

## Esthetics in Orthodontics - A Review

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### Review Article

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#### Article History

Received: 07.07.2018

Accepted: 16.07.2018

Published: 30.07.2018

#### DOI:

10.21276/sjds.2018.5.7.2



**Abstract:** The technology used to make orthodontic products and materials has advanced at an exponential rate. Newer materials, methods, and designs are coming up on a daily basis. These products help the orthodontist to give the best functional and aesthetic results to the patients. Orthodontists are concerned about the aesthetics and it is one of the major concerns among patients who seek orthodontic treatment. To address the increasing aesthetic demand for an alternative to conventional braces, investigators have developed several solutions, such as lingual orthodontics and clear aligners. The purpose of this review article is to highlight the recent advancements in aesthetic orthodontics and how they help the orthodontist to give better treatment aesthetically.

**Keywords:** Lingual Orthodontics, Clear Aligners.

### INTRODUCTION

Orthodontic patients, including a growing population of adults, not only want an improved smile, but they also want better aesthetics during treatment. The development of appliances that combines both acceptable aesthetics for the patient and adequate technical performance for the clinician is the need of the hour[1].

Dental and facial aesthetics is considered a new paradigm in diagnosis and planning for orthodontic treatment. Patient demands for aesthetic orthodontic treatment outcomes have grown to include aesthetic appliances during treatment. Efforts have been made to increase the aesthetic quality of orthodontic appliances[2].

Ziuchkovski *et al.* [3] examined appliance attractiveness and found a hierarchy of appliance types: alternative appliances (clear trays and lingual appliances) were found most acceptable followed by ceramic appliances. Furthermore, acceptability of appliances can also be determined by attractiveness, aesthetic, comfort, economic value to the patient. This concept was explored by Parekh *et al.* [4] when evaluating smiles and attractiveness.

The purpose of this review article is to highlight the recent advancements in aesthetic orthodontics and how they help the orthodontist to give better treatment aesthetically.

### Lingual Orthodontics

Lingual Orthodontics, apart from offering the aesthetic benefit, also provides several mechanical

advantages [5]. Since its inception in 1970, great advances have been made in the modality. At present, Lingual Orthodontics is a complete system in itself and encompasses accurate diagnosis, treatment protocol, clinical and laboratory procedures. Among the unique features of these appliances were a bite plane incorporated in the maxillary anterior brackets, mesh bonding pads designed to adapt to the lingual surface of the teeth, and pre-torqued arch wire slots based on a conversion of commonly used labial torque values[6].

### Description of the Appliance

The most significant change in design is the size of the bracket. The new lingual brackets are smaller and more closely adapted to the lingual vestibule. The dimensions of the incisor and canine brackets are 2.5 mm (width) by 1.5 mm (thickness) [7]. The premolar and molar brackets have a thickness of only 1.5 mm.



Fig-1

Fig-2

The shape of the bracket has also been dramatically changed. There are three small wings (two occlusal and one gingival) and a 0.018" x 0.025" slot for the arch wire. The absence of a hook and bite plane further reduce the overall dimensions of the bracket leading to greater patient comfort[8].

### Bonding

For bonding of lingual brackets, the preferred mode of placement is indirect because: [13-14]

- The variation in lingual tooth morphology creates the need for custom measurement for selection of appropriate bracket base thickness and torque.
- The clinician's lack of familiarity with lingual tooth morphology makes it difficult to visualize angulations and bracket heights.
- It is difficult to obtain a direct line of sight for bonding.
- Increased accuracy in bracket placement is required because compensating lingual arch wire bends are more difficult and time consuming to form.

A modified dental surveyor and TARG (torque and angulation reference guide) are used to align the lingual surfaces relative to the labial crown inclinations. Once the bracket slot height and angulation are marked, indirect bonding of the brackets on the lingual is done.

