Journal of Research in Medical and Dental Science
2022, Volume 10, Issue 8, Page No: 244-248

Available Online at: www.jrmds.in
eISSN No.2347-2367: pISSN No.2347-2545

A Clear Alternative to Braces-Aligners: A Comprehensive Review

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ABSTRACT

When compared to fixed orthodontic treatments, clear aligners are becoming more popular among the younger population since they provide better aesthetics as well as better periodontal status during treatment. The amount of pain and discomfort is significantly reduced. When compared to Invisalign, fixed orthodontic treatment has been observed to produce higher periodontal tissue stress. Clear aligners, also are made using 3D computer imaging technology. They are effective in treating cranio mandibular problems. Clear aligner and fixed orthodontic equipment have significant variances. These clear aligners are nothing but thin, transparent and computerized made plastic aligners, which are removable and help to align the teeth in the desired position. So, in this review we will see about what basically clear aligners are, how efficient they are and get a brief idea about how they work.

Key words: Clear aligners, Aesthetics, Efficiency, Malocclusion

HOW TO CITE THIS ARTICLE: Tanvi S Singh, Prateeksha Lakhe, Ranjit Kamble, A Clear Alternative to Braces-Aligners a Comprehensive Review, J Res Med Dent Sci, 2022, 10 (8): 244-248.

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E-mail: stanvi883@gmail.com
Received: 01-Jun-2022, Manuscript No. JRMDS-22-47518;
Editor assigned: 03-Jun-2022, PreQC No. JRMDS-22-47518 (PQ);
Reviewed: 14-Jun-2022, QC No. JRMDS-22-47518;
Revised: 02-Aug-2022, Manuscript No. JRMDS-22-47518 (R);
Published: 11-Aug-2022

INTRODUCTION

Earlier people were not that concerned about aesthetics and their smile. But with time they started to care more about their facial appearances and their smile which led to introduction of different orthodontic treatments to enhance one's facial appearance [1]. Evidence of orthodontic treatment was first found some 3000 years back. Since then many orthodontics found different methods to correct the malocclusion until Edward. H. Angle 'Father of Modern Orthodontics' gave the first widely adopted system for correcting malocclusion using brackets with metal bands. In early 20th century 14-18 carat gold was used for making orthodontic brackets which wasn't suitable to some patients and leads to poor oral hygiene, also they were technique sensitive and time consuming [2]. Later after availability of stainless steel lead to introduction of more convenient orthodontic brackets and bands which were bonded directly to labial surface using resin. In 1980's, self-ligating brackets were introduced which have a much smaller labial footprint and does not require any other ligating material [3]. These stainless steel self-ligating brackets are patient friendly and are not technique sensitive as the previously discovered gold or metal brackets. With time patient started getting concerned about their aesthetics and since steel brackets are not suitable from aesthetic point of view, orthodontics came up with the concept of ceramic brackets which are almost transparent or tooth colour. Orthodontics also came up with lingual braces which are best aesthetically since they are placed lingual, therefore are virtually invisible to a casual observer. These lingual braces are more time consuming and also uncomfortable to the patient as may irritate the tongue of the patient since placed lingual, hence attracts a fewer patient. Therefore, so for steel braces and to some extent ceramic braces are the most widely accepted braces. Now recent advancement for orthodontic treatment is the concept of clear aligners introduced by orthodontists. Clear aligners are transparent removable appliance made of plastic is the best choice for patients looking for more aesthetically acceptable appliances and are uncomfortable with those steel brackets and wires [4]. Clear aligners are not time consuming, require fewer sittings and are very comfortable to the patients than the other conventional appliances, which are irritable to the patient. Here we will see how clear aligners work and how beneficial they are in today's era [5].

LITERATURE REVIEW

Invisible braces *vs.* metal braces

The most obvious distinction between metal and invisible braces is their look. Metal wires are visible on anyone; therefore many individuals opt for transparent braces since they are more unobtrusive. Invisible braces are also

more comfortable because they employ moulded trays rather than metal wires, putting less strain on your teeth. Those with mild to moderate tooth straightening needs may be better served with invisible braces, which are less intrusive and can take up to a year to complete. According to the American Dental Association (ADA), metal braces normally take one to three years to complete [6].

Metal braces are better suitable for people who have sophisticated teeth straightening demands that require the supervision of an orthodontist. Because invisible braces trays can be removed at any time during treatment, the risk of technical mistake increases if users don't wear them as long as they should or just forget about them. Traditional braces may be a better option for you if you desire exact results and know you'll require supervision to keep them. Metal braces have also been linked to fatigue, functional speech, and respiratory problems, as well as changes in facial appearance [7].

