Review Article

AN OVERVIEW OF LINGUAL ORTHODONTICS: ADVANTAGES AND DISADVANTAGES

Abstract

The majority of orthodontic issues that can be resolved with conventional labial technique, such as tooth malposition, anteroposterior discrepancies, and pre-prosthetic surgical cases, can be resolved with lingual orthodontics. The lingual surfaces of the teeth appear to be less prone to caries than the buccal surfaces due to differences in surface morphology, plaque retention, salivary flow, and the mechanical cleaning of surfaces by the tongue. Lingual orthodontics is one of the good options for comprehensive treatment of the majority of malocclusions. Despite being a technique-sensitive and demanding orthodontic modality in terms of expertise, special bracket and wire system, complicated system of wire bending, need for indirect bonding, and customization of treatment plan, lingual orthodontics has unquestionably emerged as the most desirable treatment option in the recent scenario because of its most acceptable form of invisible braces, especially in adults and adolescents or more appropriately young adults due to the fact that lingual orthodontics is a treatment option that can be used on both adults and adolescents.

Keywords: Orthodontics, dentistry, orthodontic modality, Lingual Straight Wire Technique

1. INTRODUCTION

Orthodontics is a branch of dentistry which has evoluted with time because of the critical situation of managing the developing malocclusions in growing children and fully developed malocclusions in adults and hindrances in achieving esthetics, functionality & structural balance and last but not least fulfilling patient's desires. The complications encountered in achieving the goals has furthered the research in orthodontics which resulted in the development of various appliances and techniques. The foremost problem faced by orthodontist through its evolution was patient acceptability of the braces because of the unsightly appearance and maneuverability of the braces as some sort of handicapping situation for the patient by kith and kins. Emphasis for development of lingual appliances came from the stigma of unesthetic perception of labial fixed orthodontic appliances [1]. Although lingual orthodontic treatment has disadvantages of soft tissue injury and insufficient volume for the tongue, the distinct advantage of invisibility and eradication of a feeling of shame in public appearances , surpasses all its other complications which can be managed with some extra efforts in maintaining oral hygiene and improvising upon the eating habits etc. patients contented with lingual orthodontic technique are around 95%. Satisfactory results and the benefit of hidden appliances, convinces most of patients to endorse the lingual orthodontic appliance as beneficial to peers and colleagues [2]. Today lingual technique is not only accepted , rather preferred by adults [3]. Improvements in bracket designs and improvisation in lingual orthodontic clinical and laboratory techniques have made it more convenient for orthodontists and a more pleasant experience for patients.

2. EVOLUTION OF LINGUAL ORTHODONTICS

It was Pierre Fauchard in 1726, who first proposed that braces could be attached onto the lingual surfaces of teeth.[4] First lingual arch for expansion and alignment of the teeth was created by Pierre Joachim Lefoulon in 1841[4]

In 1889, John Farrar described "Lingual removable Arch" with some minor modifications in the labial appliance[5]. In 1918, Dr John Mershon made a publication with the title "The removable lingual arch as an appliance for the treatment of malocclusion of the teeth." He described it as a wire of suitable size, to which auxiliary springs can be attached.[6] In 1922, Mershon's further improved the technique and presented finger springs on labial and lingual arches which aided in the movement of individual teeth.

Dr. Oren Oliver in March 1942, at a pan American congress in New Orleans, took on a demonstration on a labiolingual appliance.[7]

Dr William Wilson demonstrated a labio-loop lingual appliance in mid 50's that later developed into the Wilson modular appliance system.[7]

As the multibracket labial appliances advanced over time, partial lingual appliances were developed that were used as adjunct to the labial appliance systems such as the Goshgarian (transpalatal bar), Ricketts (Quad-Helix) and Wilson (3D Modular Enhanced Orthodontics)

The idea of Contemporary lingual treatment began simultaneously in 1970's in two seperate countries, by Dr Kinya Fujita (Kanagawa, Japan) and Dr Craven Kurz (Beverly Hills, CA, USA) who independently developed their own designs for lingual braces.

The lion's share in development of current lingual orthodontics came from Dr Craven Kurz in 1975 who was instrumental in introducing a bonded edgewise lingual appliance with few inbuilt features for the first time in association with Ormco company and further developed seven generations of lingual brackets with horizontally opening slots, each one more refined and sophisticated than the previous generation [8]. Ormco even took pain to constitute a task force including Dr Curz and others to headstart their research with the objective of refining the built-in characters like torque, angulation, thickness, dimensions etc.) in bracket designs, biomechanical aspects of techniques, designs of the archwire, stages and sequence in treatment, and criteria for selecting suitable cases..

Mushroom shaped arch wires were introduced for the first time and promoted for use in lingual orthodontics by Dr Kinya Fujita from Kanagawa Dental University, Japan. Mushroom archwires however typically involves intricate wire bending in the form of vertical step bends and first premolar insets. He initiated his endeavours in direction of developing lingual technique in 1968, paradoxically not for esthetic purpose but for protecting his patients who practiced martial arts from injury by labial brackets and after a decade of hard work and research, in 1978, described the capabilities of the Fujita Bracket, which have an occlusally opening slot. [9].