### Customisation in Lingual Orthodontics

It was first described by Wiechmann *et al.* in 2003. Conventional manufacturing processes cannot completely eliminate the problems associated with Lingual appliance system; instead complete individualization of all appliance components is needed. The processes of bracket fabrication and optimized positioning of the fabricated brackets on the tooth, which are normally quite separate, are fused into 1 unit. Each tooth has its own customized bracket, made with state-of-the-art CAD/CAM software coupled with high-end, rapid prototyping techniques. This computer-generated appliance uses three dimensional (3D) computer scanning to ensure efficiency of tooth movement by designing brackets and bonding pads specifically for each individual tooth with the bracket slot in the most advantageous position on the lingual surface of the dentition. Brackets are printed using a stereo lithography apparatus and then cast in gold

bracket bases are drafted, tie-wings and hooks are adjusted and brackets are assembled on the base in the optimal position [29].

### Advantages [9-14]

- Facial surfaces of the teeth are not damaged.
- Facial gingival tissues are not adversely affected.
- The position of the teeth can be more precisely seen

□□ Facial contours can be truly visualized as the contour and drape of the lips are not distorted by protruding labial appliances.

Most adult and many young patients would prefer invisible lingual appliances if costs, treatment times, and results are comparable to those of labial appliance treatment.

### Indications

Lingual orthodontics is indicated in cases like Low Angle Deep bite, Diastema, Class I minor crowding, Class II upper bicuspid extractions, 4-Bicuspid extractions, Posterior cross bite, High angle, Open Bite as well as in surgical cases[9-14].

Recent advances in Lingual Orthodontics have made it possible to treat almost all orthodontic problems with lingual technique, However there are some limitations due to contraindications mentioned below[15].

### Contraindications

Lingual orthodontics is contraindicated in cases with very short clinical crown, severe periodontal disease and severe TMD[14,15].

### Clear Aligners

The concept of aligning teeth with thermoplastic appliances is not new. The use of a flexible removable orthodontic appliance for minor tooth movement was first introduced by Kesling in 1945. The "tooth positioning appliance" was initially made from rubber and was a one-piece flexible appliance that covered the surfaces of the upper and lower teeth. It allowed active tooth movement -and was indicated for the treatment of mild relapse and for use as a retainer[16].

With the advent of vacuum-formed clear thermoplastic sheets it became apparent that if teeth were reset slightly and the vacuum-formed sheet was

made to fit the reset teeth, a tooth moving device would be the result[1].



**Fig-3: Aligners in place**

Such devices became known as “aligners” because the typical use was to bring mildly misplaced teeth back into alignment [18]. The early appliances were manufactured with vacuum-form machines that sucked the heat-softened thermoplastic material onto the model. The vacuum method was found to have inaccuracies in areas where the vacuum pressure was unable to reach effectively [19]. Within the last decade machines which use compressed air to blow the material onto the cast have improved the accuracy [20].

#### **Commercially available aligner systems**

Three commercial systems involving the use of a series of clear thermoplastic appliances for sequential tooth movement in the treatment of malocclusions have been available: ClearSmile, Simply 5™ and Invisalign®. ClearSmile Pty Ltd was formed by a team of orthodontists and technicians in NSW [21]. In this system thermoplastic appliances known as “correctors” are used to treat malocclusions. From a single polyvinyl-siloxane (PVS) impression, a technician manually resets teeth in sequential stages on the plaster model and fabricates a series of correctors. Each appliance is designed to move the teeth in approximately 0.5mm increments [22]. Another commercially available aligner system is Simply 5™ manufactured by AOA Orthodontic Laboratory, Inc and marketed by Ormco Pty Ltd [23]. It is designed to treat patients with mild to moderate anterior crowding or spacing, or those who have experienced orthodontic relapse and have a stable posterior occlusion and no TMD. It is a laboratory generated product that delivers five sets of sequential trays for anterior correction that require up to 2.5 mm of movement per arch from impressions or models. The reported advantages of Simpli5 include speed, flexibility, simplicity and economy [23].

#### **Transient Problems with Clear Appliances [24-27]**

- It may initially irritate oral mucosa and tongue causing soreness.
- A temporary alteration of speech, with slight lisping.
- These immediate discomforts are transient and vanish within a few days, as the patient gets accustomed to the appliance.

