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Major considerations and clinical outcomes of aligner plates in orthodontic treatments to achieve dental harmonization: a concise systematic review

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Abstract

Introduction: Harmonized teeth are synonymous with a healthy mouth, and age is no longer an obstacle to starting orthodontic treatment. There are numerous options involving technologies that serve people of the most varied ages and lifestyles. Among them, the aligner plates are ideal for those who want to correct imperfections in the dental position. **Objective:** It was to carry out a concise systematic review to highlight the main considerations and clinical outcomes of aligner plates in orthodontic treatments to achieve dental harmonization and aesthetic balance. **Methods:** The systematic review rules of the PRISMA Platform were followed. The search was carried out from December 2022 to February 2023 in the Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases, using articles from 2012 to 2022. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed accordingly, according to the Cochrane instrument. **Results and Conclusion:** A total of 68 articles were found, 22 articles were evaluated and 16 were included and developed in this systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 14 studies with a high risk of bias and 22 studies that did not meet GRADE. It was concluded that the aligners are created by computer software, require only one impression, require a few additional tests, and allow excellent predictability of the treatment when used within their indications. They have a satisfactory aesthetic level, are comfortable, easy to clean, and cause less trauma when compared to conventional fixed appliances. However, serious skeletal discrepancies cannot be treated with the aligner plates, there may also be non-cooperation on the part of the patient, in which the use of the device is insufficient, making the treatment ineffective, high cost, slight intrusion of posterior teeth may occur, speech disturbances, dysphagia, and increased salivary flow.

Keywords: Orthodontics. Dental aesthetics. Aligner plates. Harmonized teeth.

Introduction

Harmonized teeth are synonymous with a healthy mouth, and age is no longer an obstacle to starting orthodontic treatment. There are numerous options involving technologies that serve people of the most varied ages and lifestyles. Among them, the aligner plates are ideal for those who want to correct imperfections in the dental position [1]. The aligner plates are transparent acetate orthodontic appliances, used to harmonize the smile through the movement of the teeth. In addition to being completely transparent, and not affecting aesthetics, these plates can be removed so that the patient can have his meals free of any interference and discomfort [1,2].

The great advantage is when brushing, which ensures more efficient hygiene, preserving teeth and gums. The aligner plates are indicated especially for collaborating patients, as this technique requires the use of the plates for at least 18 hours a day. To make the aligner plate, a scan of the patient's mouth is performed, followed by a digital set-up, in which the dental movements are all planned by the orthodontist and projected into the software. A digital model is printed in 3D and over it, the plate is stamped with all the necessary activations so that the treatment can be performed with greater precision and comfort. An

average of 20 pairs of plates are used throughout the entire treatment, which must be planned by a specialized orthodontist [1-3].

Still, aligner plates are also a good treatment option for people who need an implant to achieve complete tooth harmonization. The prosthetic space created by tooth loss, when reduced, must be recovered for the implant to fit. Aligner plates reposition the teeth present in the recovery of this space. Thus, implants and prostheses on implants are installed with occlusion and harmonic aesthetics for the patient. In most cases, implants are installed in the final stage of treatment with aligner plates, in which small movements remain so as not to interfere as an obstacle to tooth movement. The joint completion between these two dentistry specialties leaves the patient with a much more harmonious smile [4,5].

In this context, it is noteworthy that the appearance of teeth directly influences the mental health and behavior of the individual, with the potential to cause various social, professional, and effective restrictions. The use of conventional fixed orthodontic appliances ends up causing discomfort to the patient during the treatment period since these are composed of bands, brackets, wires, and ligatures. These material characteristics ended up forcing orthodontics to evolve, seeking to achieve the much-desired esthetics [6].

At first, the solution to improve aesthetics was the development of fixed appliances with polycrystalline or monocrystalline porcelain brackets, however, it was not a definitive solution, since patients wanted invisible appliances, which would go unnoticed by third parties. With that, invisible aligners ended up becoming a great ally. Individuals looking for aesthetic orthodontic treatments are adults who are motivated and concerned about their appearance, which was generated by pressure from society and its ideal beauty standard [7].

Because of this, the present study aimed to carry out a concise systematic review to highlight the main considerations and clinical outcomes of aligner plates in orthodontic treatments to achieve harmonization and dental aesthetic balance.

Methods

Study Design

This was followed by a systematic literature review model on the main clinical findings of mandible fractures, according to the PRISMA rules.