Tae Weon Kim founded the Korean Society of Lingual Orthodontics (KSLO) and developed Korean indirect bonding system. Hee-Moon Kyung founded the Korean Lingual Orthodontics Association (KLOA) and developed the Individual Indirect Bonding Technique (IIBT), the Mushroom Bracket Positioner, as well as the Lingual Straight Wire Technique[10] He also

developed a micro screw implant, which was a major advance in the facilitation of bony anchorage in lingual and labial orthodontic techniques both.

Pioneers of lingual orthodontics in the United States were Kelly [11] (1982), who used labial brackets from Unitek on the palatal/lingual surfaces, and Dr. Stephen Paige [12,13] who introduced Lingual Light Wire technique in 1982 using brackets from Begg's technique on palatal surfaces. Dr. Thomas D. Creekmore [14] (1989) presented a comprehensive technique and lingual brackets with vertical slot, and the Slot Machine which was capable of efficient and precise laboratory procedures.

Weichmann introduced computer aided designing/ computer aided machining(CAD/CAM) into lingual orthodontics in 2002 and brought renaissance in the field by completely customizing lingual brackets and archwires with wire bending through robotic technology specific to a particular patient according to the case requirements. In 2009, 3M Unitek took its copyrights and reintroduced it as Incognito™ lingual appliance. [15]

Fillion, in 2010, used the Orapix digital system with a virtual setup to develop a customized straight-wire technique. [16]

Many other customized lingual systems have been introduced since then e.g. HARMONY (American Orthodontics), WIN (DW Lingual Systems GmbH), and Indian customized lingual systems: Lingual Matrix and iLingual 3D.

Dr Massimo Ronchin and Forestadent (Pforzheim, Germany) developed a self-ligating bracket based on the Begg technique in 1994. First self-ligating lingual brackets in its pure form were developed by Scuzzo et al. in 2011. [17]

Kairalla et al. established the size and shape of lingual arch forms in 2014 as small, medium, large and extra large and shape similar to a parabola with a slight flattening in the anterior teeth region. [18].

Park et al. introduced a new nomenclature for lingual arch forms in 2015: Narrow, tapering and ovoid [19].

Various practitioners through out the world have been working upon for development of an efficient lingual system by devising their own bracket system and evolving their techniques.

2.1. Generations of Kurz Brackets **[20]**

The main features of the Kurz Brackets were a bite plane, a base pad adapted to the anatomic morphology of the lingual surfaces and a preangulated slot according to the torque to be applied on the labial surface.

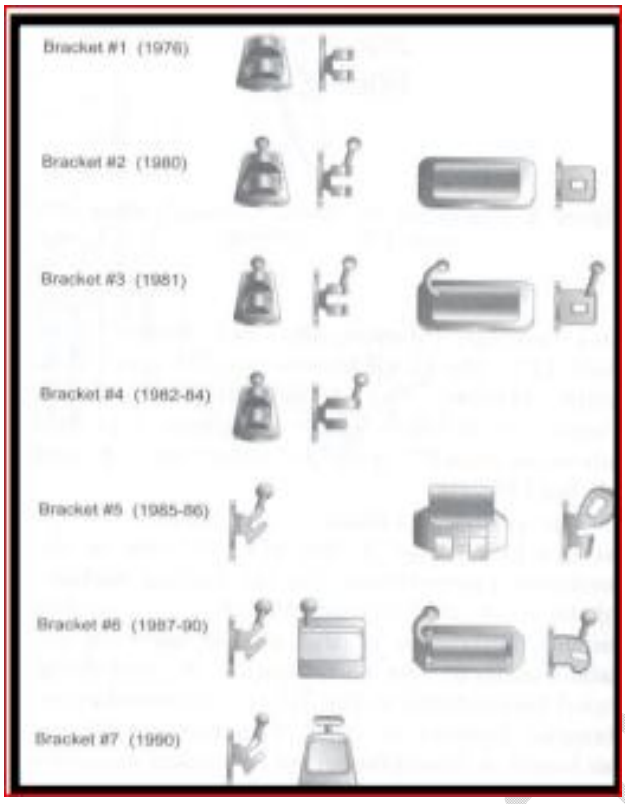

Fig. 1.a Evolution of the Craven Kurz lingual bracket. Fig.1 b 7th generation Curz bracket

First generation (1976)

Second Generation(1980)

Third Generation (1981)

Fourth Generation (1982-1984)

Fifth Generation (1985-86)

Sixth Generation (1987-90)

Seventh Generation (1990-present)[21] The seventh generation Ormco bracket presented with a larger bracket base, pre-angulated slot and hook, maxillary anterior bite plane is now heart shaped with smaller hooks. The premolar brackets have increased width to allow better angulation and rotation control. The molar now comes with either a hinge cap or a terminal sheath [22,23] .