#### **Indications [24-27]**

- Ideal for minor crowding (less than 4mm), In cases of crowding, interproximal reduction may be required to create enough space to allow teeth movement.
- Rotation control, intrusion, and extrusion are better controlled by placing tooth colored attachments on the labial and lingual surfaces.
- Open bite, deep bite, cross bite and mild to moderate expansion can also be corrected satisfactorily using clear aligners.
- The aligners can also be used simultaneously for tooth bleaching, if a bleaching gel is placed inside the tray.
- Clear aligners can also be used as active and passive retainers.

#### **Contraindications [24-27]**

- Extraction cases
- Tip control
- Torque control
- Moderate to severe open and deep bite cases

#### **Advantages [24-27]**

- Crystal clear aligners remain unnoticed while wearing.
- The transparent look and option to remove the appliance enhances the cosmetic value of the appliance.

- Less chair side time.
- There are no cuts or abrasions from wires or brackets like with traditional braces.
- The aligner trays are fabricated with soft medical grade polymers and therefore comfortable.
- The patient can remove the appliance while eating and brushing, and therefore can maintain a good oral hygiene.

#### Potential Limitations [24-27]

- Patient cooperation is utmost important for the success of treatment and a desired treatment result.
- A short clinical crown can cause problems with aligner retention, affecting stability of the appliance and tooth movement.
- Large edentulous space and sharp cusps may become cause of frequent appliance breakage.
- White spots lesions, tooth decay, gingival inflammation and periodontal breakdown may occur if proper oral hygiene protocol is not followed.
- Missed appointments, not wearing aligners the required number of hours per day, and broken appliances can prolong the treatment duration.
- Allergic reactions to the material used during treatment may occur.
- Teeth may supra-erupt if not covered by the aligner.
- Being removable appliances should be avoided in medically challenged and uncooperative patients to prevent accidental swallowing or aspirating the aligner.

#### New bracketless approach in esthetic orthodontics<sup>2</sup> (Toronto Appliance)

Recent advances in modern orthodontics has transferring from brackets to bracketless approaches. Today's era demands for esthetic orthodontics.

Bracketless systems provides superior esthetics, comfort to the patient and excellent patient compliance.

Main disadvantage of these bracketless systems is that they are costly. Hence the need for better cost effective system or modification in existing system is necessary.

The Toronto Hybrid bracketless system is used for correction of mild to moderate crowded cases. This system uses Niti wires which are directly bonded to the teeth on lingual surface so it is called bracketless.

#### Advantages

- Aesthetic as it is lingually placed,
- Less time consuming
- Patient compliance is more compared to other systems.
- Cost effective
- If patient is willing to undergo aligner treatment, by using this system number of set of aligner can be reduced which make it cost effective.

#### Disadvantage

Only disadvantage of this system is that the finishing of the case cannot be done with Toronto bracketless hybrid system so positioner are required for finishing.

#### Technique

Toronto Hybrid bracketless system uses vaseline coated niti wires. Niti wires are directly bonded to the teeth. Bonding of these niti wire done on lingual side of teeth. Direct bonding method can be effectively used for such treatment approach.

#### Procedure

NiTi wires has property of shape memory. Toronto bracketless hybrid system uses this property of shape memory of niti wire to push the teeth. This system utilizes Vaseline coated NiTi wires these Vaseline coated NiTi wires are not available in India. Some modifications were made in Toronto Hybrid Bracketless system to facilitate tooth movement. To achieve sliding movement of teeth sleeves were used. Sleeves were directly bonded onto the teeth. NiTi wires are directly bonded to lingual surface of teeth.



Fig-4: Toronto Bracketless Hybrid System

Finishing of these cases has to be done with the Clear Aligners



Fig-5: Clear Aligners

### Indications

- Toronto hybrid bracketless system is effective in treating mild to moderate crowding cases.
- Treatment of palatally/lingually placed single tooth in the arch.

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