Data Sources and Research Strategy

The literary search process was carried out from December 2022 to February 2023 and was developed based on Scopus, PubMed, Science Direct, Scielo, and Google Scholar, using scientific articles from 2012 to 2022, using the descriptors (MeSH Terms): *Orthodontics. Dental aesthetics. Aligner plates. Harmonized teeth*, and using the Booleans "and" between the descriptors (MeSH Terms) and "or" between the historical findings.

Study Quality and Risk of Bias

The quality of the studies was based on the GRADE instrument, with randomized controlled clinical studies, prospective controlled clinical studies, and studies of systematic review and meta-analysis listed as the studies with the greatest scientific evidence. The risk of bias was analyzed according to the Cochrane instrument.

Results and Discussion

Summary of Literary Findings

A total of 68 articles were found. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not include the theme of this article, resulting in 36 articles. A total of 22 articles were evaluated and 16 were included and developed in this systematic review study (Figure 1). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 14 studies with a high risk of bias and 22 studies that did not meet GRADE.

Figure 1. Selection of studies.

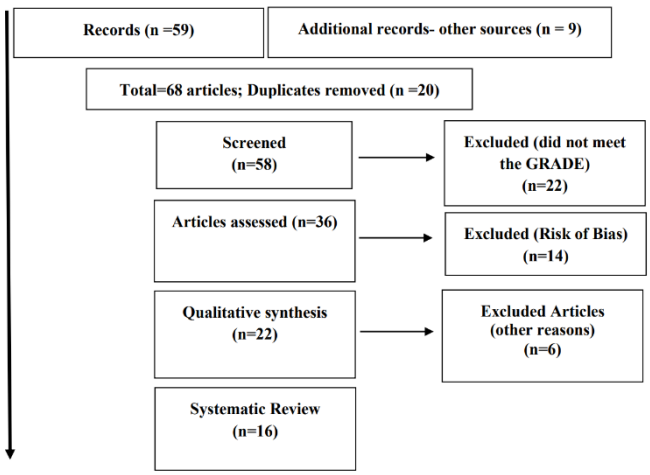
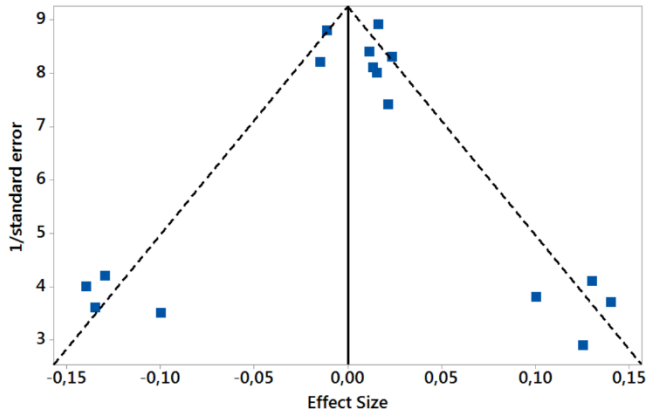


Figure 2 presents the results of the risk of bias in the studies using the Funnel Plot, through the calculation of the Effect Size (Cohen's Test). The sample size was determined indirectly by the inverse of the standard error. The graph showed symmetric behavior, not suggesting a significant risk of bias in studies with small sample sizes, which are shown at the bottom of the graph.

Figure 2. The symmetric funnel plot does not suggest a risk of bias between the small sample size studies that are shown at the bottom of the graph (N = 16 studies).



Source: Own authorship.

Major Findings - Aligner Plates in Orthodontics

The articles selected in the present study showed that the aligners are created by computer software, require only one impression, require few complementary exams, and allow excellent predictability of the treatment, when used within their indications [1,2]. They have a satisfactory aesthetic level, are comfortable, easy to clean, cause less trauma when compared to conventional fixed appliances, are less uncomfortable for patients since they can be removed and placed back without difficulty by the patient, and demonstrate excellent results. in light and moderate crowding [2].

In more complex cases, they allow the implementation of accessories that increase their effectiveness, however, they are not as indicated, as they do not achieve effective results, making conventional fixed appliances continue to be the most suitable for carrying out these treatments. Its use is also limited in the duration of a treatment since it has an open bite of the posterior teeth as a side effect. In addition, their effect may be impaired by negligence on the part of patients for not using them for the ideal time of 22 hours a day. They can be damaged, perforated, or broken, especially by patients with parafunction [1].

Also, the aligners make use of high technology, through computer-aided design (CAD) and computer-aided manufacturing (CAM) to predict the results of orthodontic treatment and then produce several personalized aligners, with a sequence to carry out their use, these are produced with a transparent plastic material, having a thickness of approximately 1 millimeter that covers the entire dental crown and the marginal gum. Each aligner can perform a tooth movement of 0.25 to 0.30 millimeters within approximately two weeks [1,8]. Orthodontic treatments with invisible aligners require successive exchanges, following a specific order, which depends on each case and the cooperation of each patient [8].

