

# CLEAR ALIGNER THERAPY- A REVIEW

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**ABSTRACT:**

*Orthodontic treatment involving clear polyurethane aligners has started dominating the market. Although it has existed for almost two decades now, it is not indicated for all type of patients. Controversies exists in the aligners treatment indications. Some indicate that they should be used in orthodontic cases without skeletal disharmonies with mild crowding, whereas others have suggested that Invisalign may be suitable for even moderately complex orthodontic cases. In this review, a basic idea of the aligners and recent advances are discussed.*

**Key words:** aligners, esthetics, effectiveness

## 1. INTRODUCTION:

With the increase in adult patients seeking orthodontic treatment, the demand for more esthetically pleasing treatment modalities have also increased. Conventional orthodontic methods have been associated with a general compromise in facial appearance. Hence, esthetic materials and techniques are being introduced to improve the quality of life, oral hygiene and periodontal support. This article reviews if that is really the case.

## 2. HISTORY:

In 1945, Dr. Kesling reported moving teeth with flexible tooth positioners. Following it, in 1964, Nahoum introduced vacuum formed dental contour appliance. McNamara in 1985, talked about invisible retainers. Align technology, Inc.- Invisalign took the principles of Kesling, Nahoum and others and used CAD-CAM technology to fabricate a series of custom appliance that are esthetic, removable and can move teeth. As a technique, Invisalign has now been commercially available to orthodontists since 1998. The company and the technique was the brain child of two graduate business students at Stanford University in 1997, Kelsey Wirth and Zia Chishti. They were fortunate in attracting the interest of Robert Boyd, chairman of the Department of Orthodontics, University of the Pacific. He assisted by consulting, and in doing so he and his residents provided a means to test this fledgling technology. Align technologies received FDA clearance to market Invisalign in August 1998, and began commercial operations in July 1999. Clearpath was incorporated in US in 2008 after 8 years of research and development. Clearpath introduced USFDA APPROVED aligners through its unique proprietary process which provides a hygienic, convenient and a clear solution for the correction of malocclusion.

ClearCorrect which was founded in 2006, received FDA approval in 2009. It was introduced into Australia via osseodent in 2015. K-line was also introduced in 2008.

Inman aligners, which is a unique modification of traditional spring retainer. It uses super elastic open coil springs to create light and constant forces on both the labial and lingual surfaces of anterior teeth. Unlike the invisalign system, the Inman aligner is not entirely clear and has visible metal bar that shows across the front teeth.

NIVOL with close collaboration of University of Pisa in Italy introduced Airnivol aligners. It commits inorganising certification courses since 2010.

NovoAlign was conceptualised in US in 2016, after two years of R and D by a team of orthodontist, engineers, dental technicians and IT professionals. It was awarded ISO 9001, ISO 13485 and CE accreditations. These aligners are made up of USFDA approved medical grade flexible plastic material and are designed to fit each individual's mouth.

3M oral care by St Paul and Minn announced entrance of 3M Clarity aligners in clear aligner sector. Dr. Neil Warshawski, applied the analysis and treatment planning tools in 3M oral care portal to treat relapse of anterior teeth using these aligners.

### 3. THE PRODUCTION PROCESS- An overview:

Diagnostic records with computer aided tomography (CAT) or a polyvinyl siloxane impression and photographs are taken. Along with the doctor's instruction, it is submitted to the company. The Intra oral scan / impression create an accurate 3D digital model of each dental arch. The teeth are then digitally sectioned, the dental arches are related to each other and the movements are staged. The preliminary plan is sent to the doctor for his approval and then the digital model is transferred to a cast and clear plastic aligner is formed over each cast. And finally the set of aligners is sent to the doctor.

#### Selection criteria:

1. Fully erupted permanent teeth
2. Growth has minimal or no effect on treatment (i.e., late adolescents and adults). Mild spacing (1-3 mm), moderate spacing (4-6 mm),
3. Mild crowding (1-3 mm), moderate crowding (4-6 mm)
4. Narrow arches that are dental in origin (4-6 mm)
5. Treated cases with relapse Orthodontic movements which can be produced effectively .
6. Tooth movement following Interproximal reduction, ,
7. Flaring,
8. Distalization,
9. Space closure following the extraction of a lower incisor

Invisalign was designed to be used in patients with Class I malocclusion and mild crowding /spacing. Literature available from the manufacturer claims that Invisalign can be used in most patients and "has been proven to be effective". However, based on the current literature available this critical appraisal suggests that Invisalign can be used only under specific conditions and is less effective compared to traditional orthodontic treatment.<sup>4</sup>

#### Factors consideration:

1. Patient cooperation is a critical factor in achieving success with Invisalign treatment. The aligners should be worn at least 20 hours per day, seven days a week.
2. Successful clear aligner treatment requires considerable clinical experience with other orthodontic methods, proper implementation of diagnosis and treatment planning, and a thorough knowledge of biomechanics .
3. In any case, if the teeth tip more than 5° from the vertical axis during space closure, fixed appliances will probably be needed to upright them.
4. If tipping exceeds 10°, the clinician should either incorporate a fixed appliance segment to upright the tipped teeth or convert to full fixed appliances to finish treatment.
5. Recently, Nelson, described several advantages of the aligner software that were summarized from a meeting. "The set-up can be used for diagnosis and treatment planning -- evaluate the need for IPR, expansion, extraction, distalization, or proclination" as well as:
  - a. Verifying that the technician has performed modifications,
  - b. A consultation device to show treatment limits to patient,
  - c. Verifying that the aligner is tracking,
  - d. Evaluating anchorage with the superimposition or surgical simulation tools and staging, and

- e. Addressing the patient's chief concern (of anterior tooth alignment) at the beginning of the series, and applying simultaneous movements to reduce the overall number of aligners.”