The choice between invisible and regular braces is based on personal preference and requirement. Weigh the elements that are most important to you, such as convenience, effectiveness, cost, and follow-up treatment, to make the best option for your needs [8]. It's critical that you consult with your local orthodontist to see if you're a good candidate for invisible braces or if regular braces are a better fit for you.

What materials are aligners made of?

Clear aligners are made up of various combination materials or thermoplastic materials. These materials include; polyurethane, polyvinyl chloride, polyethene terephthalate, polyethene terephthalate glycol. Set of aligners are made virtually by particular software designed specifically for aligners using initially taken plaster impression or by direct 3D intraoral scan of patient's dentition. 3D models are needed for each set of aligners which are printed using stereo lithography or 3D model printing [9]. Then next set of aligners are fabricated using thermosetting material over 3D model of the patient's teeth by vacuum forming or thermoforming process, and trimming is done finally. The plastic material used for making aligners are stains and cracks free because of which they remain clear even after use, which makes aligners more esthetic and are not easily noticeable in patients' mouth. Biodegradable or recyclable materials are used for aligner trays, which makes them eco-friendly when compared to conventional orthodontic braces [10].

The production process

Clear aligners are made up of different thermoplastic materials by a thermoforming process. Aligners can be produced using two methods manual set up and by CAD-CAM technologies.

Manual set-up: Manual set-up is labour involving method fabricated in laboratory and is technique sensitive. In this method impressions are manually taken on the patient and casts are fabricated in laboratory which mimics the patient's jaw. Approach of this method is wax setting; tooth movement and retainers are made by using vacuum machine [11]. It also facilitates orthodontists to make necessary changes at an earlier stage. Using polysiloxane material impressions are taken and a working cast is made on which cast further treatment is planned by adjusting the tooth movement and aligners are fabricated using vacuum machine or pressure moulding machine. After trimming finally 3D models are delivered to the patients. Aligners produced of various thicknesses provide more control over tooth movement and reduces pain caused from orthodontic forces [12]. Two or three aligners of various thicknesses are given to the patient and are instructed to use each aligner for 14-15 days. Every time the patient visits new impression are taken for working models and new aligners are fabricated which allows the clinician to make treatment plan accordingly and follow the progression of tooth movement [13-16].

CAD-CAM technologies: One of the best known aligner companies Invisalign is the one which uses CAD-CAM technology. This technology is the most common clear aligner's technology available currently. Initially Invisalign system was introduced to treat mild malocclusion while nowadays it is even used to treat more complex cases such as cases with premolar extraction. Invisalign is most widely used nowadays because of its combination of stereo lithographic prototype technology and virtual computerized treatment planning. Using computer technology other aligner systems created are companies like clear correct, orthero, EON aligner, etc.

3D printing of aligners

3D is printing, also known as additive manufacturing, has been around since the 1980's and is now approaching a point of maturity where it is being used more frequently in dentistry and medical modelling. 3D printing, as opposed to traditional manufacturing methods such as machining, casting and subtractive procedures, allows for the layer by layer creation of objects [17-21]]. Acrylonitrile-butadiene-styrene plastic, stereo lithography materials (epoxy resins), polylactic acid, polyamide (nylon), glass filled polyamide, silver, steel, titanium, photopolymers, wax, and polycarbonate are now used for 3D printing in orthodontics [22-25].

The usage of 3D printed models was the first step in reducing faults and blunders (such as geometric imperfections) during impression gathering. It is preferable to use digital impression taking and 3D printing for improvement rather than error-prone plaster models that are scanned and modelled to produce multiple alignment phases. The use of a 3D printed transparent aligner for direct use can minimise the cumulative errors created by analogue impression taking and the thermoplastic workflow that follows. Direct printing has other advantages besides increased precision, such as shorter supply chains, shorter lead times, and reduced costs [26-28].

Tooth movements

Clear aligner therapy allows for the following effective tooth motions.

- Rotation of incisors
- Tipping
- 1-2 tooth intrusion
- Expansion
- Constriction

Clear aligner therapy does not work well with following tooth motions.

- Movement of the body during extraction space closure: this is due to the system's limited ability to hold teeth upright during space closure.
- Severe rotations (over 20 degrees), particularly in the premolars and canines. According to a Sheridan survey, "uncorrected rotations" were one of the most common issues observed by orthodontists using Invisalign, often necessitating revision or the use of a fixed appliance.

