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Evolution Of Lingual Brackets – A Historical Perspective

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ABSTRACT

The development of numerous orthodontic techniques has led to achievement of high orthodontic standards of treatment. A pleasant esthetic look increases self- esteem in people. The main goal to achieve facial balance with orthodontic treatment is to balance esthetic treatment, functional balance and harmony. Lingual orthodontics represents the best solution for meeting these needs without compromising on the biomechanical efficiency. This review article discusses the various bracket systems that have evolved since the introduction of the lingual orthodontic technique.

KEYWORDS: Lingual brackets, esthetics, lingual morphology

INTRODUCTION

The popularity of adult orthodontics has increased due to tooth coloured brackets and wires, lingual orthodontics and invisalign techniques. Since the advent of the first lingual appliance, the brackets have undergone a long evolution from one appliance to the other to overcome the shortcoming of the previous technique. This review article enlists the various brackets that have evolved since the first lingual system.

HISTORY OF LINGUAL BRACKETS

In 1726, Pierre Fauchard suggested the use of appliances on the lingual surfaces. Later in 1841, Pierre Joachim Lefoulon designed the first lingual arch for expansion and alignment of teeth. Other appliances that were placed on the lingual or palatal aspects include the Lingual Arch (Mershon), Transapalatal arch (Goshgarian), Quad helix (Ricketts) and the 3D Modular Enhanced Orthodontics by Wilson.

VARIOUS SYSTEMS INTRODUCED IN LINGUAL ORTHODONTICS

1. FUJITA SYSTEM[1]

The concept of lingual orthodontics was given by Dr. Kinya Fujita in 1967, where he introduced lingual multi bracket system with mushroom shaped archwires and obtained a patent for it in 1980 (Fujita Lingual brackets). The presently available Fujita system is based on occlusal slot opening but has multiple slots. The brackets for anterior teeth and premolars have three slots, namely, occlusal, lingual and vertical. The molar brackets have five slots which includes one occlusal, two lingual and two vertical slots. Each slot aids in different tooth movements. The dimension of theocclusal and vertical slot is 0.019” and 0.016” respectively, whereas the lingual slot is 0.018” x 0.025”.

2. **KURZ LINGUAL APPLIANCE**[2]

Lingual orthodontics was introduced by Dr. Craven Kurz, in 1975, where he used plastic Lee Fischer brackets bonded to the lingual aspect of the anterior dentition and metal brackets on the posterior dentition with slots directed palatally. Initially, they had high bond failures due to shearing forces in the maxillary anterior teeth but the brackets were later rectified with addition of inclined planes that were directed with an intrusive force in labial direction. The tie wings were directed gingivally and the brackets were positioned 2mm away from the gingival margin to avoid tissue impingement. GENERATION 1: The first Lingual appliance was given by Dr. Craven Kurz and is also known as Kurz Lingual appliance. It was manufactured by Ormco in 1976. The appliance had a flat maxillary occlusal bite plane from canine to canine. The lower incisor and premolar brackets were low profile and half – round and there were no hooks on any brackets. It had a 0.018" slot that facedlingually. GENERATION 2: Introduced in 1980, it was a modification to the previous one with hooks added to all the canine brackets. GENERATION 3: Introduced in 1981, hooks were added to all the anterior and premolar brackets. The first molar bracket had a bracket with an internal hook. The second molar had a terminal sheath without a hook but had a terminal recess for elastic traction. GENERATION 4: Introduced between 1982 to 1984, there was the addition of low profile anterior inclined plane on the central and lateral incisor brackets. The hooks were optional based upon individual treatment needs and hygiene concerns. GENERATION 5: It was introduced between 1985 to 1986. The anterior inclined plane became more pronounced with an increase in labial torque in maxillary anterior region. The canine also had an inclined plane but it was bi-beveled to allow intercuspation of the maxillary cusp with the embrasure between the mandibular canine and the first premolar. The hooks were optional and a transpalatal bar attachment was available for the first molar bracket. GENERATION 6: Introduced between 1987 to 1990, the inclined plane on the maxillary anteriors were more square in shape. Hooks on the anteriors and premolars were elongated. Hooks were available for all the brackets. The transpalatal bar attachment for the first molar band was optional. A hinge cap was available for molar brackets that allowed ease of archwire manipulations. GENERATION 7: Introduced in 1990, the maxillary anterior inclined plane was heart-shaped with short hooks. They had a horizontal slot available in either 0.018 or 0.022 slot.The lower anterior brackets had a larger inclined plane with short hooks.All hooks had a greater recess/ access for ligation. The premolar brackets were widened mesiodistally and the hooks were shortened. The increased width of the premolar bracket allowed better angulation and rotation control. The molar brackets were made available with either a hinge cap or a terminal sheath.

