



## Review Article

# Lingual orthodontics - A review

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### ABSTRACT

The introduction of lingual orthodontics led to correction of malocclusion with the appliance completely not seen in the oral cavity. The acceptance of lingual orthodontics is world wide. The cooperation and confidence level of the patient has increased with the invisible appliances. The Anchorage control, indirect bonding and biomechanics is completely different from labial technique. In this article the concept of lingual orthodontics has been highlighted.

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## 1. Introduction

The research in orthodontics has led to introduction of new fixed appliance techniques which can treat many occlusions. The acceptance for orthodontic treatment is increased and esthetic impairment of labial fixed appliances has led to development of lingual appliance.

<sup>1</sup> The treatment with lingual appliance had an impairment with an injury to the intraoral tissues and inadequate space for the tongue. The percentage of patients content with lingual technique was 99%. Also 87% of patients would recommend the lingual appliance to friends and relatives.<sup>2</sup> The growth in lingual orthodontics began in the era of 1975. The lingual technique is increasingly accepted by adults.<sup>3</sup> Dr. Craven Kurz used brackets on the lingual surface for the first time and a significant contribution to the lingual orthodontics was made. This appliance consists of specially designed brackets to be placed on lingual surface of teeth.<sup>4</sup>

## 2. Lingual History

The Kinja Fujita was the first to propagate lingual technique using mushroom shaped arch wire. He began working on lingual technique in 1968 and then went on for Research in 1971 and finally published the concepts of Fujita Bracket in 1978.<sup>5,6</sup>

1889-Lingual Removable Arch by John Farrar

1918-Lingual Arch was developed by John Mershon

1922 –labial and lingual arches presentation with finger springs developed by Mershon

1942 -.Development of labiolingual appliance by Dr.Oren Oliver

### 2.1. Labio-loop-lingual appliance developed by Dr William Wilson

1975-Dr Craven Kurz who made an important contribution to orthodontics by using a lingual bonded edgewise appliance for the first time. The Kurz lingual bracket evolved further as Ormco 7<sup>th</sup> Generation Bracket.<sup>5</sup>

1979- Mushroom shaped arch wires and lingual bracket design was developed by Dr Kinya Fujita of Kanagawa Dental University, Japan<sup>6</sup>

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## 2.2. Difficulties encountered with lingual technique

1. Tongue irritation and speech difficulties
2. Gingival impingement and occlusal interferences
3. Control over the appliance
4. Adaptation over the base pad and appliance placement and bonding
5. Wire placements
6. Attachments and ligations

## 2.3. Evolution of lingual brackets<sup>7</sup>

First generation (1976)

Bite Plane and Rounded Margins

Large Brackets

### 2.3.1. Advantages

Bite opening anteriorly, facilitating mesiodistal movement or expansion. It also causes extrusion of molars and intrusion of incisors.

### 2.3.2. Second Generation(1980)

Addition of hooks on canine brackets

### 2.3.3. Third Generation (1981)

There was addition of hook to all brackets

An intraoral hook was added on first molar tube

Second molar had terminal sheath without hook

### 2.3.4. Fourth Generation (1982-1984)

Brackets were low profile

There was option for the hooks

### 2.3.5. Fifth Generation (1985-86)

Bite Plane Pronounced

Torque increased on Maxillary Anteriors

Molar brackets with accessory tubes for transpalatal arch

### 2.3.6. Sixth Generation (1987-90)

Elongation of hooks was done

An option for attachment of TPA was created

Hinge cap tube for second molar

### 2.3.7. Seventh Generation (1990-present)

Rhomboid bite Plane

## 2.4. Advantages of lingual orthodontics

1. Preferred by adults and increased demand<sup>8</sup>
2. Esthetic and absolutely invisible Appliance<sup>9,10</sup>
3. No damage to the labial enamel surface
4. No labial enamel decalcification
5. Bio-mechanically efficient during retraction

6. Easier evaluation of individual tooth malposition and treatment progress
7. Easier appreciation of soft tissue response

## 2.5. Disadvantages of lingual appliances

1. Indirect Vision hampered accurate bracket placement
2. Occlusal interferences caused frequent bond failures and at times restricted tooth development
3. Speech Distortion
4. The sharp edge lacerates the tongue
5. Gingival irritation due to plaque accumulation
6. Increased chair side time due to difficulty in insertion and ligation of arch wire