2.2. Fujita's Lingual Brackets

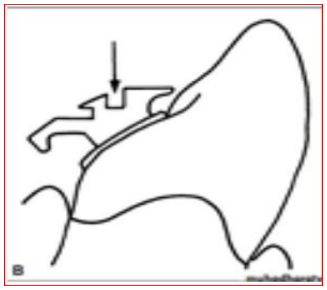
Fig. 2. Fujita lingual Bracket

Dr. Kinya Fujita developed small size , low profile brackets in 1979, so that any injury to teeth or soft tissues during physical activities could be avoided with the additional advantage of very low visibility. The occlusal slot enabled convenient insertion of archwire into the slot and avoided deformation of archwire at the time of insertion. The grooves for lockpins were parallel to the wire i.e. mesiodistally. An auxiliary groove was also present occlusogingivally for mesiodistal correction.

Currently multiple slots for different wires are present in Fujita brackets in occlusal, lingual and vertical directions i.e. 3 slots in Anterior and premolar brackets and and 5 slots in molar brackets so that comprehensive mechanics for different movements of teeth with multiple wires could be carried out simultaneously. [24]

3. BRACKET SYSTEMS

Patient compliance, force control, precise tooth positioning and mechanical efficiency are the factors that have been providing a strong impetus for the development of various lingual bracket systems. some of the systems are:

1. Conceal brackets by Thomas Creekmore [14,21] **:** occlusally opening slots and convenient archwire insertion and removal.

2. STb (SCUZZO- TAKEMOTO bracket) (Sold by Ormco.)[21,25,26] developed straight wire lingual technique by placing the brackets more gingivally.

3. Forestadent: Low profile 2D-brackets and 3D-brackets for effortless management of elementary problems and severe discrepancies respectively facilitating three dimensional control of torque and angulations of individual tooth. [22]

4. Stealth Brackets (American orthodontics)[22]

Old generation bracket with tiny proportions & large distance between adjacent brackets, comfortable to the patient but below par control of tooth rotations.rotations have to be managed by an uprighting spring.

5. Philippe self ligating lingual brackets [27,28]

No slots therefore could not control torque. Direct bonding was employed.

6. Kelly Bracket

A simple labial unitek bracket used on the lingual surface. A twin bracket with a Horizontal insertion slot best for managing tooth rotations.

7. In –ovation L bracket [29]

A self ligating bracket with large distance between adjacent brackets, therefore more comfortable for the patient. Because of the the forked design in the base there is better synchronisation with the lingual surface contours.

8. Braces (Incognito) [21, 28]

Customized low Profile brackets with good finish. The CAD-CAM technology has enabled the process of patient specific bracket production and precise bracket positioning possible in a single step in the laboratory thus producing accurate movements of the desired teeth only .

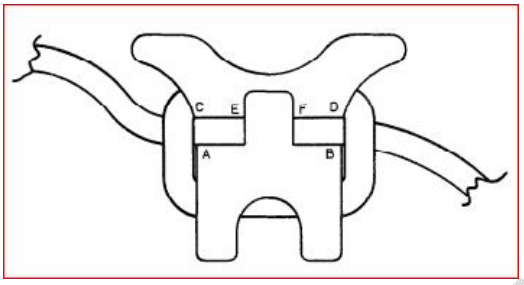

Fig. 3.a Conceal brackets have three different arch wire slot widths for the three different tip A-B, torque E-F, and rotation C-F or E-D

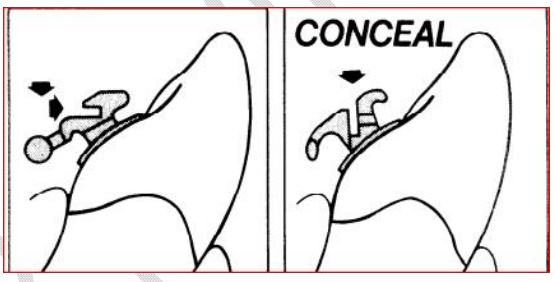

Fig. 3b. Conceal brackets A: Lingual insertion B: Occlusal insertion.

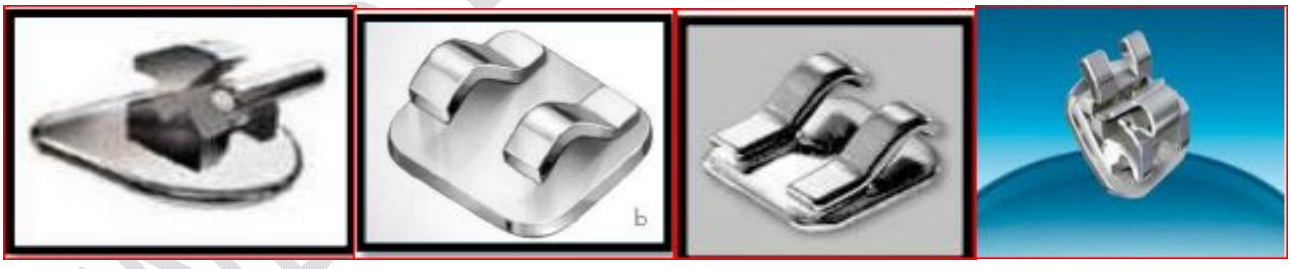

Fig. 3.b : Stealth Brackets Fig.3.c: Forestadent Fig.3.d: Philippe bracket Fig.3.e: In –ovation L bracket

4. ARCHWIRES IN LINGUAL ORTHODONTICS

Because of the anatomical variations in the morphology of the lingual surfaces, adapting the brackets intimately to the surface becomes a cumbersome process and therefore proper engagement of the archwire into the bracket slot requires intricate wire bending or preformed wires shaped according to the generalized archform on the lingual aspect of the teeth**.** Hence two types of archewire forms have been developed to be used in routine practice of orthodontics: the straight (ovoid) and mushroom-shaped archwires.