The patient is one of the main ones responsible for the treatment and can directly influence its effectiveness, as it is necessary to use the aligners for 22 hours a day so that at the end of 2 weeks there will be a total of 400 hours of use before moving on to the next aligner. When compared with conventional fixed orthodontic appliances, invisible aligners end up favoring better oral health due to the possibility of removing them whenever performing oral hygiene [1,9].

In this scenario, aesthetic orthodontic aligners are an excellent treatment option for simple malocclusions in adults and young people, who are demanding in terms of aesthetics and are not willing to undergo conventional fixed orthodontic treatment using brackets and wires. The Invisalign® mesh treats mild and moderate occlusions, showing good results in cases such as mild and moderate crowding (1-5mm); mild dental malocclusion; deep bite problems (especially class II, division 2 malocclusion); mild to moderate diastemas (1-5mm); recurrence of orthodontic treatments; dental arch atresia of non-skeletal origin (atresia arches that can be expanded without excessive tooth tipping); overbite that can be reduced by intrusion and in cases where the arch perimeter discrepancy, associated with a Bolton discrepancy, which would be resolvable with the extraction of a lower incisor [10].

Even though this system allows the placement of attachments, bonding of buttons to the teeth, and use of intra and intermaxillary elastics, when the case requires these devices and more complex mechanics, it is not possible to guarantee the results using such mechanisms. The Invisaling® system is sometimes able to treat some cases with difficulties, causing doubts as to the effectiveness of the treatment. Examples of

these cases can be mentioned: crowding and spacing greater than 5 mm; anteroposterior skeletal discrepancies greater than 2mm (measured by Class I ratio); teeth with short clinical crowns; tooth extrusions; dental inclinations greater than 45°; Teeth with rotation greater than 20°; anterior and posterior open bite; the discrepancy between centric relation and centric occlusion; arches with multiple tooth losses and as containment in the period after orthodontic treatment [1].

These cases may be factors for not using these devices, due to their complexity and because they lead to an increase in cost and treatment time. The treatment of complex malocclusions, which require extraction of premolars and lower incisors; distalization of molars; accentuated overbite; impacted teeth; patients with periodontal problems, and the lack of compliance by the patient may be examples of cases in which the use of Invisalign® is not indicated. The use of the aligners technique brings several advantages to the patient. Its main advantage is that it is aesthetic, usually made of polyurethane, which is a translucent material that blends with the color of the teeth [1,11].

The patient can remove it to eat, clean, or even go to special situations or events. The preparation of the aligners takes a single impression at the beginning of the treatment, providing comfort to the patient, and speech is usually altered only in the first 24 hours. After eating, the patient will be able to brush their teeth normally and replace the aligners, thus maintaining good hygiene. Predictability in the treatment, through which the patient can see the entire treatment before it even starts. Less soft tissue injuries such as canker sores and more comfort during treatment of injuries caused by appliances [2,3].

In addition, athletes who practice physical contact sports, in which a strong blow can cause major injuries and bleeding that can unbalance their performance in an activity. Possibility of teeth whitening during treatment. Preservation of the buccal surface of the teeth: because they do not have bonded brackets. Lower risk of loss or fracture of porcelain restorations or prostheses and risks to the dental structure: when removing fixed appliances. It manages to benefit patients with myofascial pain and joints, causing a reduction of this pain. Enables the enhancement of accessory tools for more complex cases, such as "Attachments", buttons, and others; in addition to the excellent support provided to orthodontists [12].

Still, for the trained professional, the use of the technique also has some advantages, such as an increase in the target audience in the office, aesthetic aligners are an important tool for patients who are averse to using fixed orthodontic appliances, the possibility of improving performance and motivation of the patient for use, generating positive marketing [3].

Despite these advantages, some disadvantages limit not only the expected result but also exclude certain cases or patients from the use of the technique. Examples of these cases are limited intermaxillary correction (severe skeletal discrepancies cannot be treated with Invisalign® alone), non-cooperation on the part of the patient, in which the use of the device is insufficient, making the treatment ineffective, high cost, may occur slight intrusion (0.25 to 0.50 mm) of posterior teeth, which will be corrected during the retention period, speech disturbances, dysphagia, and increased salivary flow concerning the use of fixed appliances, and limitation in movement control root and extrusive in addition to little control of space closure with adequate root parallelism after extractions [1].