## 2.6. Indication for lingual appliances

1. Intrusion of Anterior teeth
2. Expansion of the Maxillary Arch
3. Repositioning of the mandible with orthodontic tooth movements
4. Distalisation of maxillary molars
5. Treatment of cases with case complicated with an existant tongue thrust habit

## 2.7. Ideal Cases<sup>11</sup>

1. Low Angle Deep bite
2. Class II Division 2
3. Class 2 upper arch extraction cases
4. Class I minor crowding<sup>11</sup>
5. Diastema Closure
6. Pre-Prosthetic Tooth movement and Surgical cases
7. Class III Cases<sup>12</sup>

## 2.8. Difficult Cases

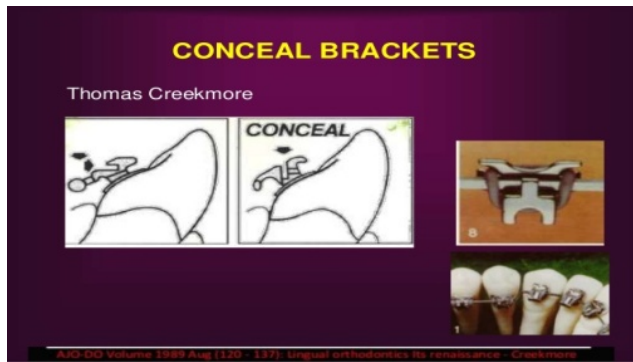
1. Bicuspid extractions
2. Posterior Crossbite
3. High Angle
4. Open bite

## 2.9. Anchorage considerations in lingual orthodontics

1. In non Growing Adults anchorage is critical
2. In Mutilated cases the anchorage is critical
3. Poor periodontal support and bone loss
4. Aesthetic demand in these category of patients is very high
5. Introduction of bite plane induces loss of occlusion and intercuspatation which results in loss of anchorage.

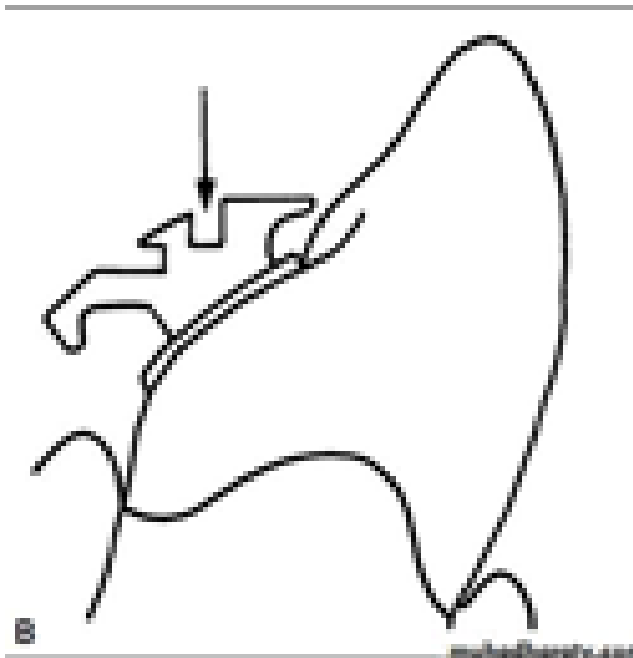
## 2.10. Bracket Systems

Various Lingual brackets have been developed from the past 25 years and also modifications have been done for patient control, Precise tooth positioning and mechanical efficiency



**Fig. 1:** Conceal Bracket by Thomas Creekmore

The Arch wire insertion and removal with occlusal approach is better than arch wire insertion with lingually opening slots.<sup>13</sup> The opening of the arch wire surface is towards occlusal rather than towards lingual aspect



**Fig. 2:** Fujita lingual Bracket

Fujita Lingual Bracket had a slot that opens towards occlusal. Into the slot the lock pin was inserted mesiodistally into a groove in the slot to hold the arch wire along with elastomers and ligatures. Modifications were made to the brackets and the opening remains occlusal.<sup>14</sup>

Development by Dr.Scuzzo and Dr.Takemoto (Sold by Ormco)