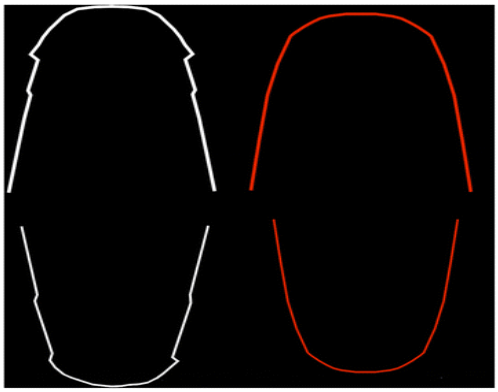

Fig 4: Standardized arches for the lingual technique: (a) mushroom shape and (b) straight.

The mushroom shaped archwire is shaped according to the general lingual surface contours having sharp inset between canine and first premolar, whereas a thick base has to be built in the bracket for use with the straight archwire or some surplus composite has to be added under the bracket base to compensate for the different labio-lingual thickeness of various teeth. Nevertheless, the difference is very small in a horizontal plane at the junction of crown and root, therefore a "lingual straight archwire" having a configuration of a simple curve in the horizontal plane with no insets has been developed.

Both the types of archwires need to employ different mechanics, because the location of force and/or moment application with respect to the centre of resistance (CR) varies as the thickness of the base in the anterior region, primarily lateral incisors and canines increases. In addition the first-order bends in the form of insets also changes manner of loads transmitted in the archwire.

Although very little research has been conducted to differentiate between mushroom and straight wires, a comparative study was done by Brandon owen [30] measuring the force and moments in lingual appliances which concluded that straight wires produce larger forces and moments at the CR. This is because the large inter-bracket distance in the mushroom archwire between the canine and first premolar decreases the stiffness of the archwire, and the mushroom shape keeps the bracket-archwire interface closer to the long axis of the teeth which reduce the moments. Further the thicker bases in straight wires increase the distance of the bracket from the long axis of the tooth which increases the moment arm from the CR , hence producing greater moments. lateral incisors, first premolars, and canines are the teeth most affected by this difference in characteristics of the different archwires.

Mushroom archwires need a large inventory to be hosted by the orthodontist since the different mesiodistal dimensions of anterior teeth displaces the inset bend between canine and first premolar mesially or distally, therefore necessitating different sizes for individual patients. Also the high profile of brackets used along the mushroom archwires because of thicker bases or additional composite leads to frequent bond failures. With the straight archwire, the same archwire shape can be used in all the patients for any malocclusion.

With the pros and cons of each archwire type in view, priority of using one over other is entirely dependent upon the orthodontists convenience and preferences since not only it is easier and faster to work with straight archwire but also the mushroom-shaped archwires need ardous, still

precise wirebending practice for its construction [31] which is laborious and time consuming for the orthodontist and if not given proper time, may produce unsatisfactory results as well.

5. INSTRUMENTS IN LINGUAL ORTHODONTICS [22]

Because of the difficulty in accessing the lingual surface of tooth, maneuverability and dexterity in performing any procedures cannot be achieved with conventional instruments so specially designed instruments have been developed by ETM corporation with longer handles and angulated beaks either at 45˚/90˚

1. Lingual Ligature Cutter- Angulated 45°(Figure 5.a)

2. Light ligature plier, Mathieu style plier (Figure 5.b)

3. Kurz First order bending fork. (Figure 5.c) it can place first order bends directly in the mouth, thus eliminating the need to remove wire and ligatures.

4. Kurz Archwire Cutter (Figure 5.d) its function is same as that of distal end cutting plier.

5. Kurz Mosquito Forceps: curved at 45˚ (Figure 5.e) used for attaching elastics and elastic chains.

6. Kurz Ligature wire cutter (Figure 5.f) angulated at 90°.

7. Direct bond removing Plier (Figure 5.g)

8. Kurz tongue retractor and Saliva ejector. (Figure 5.h)

9. Kurz Utility Plier (Figure 5.i) same as Weingart utility plier.

10. Kurz Second Order Bending Fork. (Figure 5.j)

11. Module Remover (Figure 5.k)

Figure: 5.a

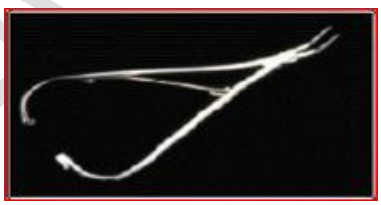

Figure: 5.b

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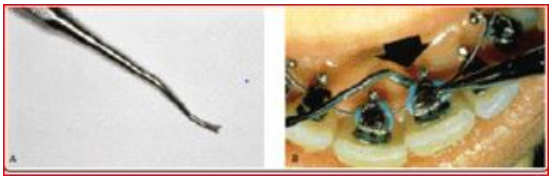