Mesiodistal tip: more than 45 degrees. Following movements are possible using attachments:

- Premolar extraction space closure
- Molar translation
- Incipient incisor extrusion

The efficacy of tooth movements using clear aligner therapy can be assessed a single bicuspid extraction instance was examined, and it was discovered that not all of the scheduled movements were carried out. The treatment outcome, in particular, revealed that many teeth pointed into the extraction site [29-32].

Advantages

- Outstanding aesthetics
- Assist in maintaining healthy oral hygiene
- Patients will find it simple to use.
- More pleasant to use than fixed appliances
- Ability to eat while wearing aligners
- Only minor adjustments are required
- Less time in the chair
- Minimal speech impairment
- Root resorption may be reduced

Efficacy and efficiency of clear aligners

As the demand for and interest in the clear aligner system grows, questions about the system's efficacy remain unanswered. There has been no clinical study on the effectiveness and efficacy of transparent aligners. Previous research has mostly consisted of case studies or product descriptions, making it impossible to objectively quantify the efficacy of clear aligner systems.

Time efficiency of clear aligners

For private practice orthodontists, time efficiency is an important result to consider because spending less time with one patient in the clinic and finishing treatment sooner both pleases current patient and allows the orthodontist to treat new patients. In aligner therapy, patients with good compliance are required to visit the orthodontist every 10-12 weeks, whereas fixed appliance treatment requires 4-6 weeks intervals. As a result, in fixed appliance therapy, additional appointments are required. In addition, the clear aligners group has a much shorter chair time, allowing the doctor to treat more patients [33-35].

Root resorption

Root resorption is the loss of mineralized tissues (cementum, dentine, and bone) as a result of orthodontic therapy. It is associated with orthodontic treatment which is typically minor to moderate, and does not usually result in significant clinical problems.

It is one of the most prevalent orthodontic problems, and is widely known that fixed orthodontic equipment can cause root resorption by putting a lot of pressure on the apical level which causes external apical root resorption. However, there has been little research on root resorption due to impact of thermoplastic aligners. Root resorption can occur with aligners; however, the incidence is lower than with fixed appliances.

Pain levels with aligners

During the initial few days of therapy, orthodontic patients wearing aligners appear to have less pain than those wearing fixed equipment. However, the types of malocclusions were not specified in detail, which could lead to conflicting results. Following that (up to 3 months), There were no distinctions made. The amount of malocclusion complexity in the studies that were included was moderate.

DISCUSSION

Based on an idea that dates back to the 1940's, clear aligners are a modern invention. In order to imitate the movement required for orthodontic therapy, Kesling created a tooth positioning device in 1945. The vacuum-formed dental contour appliance, popularly known as the "Invisibles," was created by Nahoumn the late 1950's, many years later.

The supposedly "invisible" retainers were introduced in 1971 by Ponitz of AnnArbor, Michigan, USA. He asserted that the tooth movement caused by these appliances was minimal. McNamara et al.'s description of using invisible retainers to cause minimal tooth movement is also noteworthy. Later, Sheridan et al. created a technique including interproximal tooth reduction and progressive alignment utilising clear Essix appliances, and Hilliard and Sheridan improved those techniques using a set of special thermoforming plier. Made to facilitate particular movements. Using CAD-CAM and the theories of Kesling, Nahoum, Raintree Essix, and others, a number of unique transparent appliances known as "aligners" are produced.

CONCLUSION

Clear aligners are a more aesthetically pleasing As well as convenient alternative to traditional fixed mechanics.

Clear aligners can be used in mild to moderate crowding instances, but complex cases should be approached with caution.

In aligner therapy, such as fixed appliances, root resorption is still a danger linked with orthodontic treatment.

In this discipline, long-term stability studies are essential. The success of educating patients about the benefits and drawbacks of clear aligner therapy or clear braces is highly dependent on their expectations and compliance. First and foremost, as a provider, an orthodontist must rule out traditional braces by communicating clearly with the patient. Conventional braces are the only treatment to recommend if the patient wants no treatment obligations, is willing to attend the clinic monthly, and wants the dentist to perform all of the treatment. The use of clear aligner therapy might be ruled out right away. Patients must be informed about the advantages and disadvantages of clear aligner therapy if they want to profit from it. First and foremost, the patient must be aware of their obligations and responsibilities. They must wear the aligners for 22 to 23 hours every day, removing them only to eat. Throughout treatment, it's vital to keep encouraging each patient to wear their aligners correctly in order to realise the therapy's advantages and ensure patient compliance and self-discipline.

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