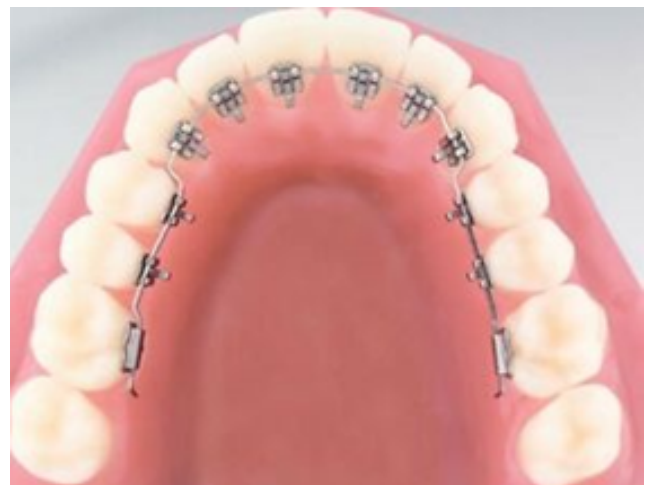
The acceptance for the orthodontic treatment is improved greatly with these brackets. The tolerability of the appliance has greatly improved and minimum speech disturbance.

The less complex cases were treated by 2D brackets of forestadent and 3D brackets for more complex cases. These



**Fig. 3:** STB(Scuzzo-Takemoto Bracket)

brackets are hardly noticeable for the patient and low profile and manufactured by Forestadent



**Fig. 4:** Stealth Brackets

It is the old generation lingual bracket manufactured by American orthodontics. This bracket has poor rotation control without the use of auxillary. A Vertical slot has been incorporated to attach an uprighting spring to adjust for the inadequate control caused by a slot that is too short.

### 2.11. Philippe self ligating lingual bracket

Massimo Ronchin in 1994 developed a self ligating lingual bracket which was based on the begg technique.<sup>13</sup> The same company had also developed the Phillippe Self Ligating Lingual Bracket which could not control torque but was useful for alignment and leveling. As there is no slots they can be directly bonded to the lingual tooth surface. The first order and second order movements can be anticipated

in these type of brackets. A three wing bracket for the attachment of intermaxillary elastics and application of 3<sup>rd</sup> order movements and a narrow single wing bracket for lower incisors,<sup>15</sup>



**Fig. 5:** Kelly Bracket: Horizontal insertion bracket

The best in controlling rotations since it is twin with two actual contact points between the bracket and wire. It is a labial unitek bracket adapted as a lingual one and not related to any special technique.

This is best in controlling rotations since there is two actual contact point contact between bracket and wire. It is adapted as a lingual one and not related to any special technique.



**Fig. 6:** Kurz lingual bracket

They are available in 0.022 inch slot. The brackets have rounded facial contours, large hooks which help in power chain and attachment of springs, increase In the surface area of bracket to help in engaging double overtie. To improve bonding the bracket base is made large and horizontal slot enables easier expression of torque control.



**Fig. 7:** In -ovation I bracket from gac

There is greater inter bracket distance in IN-Ovation bracket which helps in increased patient comfort. The bracket can be placed in the greatest portion of lingual fossa with better adaptation to the anatomical contours. The base pad can be easily bent to adapt to the complicated lingual shape of the cuspid due to the forked design built into the base. There is a self ligating clip incorporated so there is no necessity to change the ligature ties during appointments<sup>16</sup>

## 2.12. Braces(Incognito)

The main benefits of this bracket system are lower Profile with less patient discomfort and good finishing.<sup>15</sup> The manufacturing methods and design of this bracket system is different completely from the existing appliance. The technology of CAD-CAM appliance has made the process of bracket production and bracket positioning in one unit.

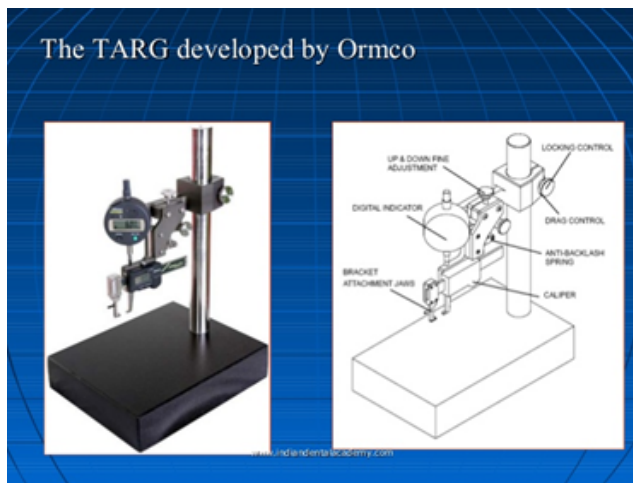
In earlier days due to poor training ,unavailability of bonding set up and no availability of preformed arch wires there was poor finish in lingual orthodontic treated cases.<sup>17</sup>

## 2.13. Bonding in lingual orthodontics<sup>18</sup>

A key factor for successful correction of a malocclusion with lingual orthodontics is precise and accurate positioning.