Figure : 5.f

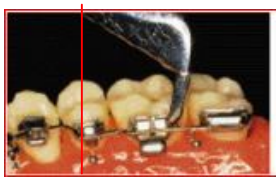


Figure : 5.g

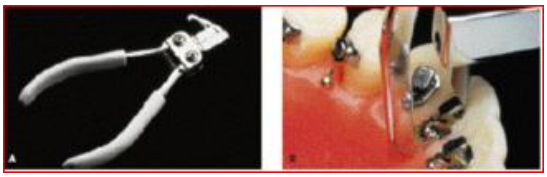


Figure: 5.h

Figure: 5.i

Figure: 5.j

Figure: 5.k

6. BONDING AND LABORATORY SETUP IN LINGUAL ORTHODONTICS [22,32,33,34]

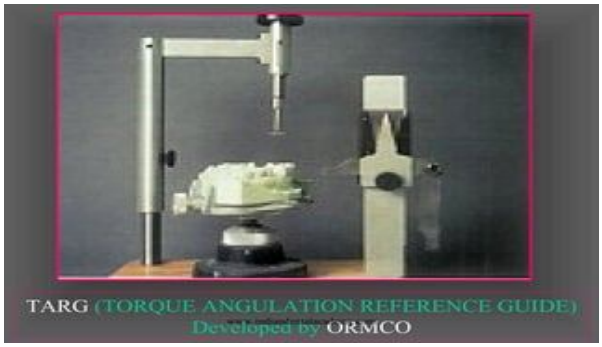
Direct bonding of brackets as is done routinely in labial fixed orthodontics , is not a viable option in case of lingual orthodontics since the anatomical diversity of the lingual suface morphology i.e. differences in labio- lingual thickness, height of cingulum , less interbracket space etc. does not allow accurate and precise positioning of brackets onto the lingual suface under direct view. Therefore It is cumbersome and strategically problematic for the orthodontist to put on brackets directly onto the lingual surfaces. Hence indirect bonding procedures in the laboratory setting have been devised to ensure exactitude in bracket positioning so that biomechanics is not affected adversely because of a faulty technique. Furthermore advancements in Laboratory equipment and technology has made it possible to design and produce brackets and archwires and other appliances completely customized for individual patient needs. Broadly laboratory setups work in two main ways in customization sector, A manual setup working upon patient's dental models and includes systems like BEST, CLASS, and HIRO, etc.,

the second being a completely customized digital lingual setup e.g. Orapix, WIN, HARMONY, Incognito™ and Lingual Matrix, and iLingual III D, which uses computer aided designing (CAD) and computer aided machining(CAM) which uses scanned models or three dimensional images of the patients' dentition to manufacture brackets and archwires and provides detailed description of analysis of dentition and biomechanical aspects specific for that particular patient.

A) Systems with manual setup:

6.A.1. Torque Angulation Reference Guide (TARG)

Launched by the Ormco Company in 1984 the TARG machine provides a specific Tip and Torque to each bracket which are bonded on to a malocclusion model via medium of a virtual set up, by putting additional composite at the base of each bracket.



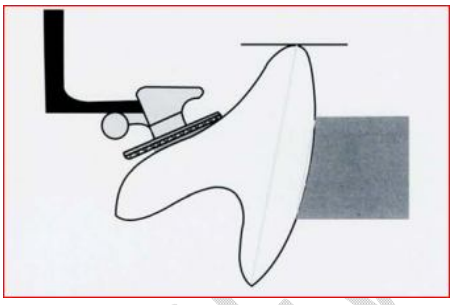


Fig. 6 a : Torque Angulation Reference Guide (TARG) 6 b: : Labial reference gauge for placing brackets (TARG)

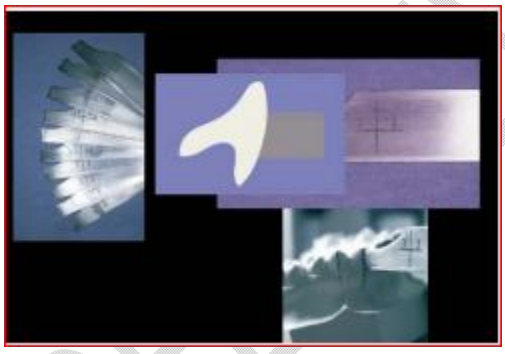


Fig. 6c: The TARG machine has several blades, making it possible to prescribe the torque and angulation for each individual tooth.

6.A.2. Bonding with equal specific thickness (BEST)

Didier Fillon invented Electronic TARG in 1986 which was more accurate compared to original TARG [35] and DALI (dessin de l'arch linguale informatise)which is an arch wire tracing produced by a computer. The most critical problem in lingual orthodontics that is placing brackets according to the variation in the labiolingual thickness of different teeth, also present in original TARG, was eliminated here with a precise measuring device which provided compensation by enabling precise measurement of the labiolingual thickness of each tooth and the amount of composite needed under the base of the bracket.