One of the biggest advantages of orthodontic treatment with aligners is the possibility of choosing how each tooth will move. In Invisalign® treatment, this is done with clincheck software. The Invisalign® system presents a very effective virtual planning method, however, not always the final virtual planning of the system will present the same result in the patient since the system has some limitations and does not completely perform some tooth movements [1].

Through a study with 37 patients, the precision of movements during treatment with Invisalign® was evaluated and they were able to state that the average precision for movements in all teeth was 41%. However, they found that there is a huge variation in accuracy with this treatment, whereby they achieved an accuracy rate of 59.3%

for lingual constriction of mandibular canines and an accuracy rate of 18.3% for maxillary extrusion [13].

A study with digital models of 14 patients, also evaluated the predictability of the Invisalign® treatment in the movements of rotation, angulation, and inclination and concluded that, in general, this device presents a moderate to low predictability. It was proven that there is good predictability for rotation, inclination, and angulation of incisors; lower canine rotation and angulation and canine inclination; rotation of maxillary first molars and second molars. However, this appliance has low predictability for the angulation of upper canines; rotation of lower premolars; angulation of upper premolars; the inclination of the molars, and angulation of the second molars, therefore, it is up to the orthodontist to make some overcorrections in the planning of movements with low predictability [14].

Although both conventional orthodontic treatments and those performed using invisible aligners are reliable and efficient, it has been shown in the literature that each one has its indications of where it performs better [15]. Patients undergoing treatments with invisible aligners report a greater occurrence of pain after the first 4 days of treatment and, consequently, consume a greater amount of analgesics, which leads to the question of whether the aesthetic benefit compensates for this increase in pain and medication consumption. But it cannot be overlooked that the pain during aligner changes is less than the pain after the maintenance of the conventional device [16].

It is observed that patients prefer to undergo treatments using invisible aligners, and demonstrated better gingival health in the short term compared to patients who opted for conventional orthodontic treatment with fixed appliances, however, when observing the state of periodontal health in the long term, no significant difference was found between the two treatments. This fact makes it clear that when faced with a case that can be treated both with invisible aligners and conventional fixed appliances, the periodontal health issue is not the best to help in the choice and once again the points that have greater weight at the time of choice is the still unbeatable aesthetics of the aligners and comfort [1-3].

It is also possible to observe, when analyzing the available literature, that patients using conventional fixed appliances demonstrate less difficulty in performing general activities compared to aligners, however, when feeding, the aligners overlap since they can be removed during the procedure. feeding providing greater comfort to patients [15,16].

Although invisible aligners have proven to be efficient in the treatment of simple malocclusions, they encounter serious difficulties in achieving results similar to those delivered by conventional fixed appliances, which in turn ends up generating higher costs in treatments due to the longer time required to achieve similar results. to those provided by conventional devices and even at the end of the treatment, the result obtained may not be exactly what was expected since the invisible aligners do not have such efficient predictability, a fact that is demonstrated in several studies [4-6].

The aligners within their indications can be considered an excellent choice providing aesthetics, comfort, ease of oral hygiene, and reduction of working time, however, it is important to emphasize again that this system is not indicated for all cases, this presents its best results in cases of simple malocclusions, in more complex cases conventional orthodontic appliances continue to demonstrate superior results [7-9].

Although the recommended time for changing each pair of aligners is 15 days, several studies have observed that this time has been insufficient in many cases to perform efficient tooth movements, this fact increases the chances of relapses, which ends up causing orthodontists to give greater preference to treatments with conventional fixed appliances. It is worth noting that the predictability provided by the ClinCheck® system of aligners has not been demonstrating 100% efficiency, which ends up increasing questions on the part of orthodontists about the real cost/benefit of these orthodontic appliances [10,11].

Finally, it should be noted that the patients who close the treatment to use these devices are people with greater purchasing power and who

have a greater aesthetic demand, where many of the questions and initial demand for treatment are focused on corrections of position and minimal and specific tooth inclination, which requires greater refinement in orthodontic movement techniques [1].

Conclusion

It was concluded that the aligners are created by computer software, require only one impression, require a few additional tests, and allow excellent predictability of the treatment when used within their indications. They have a satisfactory aesthetic level, are comfortable, easy to clean, and cause less trauma when compared to conventional fixed appliances. However, serious skeletal discrepancies cannot be treated with the aligner plates, there may also be non-cooperation on the part of the patient, in which the use of the device is insufficient, making the treatment ineffective, high cost, slight intrusion of posterior teeth may occur, speech disturbances, dysphagia, and increased salivary flow.

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Ethical Approval

Not applicable.

Informed consent

Not applicable.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

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