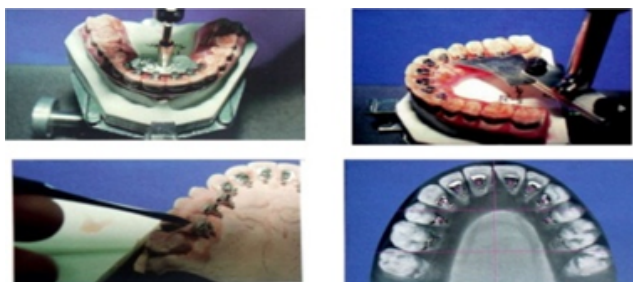
#### 2.14. Customized lingual appliance set up service system

There exist anatomic discrepancies on the lingual surface of teeth and this is taken care by CLASS Technique. From the duplicate model of the patients ideal occlusion an ideal diagnostic set up is prepared .By using the template as a guide the placement of brackets is done in an ideal configuration. By using the composite adhesive as spacer the brackets are placed on the diagnostic set up before they are next transferred back to malocclusion cast. Once the transfer trays preparation is done an indirect bonding method is used to transfer the brackets clinically.



**Fig. 8:** Torque Angulation Reference Guide (TARG)

The Ormco Company has launched the TARG machine as an important tool to the laboratory technique in 1984. Each tooth has a specific Tip and Torque individually and also it could be placed at a specific distance from the incisal and occlusal surface of the teeth. Now a virtual set up base can be created bonded on the malocclusion set up with attached resin modified base at the base of each bracket. In 1986 Didier Fillon developed a precise measuring device that was similar to the original TARG machine called as Electronic TARG<sup>19</sup>

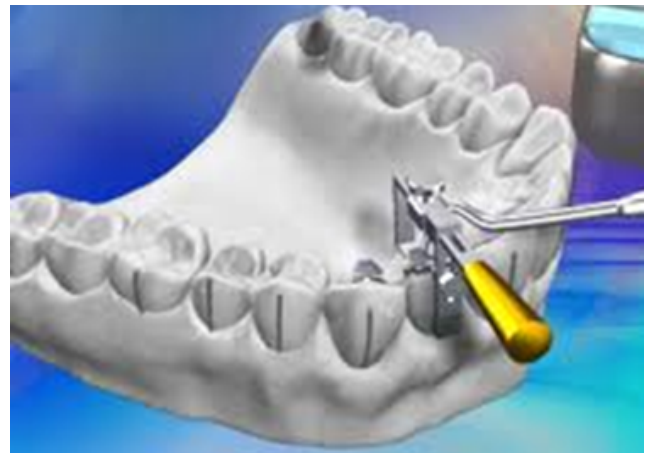


**Fig. 9:** Bonding with equal specific thickness (BEST) System

A new system was developed by Fillion in 1986. An important aspect was missing in this Original TARG that is the distance from the in the horizontal plane from the labial surface of the tooth to the slot of the lingual bracket. Also the different thickness between the teeth are compensated by adding a precise measuring device to the original TARG machine.

#### 2.15. Slot Machine

Thomas Creekmore has designed the slot machine in such a way for placement of both conventional and lingual brackets directly on to the malocclusion model. Each tooth will be designated with specific tip and torque value. The bracket slot is oriented to the machine. The placement of brackets having either horizontal or vertical access arch wire slots is done by the slot machine. There is no requirement of a model tooth set up which is a major benefit. There is difficulty in managing lot of pieces of the slot machine which is a disadvantage.



**Fig. 10:** Lingual BracketJIG (LBJ)

The Lingual Bracket Jig was developed by Geron and the lingual bracket jig helped in direct and indirect positioning of the brackets. In this set up there is a ruler, universal jig for the posterior teeth and a set of six jigs for the maxillary anterior teeth. The Andrews labial bracket prescription is transferred to the lingual surface by means of jigs. The height of the bracket from the incisal edge is measured using an occlusal stop. Even direct bonding of bracket is done on the lingual surface by using Lingual Bracket Jig.