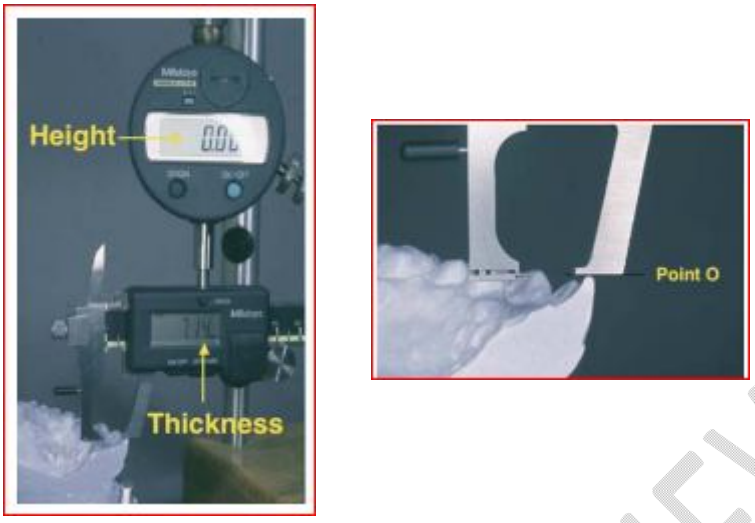


Fig. 7: The Electronic TARG has a precise measuring device that measures the distance (thickness) between the labial surface of the tooth and the slot of the bracket

6.A.3. Customized lingual appliance set up service system (CLASS) [22,36]

The CLASS technique was described by Scott Huge. In this system an ideal diagnostic model is prepared from the malocclusion model of the patient. Using this ideal setup as a template, brackets are bonded onto the malocclusion model keeping in mind to produce an ideal configuration of teeth . Rest of the procedure to prepare transfer trays and the indirect bonding method to transfer the brackets clinically in the mouth is similar to other manually managed indirect bonding methods.

6.A.4. Korean indirect bonding set up (KIS) [37]

Tae Weon Kim was the founder of the Korean Society of Lingual Orthodontics (KSLO). He contrived an indirect bonding system that included a Model Checker, a bracket positioner, and CRC Ready-Made Core Trays[38] which were plastic preformed attachments, perfectly conforming to the external surface of the Ormco lingual bracket[39]. Dr. Kim also designed special pliers to be used exclusively in the lingual technique. Bracket positioning is swift and convenient with this bracket positioner. The model checker confirms the accurate and precise positioning on the setup model.

6.A.5. Slot Machine [14]

Designed by Thomas Creekmore, the slot machine helps in conveniently placing both labial and lingual brackets directly on the malocclusion model without the need for an ideal model setup.. The bracket slot horizontal or vertical, is oriented to the machine.

6.A.6. The Lingual Bracket Jig

ig. 8: Lingual Bracket JIG (LBJ)

This is a ruler developed by Geron. This measurement device greatly facilitates easy and convenient placing of brackets by either direct or indirect means of bonding. This ruler consists of a universal jig meant for measurement on the posterior teeth and a pack of six different jigs for the measurement of six individual maxillary anterior teeth.

6.A.7. HIRO system

Fig. 9 HIRO system

HIRO System was named after its inventor Toshiaki Hiro and was later adapted and improvised by Kyoto Takemoto and Giuseppe Scuzzo. The system is very simple and all the procedures are carried out without the need for any special equipment. First of all sectioning of teeth is carried out from the malocclusion model and then teeth are arranged according to the ideal alignment anticipated. Archform is prepared using a rigid rectangular arch wire and bending it as per the anatomic contours and positioning the brackets according to it. Transfer trays are fabricated using the Convertible resin core system which in itself manipulates to precisely reposition the brackets.

6.A.8. Hybrid Core System

The Hybrid Core System was developed by Matsuno with the objective of devising a technique for the construction of transfer trays and transfer of brackets. The brackets are firstly covered by silicone and then composite which results in biologically sound trays which are not easily distorted during transfer of brackets onto the teeth. The transfer trays remain stably positioned in the mouth because of the composite covering and is conveniently removed from the mouth as silicone easily gets separated from the brackets after bonding.

B). Completely digital customization:

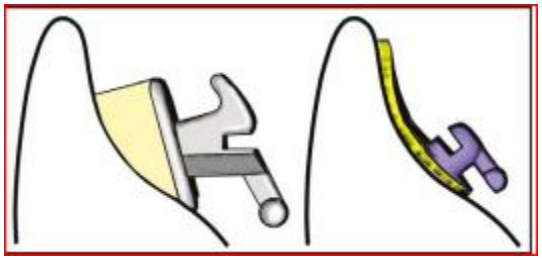


Fig 10. Conventional lingual bracket (left) and customized bracket

6.B.1. Top/Incognito I Braces system

Lingual braces as they are commonly known, the Incognito I braces are constructed using the CAD-CAM technology which enables complete customization of brackets according to individual case and even archwires are prefabricated with all the features inbuilt according to the biomechanical needs in a particular patient.

