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Clinical Effectiveness of Invisalign (clear aligners) in Orthodontic Tooth Movements

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Abstract

Invisalign is Elastic thermoplastic material is used in orthodontic devices to apply pressure to the teeth, causing them to slide into the aligner's position. When compared to typically fixed appliances for mild to severe malocclusion, these devices are more attractive, efficient, and comfortable. Clear aligners provide significant advantages, especially for adult patients, but they also have some disadvantages.

Introduction

Invisalign are clear plastic aligners that are worn over to shift the teeth into the right position (1) These tools are used to shift teeth into alignment with the aligner, which is an alternative to dental braces, pressure is applied to the teeth. When compared to typically fixed appliances for mild to severe malocclusion, they are more attractive, efficient, and comfortable. (2) These are the active clear plastic trays

fitting snugly onto the teeth, each worn for two weeks on an average and changed sequentially to accomplish the incorporated tooth movements. (3) Because it's difficult for patients to keep their teeth clean while wearing fixed orthodontic gear, bacterial plaque builds up, causing temporary periodontal disease. (4) An alternative for fixed orthodontic appliances is Invisalign, which has been

around since 1999 and provides greater aesthetics as well as the convenience of being able to remove the braces for eating, drinking, and dental hygiene. (5) The introduction of computer-aided design/computer-aided manufacturing processes has enabled the use of thermoplastic materials to manufacture clear and removable tooth aligners for orthodontics. The physical, chemical, and mechanical properties of thermoplastic polymers include low stiffness, good deformability, biocompatibility, and dimensional stability. (6) As the need for aesthetic treatments grows, more people are looking for alternatives to fixed braces. Over the last decade, clear aligners have grown in prominence as an attractive and comfortable orthodontic treatment alternative. (7,8)

Indications of Invisalign (1,9,10,11)

- Aligner is used On non-growing topics, to align and level the arches The amount of anterior incursion movement achieved is similar to what has been reported for the straight wire approach..
- Deep overbite (class 2 div. 2 cases).
- In extraction cases, proper root angulations can be attained with the use of suitable attachments and adequate knowledge of the system.
- Invisalign is recommended in non - extraction cases with mild to moderate malocclusion in non-grown patients.
- Lower incisor extraction for severe crowding cases.
- Malaligned and mildly crowded teeth (1-5 mm).
- Maxillary molar distalization (2 mm) and premolar extraction space closure (7 mm) are the most predictable and controlled movements that can be obtained.
- Narrow arches.
- Spacing problems (1-5 mm).
- Tip molar distally.

Advantages (1,3,12,13)

- Invisalign is aesthetic; it is clear and comfortable. There are no metal brackets or wires, which lead to laceration and inflammation of the mouth.
- They are invisible, and it gives confidence to the patient when they smile.
- Technically is much easier than a lingual appliance.
- Good oral hygiene compared to fixed.
- Ideal for treatment.
- Short dental appointment. With more précised treatment duration than braces, digital planning provides an accurate treatment time estimate.
- It creates interdental space via interproximal reduction, so extraction of premolars is avoided.
- It allows Patients to be responsible for replacing their aligners every few weeks., so visits to the dental clinic are few.
- No food restrictions. Patients are free to eat or drink anything during clear aligner therapy.
- Minimal emergencies significantly reduced emergency appointments as compared to fixed orthodontic treatment.
- Possible to include teeth with structural anomalies and difficult to bond surfaces.

Disadvantages (1,3,14,15)

- In nature, it is removable.
- The motivation of the patients is required.
- It must be worn 22 hr/day, depending on patient compliance; an aware time of 22 hrs/day is mandatory for therapy to be effective.
- The majority of appointments are missed, resulting in excessive bone growth, increased treatment time, and poor-quality results.

- Price increase (high cost).
- The limited extent of tooth movements by aligners alone: auxiliaries are necessary as an adjunct to aligners for complex movements.
- Initial slurring of speech subsides after 2-3 days of wear.
- Breakage: while wearing or removing if the applies excessive force.
- Chances of losing the aligner's removable nature make aligners prone to being misplaced.
- Inconvenience removing aligners every time one eats or drinks can be a burden.
- Manufacturing defeats results in ill-fitting aligners.

Principles of -Invisalign (16)

Invisalign works on two basic principles:

1. Invisalign creates space through arch expansion, tooth extraction, or interproximal reduction.
2. Force/pressure application through small incremental movements incorporated in aligners itself and with auxiliaries (attachments, dimples, elastics, or digital power chairs). The amount of pressure required for moving a tooth depends on factors such as tooth shape, tooth size, type of movement, and periodontal condition.

The most accurate tooth movement is buccal – lingual crown tip. Aligners work by pushing teeth into place, and the buccal and lingual portions of the crown have the most surface area to push against. Rotation was the least precise tooth movement, and it was especially difficult for canines, premolars, and molars to do. (17)

Biomechanics of aligners (18)

The mechanism of tooth movement with clear aligners is centered around two systems:

1. Displacement-driven system: controls tiny rotations and tipping. Aligners are produced in accordance with

the next staged position. The tooth will continue to shift until the aligner is no longer active. There was no root movement.

2. Force-driven system: the software determines the type of movement required for an individual tooth, the mechanical principles needed to achieve that movement, and aligner shape. Pressure points and attachments are incorporated into aligners that apply the force required for planned movements.

It is difficult for aligners to extrude a single tooth, when compared to a fixed-appliance system, auxiliaries such as buttons and elastics can be utilised to aid mobility.. (7)

Clinical effectiveness of clear aligners

Invisalign and traditional fixed braces systems are said to be equally successful in terms of space closure, marginal ridge alignment, and root paralleling. The Invisalign system, on the other hand, is less effective in correcting anterior anteroposterior discrepancies, occlusal contacts, and posterior torque. (19) While a clear aligner system is effective at leveling and aligning arches in mild and moderate cases, as well as correcting buccolingual inclinations, it is useless at correcting buccolingual inclinations. (20) The thickness of aligners causes deterioration in occlusal contacts by interfering with the occlusal plane's settling. (21) Tooth movement accomplished by the Invisalign system: just 41% of anticipated tooth movement was realized, with lingual constriction (47.11) being the most influential movement, extrusion (29.6%) being the least accurate, and only 33% of the projected rotation correction is accomplished.. (22) As a result, the Invisalign system's initial aim was to treat low and moderate crowding instances as well as close small spaces, and it is now one of the most widely utilized aligner systems.(23)

Conclusion

- When compared to traditional fixed mechanisms, Invisalign is a more aesthetic and comfortable solution.
- Invisalign is used to treat mild to moderate crowding, but complex cases require extra caution.
- A buccal–lingual crown tip provided the highest level of precision.

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- Rotation had the lowest precision, and this movement was challenging for the canines, premolars, and molars.
- Better periodontal health was observed in patients treated with clear aligners, and few white spot lesions developed during the treatment.
- Invisalign is removable, requires patient motivation, and is costly.

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