#### 2.16. Transfer Optimized Positioning

#### 2.17. (Top/Incognito I Braces system)

Incognito braces are commonly known as lingual braces. They are manufactured using the robotic technology where there is 100% customization of bends in the arch wires and even each bracket is made to conform to individual

surface of each teeth also more effective than aligners. They can be used to treat complex malocclusions like spacing, crowding, rotations. The contouring of the bracket base is much smoother and rounder with incognito braces. Dirk Wiechmann fabricated a lingual bracket that adapted to the scanned model<sup>20</sup>



Fig. 11:

#### Korean indirect bonding set up (KIS)

Tae weon kim established the Korean society of lingual Orthodontics and found Model Checker, Bracket Positioner and CRC –Ready made Core trays which together form the Korean Indirect bonding set up System<sup>20</sup>

The Korean indirect bonding set up was developed by the Korean society of Lingual Orthodontics. Indirect bonding set up allows positioning of all brackets at once using a bracket positioning machine. A set up model is created and then it is checked for increased precision with a model gauge.

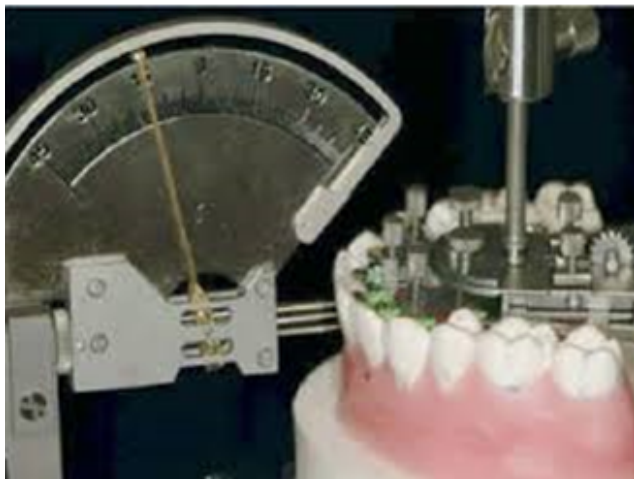


Fig. 12:

#### 2.18. HIRO system

HIRO System does not require any special equipment like other systems. It was introduced by Toshiaki Hiro and later improved by Kyoto Takemoto and Giuseppe Scuzzo. The first set up in preparation of the set up model is sectioning of the teeth and aligning. The fabrication of arch form is done by bending a full sized rigid rectangular arch wire and positioning of brackets on it. Now the transfer trays are prepared individually and transferred from the set up.



Fig. 13:

Preparation of individual transfer trays is done by hard resin in the Convertible resin core system and here the tray and bracket were held together by an elastomeric ligature. Then there is accurate repositioning of the brackets within the resin core system and trays can be reused in case of debonding of brackets. The first bonding session with the unitary trays is of long duration and then this technique would rely on the set up model.

#### 2.19. Hybrid Core System

In this system there is mainly transfer of brackets. Matsuno developed the Hybrid Core System which has the favourable properties of silicone and composite resin in the construction of its indirect transfer tray. The bracket is covered by silicone and then by composite resin during the construction of indirect transfer tray. By doing this combination there is stable positioning of the transfer tray within the mouth and removal of the silicone component from the bonded bracket made easier.

#### 2.20. Simplified Technique

In the Simplified technique the STB brackets are placed directly on the lingual surface of teeth by using a bracket placement plier and simple tweezers. The Placement of brackets are done by keeping a distance of 1.5 to 2mm from

the incisal edge of anterior teeth. The STB brackets were developed by Giuseppe Scuzzo along with Kyoto Takemoto from Japan fabricated a lingual straight wire bracket and technique known as STB<sup>21</sup>



**Fig. 14:**

### 2.21. Orapix System

The recent lingual orthodontic laboratory system is the Orapix system. The scanner scans the patient model to a three dimensional data file. The Prepared data file along with the 3-txer software package is sent to the orthodontist via the internet. The orthodontist will create a virtual set up on the computer by using the 3D model. In Once the clinician receives all the details about the patient on the computer screen the orthodontist can decide on the amount of angulation and torque to be given. once this step is done the information is sent back to the laboratory through the internet.

### 2.22. Retention protocol in lingual orthodontics

Fixed Bonded retainer  
Begg wrap around retainer  
Hawley retainer

### 3. Conclusion

The future of orthodontics is undergoing rapid changes. The demand for aesthetics and as the awareness of lingual orthodontics is being spread everywhere. There will be lot of patients opting for Lingual orthodontics in future.

### 4. Sources of Funding

None.

### 5. Conflict of Interest

None.

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