Fig. 11. Incognito Braces

6.B.2. Orapix System

The Orapix system is the latest and most beautiful flower in the bouquet of lingual orthodontics. There is a digital scanner that scans the patient's model or the patient's dentition intraorally three dimensionally and transforms it into a three dimensional data file which consists of multiple well integrated images taken from each and every angle by the scanner. The orthodontist then makes a ideal virtual set up on the computer using the digital model dictating the parameters that are required in a particular case. Based on the information provided by the virtual setup , orthodontist formulates his diagnosis and treatment plan deciding upon the biomechanics required to produce the desired occlusal adjustments.

Fig. 12. Orapix lingual straight wire technique

According to the diagnosis and treatment planning , the digital software designs the transfer trays and a rapid prototype (RP) machine prepares the transfer trays in resin. Then the technician positions the brackets in the transfer trays and the resin pads on the base of the brackets to complete the lab. work.

6C. Direct bonding/ Simplified Technique

Dr. Michael Diamond in 1984 designed a device called as Peri/Reflector which was composed of a mirror, tongue retractor, and saliva ejector.

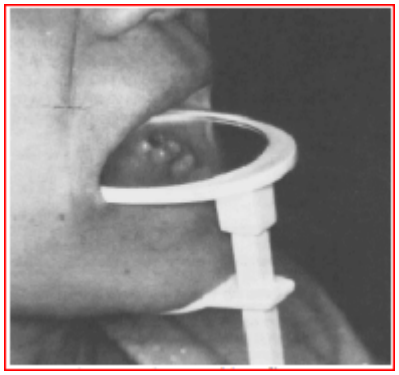


Figure. 13 : Peri/Reflector.

The saliva ejector keeps the working field dry thus avoiding moisture contamination during bonding, the mirror increases the brightness, and enables a hindrance free view of the complete operative field [40]. The Simplified technique uses the STB brackets and a bracket placement plier and simple tweezers for bracket positioning at a distance of 1.5 to 2mm from the incisal edges of anterior teeth.

7. ADVANTAGES AND DISADVANTAGES OF LINGUAL ORTHODONTICS [34]

Esthetics and absolute invisibility of the Appliance is its foremost and paramount advantage when compared to the labial fixed orthodontic appliances, along with its biomechanical efficiency in managing the non- extraction cases and with the advancement of the technique the most difficult cases involving extraction and retraction of anterior teeth can be maneuvered without any difficulty. In addition there are no chances of damage or decalcification of the labial enamel surface which is one of the problems with the labial appliances during or at the completion of orthodontic treatment. There is significant intrusion of the anterior teeth and some extrusion of posterior teeth which becomes very useful in case of reduction of deep bites especially the severe ones [25] as the position of bracket slot which engages the archwire is very close to the centre of resistance of the anterior teeth in case of lingual brackets, there is more planned movement of the desired teeth and other unwanted factors as anchorage loss and angulation and torque changes are avoided while attempting space anterior teeth retraction during space closure and also during bite opening. [41] .

Disadvantages primarily include a lack of direct vision which hampers direct bonding technique and there arises a need for Indirect bonding technique for accurate bracket placement.

[42] Other problems are occlusal interferences causing frequent bond failures, Speech Distortion , lacerations to the tongue, Gingival irritation , difficult oral hygiene ,white spot lesions and increased chair side time and high cost. [43].

8. INDICATIONS FOR LINGUAL APPLIANCES

There are a few situations where lingual brackets come advantageous because of their inbuilt design features and distinct mechanical characteristics such as a bite plane, occlusally opening bracket slots, mushroom shaped arch wires etc.

1. Intrusion of Anterior teeth : The intrusive force in case of lingual brackets passes through the centre of resistance of the teeth as the brackets are placed more close to the centre of resistance on the lingual surface because of the morphological contours and also lower anterior teeth touch the horizontal plane of the lingual brackets. Both these factors produce a bite plane effect on upper teeth effecting light, continuous, forces and hence this force system becomes very effective in intrusion of teeth and therefore deep bite reduction.

2. Expansion of the Maxillary Arch: as the lingual brackets are located between the tongue and lingual/palatal aspect of the teeth, a continous buccal/labial force is exerted by the tongue over the teeth which is centrifugal and expansile in nature. This force is further sustained and supported by the mushroom shape of the archwires and the reduced interbracket distance.

3. Repositioning of the mandible with orthodontic tooth movements: In the first stage of treatment any temporomandibular problems and pain/related symptoms are sorted out because of the bite plane effect of the lingual brackets and in the following clinical stage, a new mandibular position is acquired because of the change in occlusion which further stabilzes the occlusion.

4. Distalisation of maxillary molars: molar distalisation through lingual technique is more efficient producing more bodily movement and less distal tipping [22].

5. Cases which are complicated by an existing habit of forceful tongue thrust because of the tongue restriction due to lingually placed brackets.

Ideal Cases [44] for lingual orthodontics include Deep bite in horizontally growing individuals , Class I malocclusion with slight crowding, Class II Division 2 malocclusion , extraction cases with class II malocclusion , midline diastema ,Pre- Tooth movement required for ideal alignment in case of planned fixed Prosthesis and Class III malocclusion and others needing Surgery.

