Evaluation of the effectiveness of clear aligners therapy in orthodontic tooth movement

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Abstract

The aim of our study was to evaluate the effectiveness, in the dental movement, of orthodontic therapy with invisible aligners. This is a literature review conducted by using several scientific databases to search for studies that answer to our question. Among selected studies, although not all of them enjoyed a large sample size and a control group with which to make a comparison, it has been possible to evaluate predictability of each orthodontic movement. Good results can be obtained with this orthodontic treatment considering it an effective and aesthetic therapeutic innovation in the world of orthodontics.

Introduction

Over the last few years, it has become increasingly important to achieve an aesthetic and attractive smile [1-2]. At the same time, however, it is increased the demand for achieving the same through a becoming less visible and bulky [3]. In addition, the system of clear aligner treatment (CAT) was introduced in 1946 by Kesling, who designed a series of thermoplastic devices to progressively improve dental malposition and dental crowding. [4] In 1997, Align Technology© proposed this type of device as orthodontic treatment [5]. In 2005 Lagravere and Flores-Mir [6] studied the efficiency of this therapy, but stated that it couldn’t be expected reliable results, so the decision to use this approach should always rely on the clinical experience of operators. Similarly to Lagravere and Flores-Mir [6], also Mc Namara [7] stated that further studies are needed to understand the applicability range of invisible aligners. In this review we wanted to investigate the entity of orthodontic movements through the use of clear aligners.

Methods

Our research has studied and analyzed eleven studies between case-reports and case-series [8-18]; with patients aged between 15 and 70 years.

The scientific databases on which the research was conducted were Pubmed, Medline, Scopus. We have analyzed the studies carried out from 2003 to date.

The keywords used were [orthodontics] [clear alignment therapies] [dental movement] [invisible orthodontics].

The inclusion criteria of our research consisted in including studies which treated subjects in permanent dentition and subjects who were carrying orthodontic therapy with either clear aligners or with conventional braces.

Review

The articles published up to now on this topic are essentially case-series and case-reports about the use of clear aligners. It has been very difficult to evaluate, therefore, objectively the efficiency and effectiveness of invisible aligners about the amount of movement obtained and the duration of treatment. The movements that were evaluated were dental intrusion, dental extrusion, mesio-distal tipping, buccolingual tipping and dental rotations. Kravitz et al. [8], in 2009, analyzed the entity of the intrusion and extrusion movement on dental elements. The results obtained showed that the most intrusive intrusion movement is obtainable on both upper and lower central incisors, while the least accurate is due to the upper side incisor. By considering the extrusion, Kravitz et al. [8] considered that as the less predictable orthodontic movement with invisible aligners. Less accurate results have been achieved by upper and lower central incisors. About rotation, Kravitz et al. [8], have verified that the accuracy is reduced considerably in canines rotated more than 15°. In another study, Kravitz et al. [12] and Simon et al. [11] found that the best results (with less standard deviations, SD) in the maxillary canines were obtained by the combination of use of invisible aligners and interproximal reduction (IPR). Mesio-distal tipping, in the study of Djou et al. [13], was compared with clear aligners and conventional fixed orthodontics. The obtained values are very similar. Simon et al [11], showed that the predictability of molar distalization movement was almost 90%. Baldwin et al. [18], on the other hand, claimed that mesio-distal tipping of about 15-17° in the invisible aligners therapy is obtainable. We can not consider the same predictability in obtaining vestibular-oral
tipping, because, according to different studies, the best results have been obtained with conventional fixed orthodontics. [10, 13] According to Clements et al. [17], dental alignment improved by about 80% in the patient group and only a 20% showed unchanged or worsened results. However, according to Kuncio et al. [14], the stability of dental alignment was lower than the stability obtained with other retainers. According to Pavoni et al. [15], the interpemolars and intermolars width increasing was significant both with clear aligner treatment and self-ligating orthodontics. According to this review we can state that treatment with invisible aligners is a good therapeutic choice for class I malocclusions. However, the absence of a control group in some of the analyzed studies did not allow them to obtain certain results. In relation to intrusion, the choice to intrude the frontal group to improve deep bite, especially in patients with a vertical growth trend, has obtained results similar to those obtained from other studies of treated patients either with light arches or with sectional arches [19]. About extrusion to improve open bite, the movement was most difficult to obtain with invisible aligners, even because it shows a high incidence of recurrence[20, 8]. Dental rotations demonstrated a good percentage of success for incisors while less predictable results regarded rotations of premolar and molars; however, the interproximal stripping in association with the CAT has allowed to reach better results in canine derotations [12, 21]. Mesio-distal tipping, although controllable by the use of transparent aligners, is very complicated in the case of multi-rooted teeth. [8] In fact, as confirmed by Drake et al. [16], it is difficult to be able to carry a torque movement with CAT, and the most easily obtainable result is a crown tip movement without the contextual displacement of roots. This result, however, is not consistent with what Simon et al. [11], which has, however, achieved good results in the distalization of the molar group, although with the aid of attachments. In addition, even in mild or moderate crowding, the results obtainable through CAT are even predictable as those obtained with fixed orthodontics with conventional brackets. The rate of recurrence in treatment with CAT is higher than a three year therapy with a fixed device [10, 14]. The forces applied to the alignment devices are considered intermittent forces and thus this is not dangerous for periodontal ligament [22].

Conclusions

This review allows us to consider the use of invisible aligners as a good therapeutic choice for arch alignment. The intrusion of upper and lower central incisors let to good results, while extrusion remains the most difficult movement to obtain. Buccolingual tipping is possible and this has been demonstrated in distalizing molars up to 1.5mm. Monitoring patients, by performing follow-up, is necessary to evaluate the possibility of recurrences, more correlated with clear aligners therapy than with traditional fixed orthodontics. Better results can also be achieved by supporting attachments, interarch elastics and interproximal reduction.

The future goal is certainly to achieve more reliable results by increasing the sample size, however in cases of simple malocclusion with mild or moderate crowding the use of CAT is an innovative, aesthetic and efficient therapeutic hypothesis.

References


