discussion

From the results of this pilot study, it emerged that the two devices analyzed have no statistically significant differences in terms of alignment of the lower dental arch as shown in Table I and Figure 1. Clear aligners are an aesthetic and comfortable option for orthodontic treatments and have gained immense popularity over the last decade. These devices' main focus is to have a natural and ergonomic treatment experience, to facilitate oral hygiene, to cause less pain as compared to fixed orthodontic procedures, to reduce the number and duration of appointments, and to require less emergency visits. Most of the time ,unfortunately, the costs of the therapy do not always allow the dentist to choose the aligners over the most common options (9). In recent scientific literature, authors who have studied the effectiveness of clear aligners show different results. As analyzed in the article of Gatto et al., clear aligners have a biomechanical action to control the incisors inclination, that could be attributed to its structure, that surrounds the tooth crown surface (7). Also, Kassas et al. reported that the clear aligner system is effective in leveling and aligning arches in mild and moderate cases and also, in correcting buccolingual inclinations effectively. However, it is not sufficient for providing an ideal occlusal contacts of the posterior teeth . Their deterioration is caused by the thickness of the aligners, which interferes with the settling of the occlusal plane (4) Yıldırım et al. investigated that the effectiveness of the teeth movements was due to the use of clear aligner devices. In their study, the retrusion of the mandibular central incisors was considered to be

the most accurate single-tooth movement but long term stability studies still need to be presented on this matter (10). It might also be noted that , the elastodontic devices are valid aids for early treatments, reconditioning the natural growth forces of neuro-musculo-skeletal system to correct malocclusions. Recent studies demonstrate as these device are optimal in all the stomatognatic system, the absence of indentations allows simultaneous involvement of both dental arches with the repositioning multidimensional orthopedic effect and gives teeth freedom to find their position without any pressures (5). Here, in this study demonstrated how elastodontic devices could be used in addition to correcting lower arch crowding such as the clear aligners, and to improve the general condition of the body. Both techniques analyzed here improved the degree of lower dental arch crowding between T0 and T1, even 1-year after the start of therapy. The limitations of this study include the small sample size and relatively short (12-month) orthodontic evaluation period. It would be useful to repeat this study with a larger, and possibly more homogeneous, cohort.

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