Some difficult situations to handle with lingual orthodontics are 1. premolar extraction cases 2. Bilateral/unilateral Crossbites of the poaterior teeth. 3. High mandibular plane Angle(vertical facial pattern) cases and 4. Open bite cases [43,45,46]

9. COMPARISION OF LINGUAL AND LABIAL APPLIANCES

Scuzzo and Takemoto known for their significant contribution to the lingual orthodontics, took on a study to compare the different orthodontic forces acting on the lingual and labial brackets in all 3 dimensions. [22,45]. They summarized the major findings as following:

In the vertical plane the most perceptible and immediate effect is opening of the bite since the horizontal plane of the lingual brackets inferiorly touches with the incisal edges of the mandibular and cause intrusion of the maxillary and mandibular anterior teeth and slight extrusion of the posterior teeth which produces the deep bite reduction effect. Bite opening is advantageous in brachyfacial patients and TMJ cases and tooth movements occur speedily because of posterior disclusion, but in faces with vertically growing and average growth pattern, there is a tendency of increased anterior and posterior vertical height in already long faces due to the bite opening effect. This increased facial height produces anterior open bite , mouth breathing etc., the kind of problems which are difficult to manage clinically once the growth pattern is disturbed due to faulty biomechanics. Therefore care has to be taken in treating dolicofacial patients with lingual orthodontics and biomechanics has to be modified according to the case requirements.

Since the lingual brackets are positioned in the center of cingulum there are lesser moments of forces acting on the tooth in all the three planes i.e. vertical , sagittal and horizontal planes when compared in relation to the labial brackets because the distance from the centre of brackets to the centre of resistance of tooth becomes shorter and hence arm of the moment becomes small. Therefore when intrusive forces are applied , the labial vector does not produce labial tipping in normally inclined and already protruded teeth. But in case of retroclined maxillary anterior teeth a clockwise moment is produced by the lingual brackets which increases the lingual inclination of the already retroclined teeth whereas vice versa happens with the labial brackets because of their position on the labial surface. [45] .

Effect of extrusive forces has also been studied. Extrusive forces in lingual appliance have been examined by geron and romano. They concluded that Extrusive forces produced labial root movement only when there was more than 20 degrees proclination of the maxillary incisors. Otherwise there is lingual root movement only. Conversely it was observed that there were only labial rooy movements only with the labial brackets. [47]

Anteroposterior plane since there is backward and downward rotation of mandible immediately after appliance installation, due to bite opening, the lingual appliance produces a Class II tendency.

Due to posterior disocclusion with bite opening, Aneroposterior movement of molar becomes easily achievable. Molar anchorage is also secured firmly since there is routine banding of the second molars and reduces the extrusion of posterior teeth due to Class II elastics [42,43,45,48] .

On application of same amount of retraction force, as it becomes equal to the intrusion force equals, the net force is directed through the center of resistance in the labial technique, but remains lingual in the lingual orthodontics which produces lingual tipping and a bowing effect vertically similar to the roller coaster effect produced in labial technique with excessive retraction forces.(Fig 14).

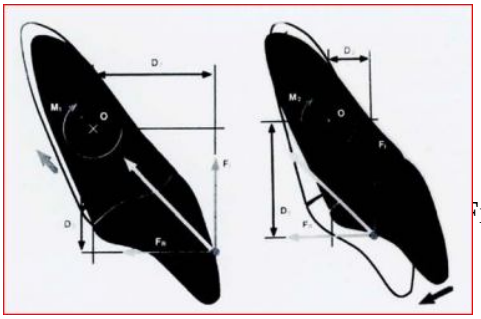


Fig 14: Comparison between the anterior retraction in labial and lingual mechanics,

So to avoid these side effects during en masse retraction in lingual orthodontics, the applied force must be within the biological limits of retraction and forces must be concentrated on intrusion vector producing more lingual root torque [22,45].

In the transverse plane the lingual appliance produces expansile forces which together with. posterior disclusion, cause mesiobuccal molar rotation when spaces are closed using retraction forces. Therefore anchorage in form of transpalatal arches is critical. Retraction is always done on stiffer wires to resist the "bowing effect" due to excessive forces or the failure to manage the force vectors due to the lingual nature of the appliance, both in transverse and vertical plane (Fig 15. 1 & 15.2) [22,42,43]

Fig 15.1 Transverse bowing and mesiobuccal rotation of molars

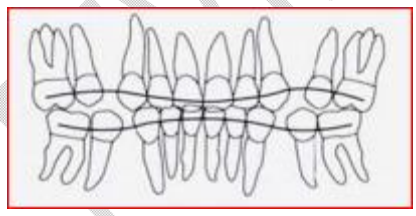


Fig 15.2 Vertical bowing effect of retraction forces

10. CONCLUSION

Lingual orthodontics, inspite of being technique sensitive and a demanding orthodontic modality in terms of expertise, special bracket and wire system and complicated system of wire bending , need for indirect bonding and customization of treatment plan; has definetly emerged as the most desirable treatment option for in the recent scenario because of its most acceptable form of invisible braces ,especially in adults and adolescents or more appropriately young adults due to the elimination of the feeling of ignonimity or the social stigma that orthodontic treatment represented in the past. This along with improvisation of bracket system and techniques and the research in the coming years will sure shot be a boon in the hands of skilled orthodontists.

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