#### **Advantages:**

1. Unlike traditional braces, the trays can be removed for brushing, flossing, and eating.
2. The trays are clear, esthetic, comfortable - no metal brackets or wires to cause mouth irritation.
3. Better oral hygiene than fixed. Teeth can be bleached with the appliance at the beginning and during treatment
4. Shorter appointments.
5. Decreased doctor & auxiliary time.
6. Decreased allergic response.
7. Retention facilitated.
8. Decreased occlusal abrasion from parafunctional habits during treatment.
9. Disarticulation of the teeth may be advantageous for patients with TMJ problems. Technically much easier than lingual appliances.
10. Ability to present case to patient with final result prior to treatment.

#### **Limitation:**

1. Primary among them is compliance. Because the aligners are removable, the orthodontist must rely on the patient's motivation and dependability to achieve the desired results.
2. All permanent teeth should be fully erupted for treatment using this appliance.
3. There is currently no capability to incorporate basal orthopedic change with this appliance system.
4. Due to the fact that the surface anatomy of the teeth cannot undergo change during treatment as it will affect the fit of aligners, major restorative work should be performed for the commencement of treatment.
5. Lack of operator control.
6. Inability to integrate hard and soft tissues of the head into the computer treatment. Thus, the clinician has no direct indication of where teeth are in relation to basal bone or in relation to the lips or other soft tissues of the head.

#### **4. MANDIBULAR ADAVANCEMENT:**

On march 6, 2017 Align technology announced invisalign teen with mandibular advancement, the first clear aligner solution for class II correction in growing teen. It has an advantage of no compliance concerns associated with using elastic bands by providing elastic free correction.precision wings integrated into thealign held the mandible in a forward position whilst simultaneously correcting dental malocclusion and crowding.

#### **5. COMPARISON WITH FIXED APPLIANCE:**

According to a systematic review by Papadimitriou,<sup>5</sup> Invisalign might treat faster mild non-extraction cases, but it requires more time than fixed appliance treatment for more complex cases. A small inadequacy in levelling and derotation was reported in canines and premolars. Crown tipping can be easily performed. Teeth inclinations and occlusal contacts seem to be among the limitations of Invisalign®, when accuracy of planned movements achieved with aligners is concerned. Use of additional-novel attachments might be more effective for various types of movement, such as bodily expansion of the maxillary posterior teeth, canine and premolar rotational movements, extrusion of maxillary incisors, and in overbite control.

Lopaz<sup>6</sup> In 2019, recommended IPR especially in canines for accomplishing difficult vetical movements and derotation. The results from the study were,

- a. It is not necessary to incorporate an attachment when molar distalization is required in Invisalign® treatment.
- b. The expression of the programmed movement is not fully accomplished with Invisalign®.
- c. There is better root control with fixed appliances
- d. Invisalign® and fixed appliances are able to alter intercanine, interpremolar, and intermolar width in the presence of crowding

Moderate level of evidence<sup>7</sup> was reported stating that most of the tooth movements may not be predictable enough with clear aligner therapy except for minor horizontal teeth movement and very low evidence that minor extrusion of anterior teeth has been increased as compared to previous SRs conclusions.

## 6. ROOT RESORPTION:

There is low quality evidence suggesting that,<sup>8</sup> Clear aligner therapy might not prevent ERR during orthodontic treatment, but both incidence and severity of ERR could be lower compared with results reported by studies in fixed appliance. Intermittent force system and less jiggling movement, which require well-designed treatment plan by orthodontists and good cooperation by patients, might help to achieve it. This result was in correspondence with another study<sup>9</sup> by Al-Zainal MH

Another study<sup>10</sup>, concluded:

- a) Neither PEA nor CAT technique lead to clinically significant root resorption (up to 1 mm) of the permanent maxillary incisors.
- b) The amount of EARR of permanent maxillary incisors is non-significant on comparing two treatment modalities (PEA and CAT), except for 12 where the PEA group has significantly more EARR as compared to CAT.
- c) CBCT shows a decreased magnitude of EARR than 2D radiographs, and that is why 2D radiographs may overestimate the amount of EARR with orthodontic treatment.

High-quality RCTs and considerations of more confounding factors are needed to conclude a more persuasive result.

## 7. PAIN LEVELS WITH ALIGNERS:<sup>11</sup>

Orthodontic patients treated with Invisalign appear to report lower levels of pain than those treated with fixed appliances during the first few days of treatment. However, the type of malocclusions was not comprehensively described which may lead to controversial results. Thereafter (up to 3 months), differences were not noted. Malocclusion complexity level among included studies was mild. Based on the level of certainty, the results should be evaluated with caution, and it is suggested that studies with better methodological qualities be performed.

## SAFETY CONSIDERATIONS:

Overall, no estrogenic or cytotoxic effect of the thermoplastic appliances could be confirmed based on limited preliminary evidence from in-vitro studies<sup>12</sup>, while their effect on monomer or BPA release across both in-vitro and clinical evidence remains ambiguous. More high quality studies are required before a decision can be made.

## 8. CLEAR ALIGNERS ON ORAL HEALTH RELATED QUALITY OF LIFE:

The effect of CAT on OHRQoL compared to Fixed appliance is still inconclusive. In terms of individual dimensions, weak evidence<sup>13</sup> supported that CAT might produce less negative impact on eating disturbance. The shortage of high-quality clinical studies and the paucity of studies applying validated OHRQoL instruments limited the evidence of the review. Future high-quality prospective trials are needed to validate the results and to investigate the effect of CAT on OHRQoL using appropriate measuring tool.

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