3. **Lingual Begg Light Wire Technique**[3]

It was introduced by Dr. Stephen Paige in 1982. This technique used regular Begg labial brackets and this bracket system used Unipoint combination bracket (Unitek) which had a gingival wing to place elastic modules or continuous elastic chains. The brackets had a TP 256-500 mini mesh lower incisor labial brackets which were used for both upper and lower incisors. The upper lateral labial brackets were adapted to the cuspids and the curved upper cuspid labial brackets were adapted to the bicuspids. To provide proper interbracket distance in Stage I, the vertical slots of the brackets were directed incisally. For stage II and III, a new set of brackets were bonded with the vertical slots directed gingivally. 0.036" oval tube with a mesio-gingival hook was used for first molars that allowed molar control and aided in accepting a ribbon arch. The mushroom shaped archwire had horizontal loops distal to the cuspids.

4. **STb (SCUZZO TAKEMOTO bracket)**[4]

Introduced by Giuseppe Scuzzo with Kyoto Takemoto from Japan in 2003, it was a prototype of lingual straight wire bracket and technique of STb(Scuzzo/ Takemoto bracket, Ormco). It was based on three concepts: greater comfort, more speed and enhanced reliability. This method required bracket being positioned much closer to the gingival margin and lingual surface of the tooth. The complicated wire bending of the mushroom-shaped archwire affected both the treatment results and the time spent on the chair. The lingual straight wire method had the advantage of arch coordination and simplified mechanics. A manual or computerized set up was a must for this technique. The set up model included information on torque, angulation, height and rotation (incorporation of over torque and over angulation were necessary for extraction treatment protocol). A mild

Wilson curve and a mild curve of Spee was established in the occlusal plane and a simple template was used to confirm arch form symmetry.

NEW STb DESIGN

The new STb had a 0.018 x x0.025-inch horizontal slot made up of a 17-4PH stainless steel milled alloy while the pad material was 316 L stainless steel. The slot was narrower to increase inter-bracket distance. This reduced both the force delivered by the archwire and the resistance to sliding mechanics. To increase the interbracket distance, the brackets had to be bonded much closer to the lingual tooth surface as the force was inversely proportional to the cube of the inter-bracket distance.Thus the difference between the conventional versus new STb(Ormco) was that the new one has a gingival offset and a hook. The conventional and the new STb had a passive ligation step (0.3mm) on both sides of the slot to prevent binding of archwire against the slot when a 0.012 or 0.013-inch main wire was used. The gingival offset reduced the in-out thickness thus reducing the composite pad thickness, bonding failure, build up time and patient discomfort. The new STb lingual straight wire permitted simpler sliding mechanics by eliminating the need for inset ends between cuspid and bicuspid. Hence, it enhanced tooth alignment and leveling.

ARCH FORM.

The Lingual Straight Plane (LS Plane) was established at 2/3rd of the clinical height on the upper anterior teeth and at ½ of the clinical height on the upper molars and lower teeth to achieve ideal bracket positions. The brackets were to be bonded as lingually as possible to allow ideal bending of the wire. The archwire was also modified to a square-like shape compared to the rounded arch wire used earlier.

5. **PHILIPPE SELF LIGATING LINGUAL BRACKET**

It was first described by Macchi A et al[5], in Journal of Clinical orthodontics in 2002. They were designed to be bonded directly to the lingual tooth surfaces. Since they did not have slots, only first and second order movements were deemed possible. They were available in four types : standard medium twin bracket (commonly used), narrow single wing bracket for lower incisor, large twin bracket and three wing bracket for attachment of intermaxillary elastics and simple third order movements. Their clinical applications were limited to post treatment retention, closure of minor spaces, limited intrusion and correction of simple tooth malalignment.They acted as an alternative to conventional lingual brackets in cases that did not require third order bends.

6. **ADENTA BRACKETS**

Hatto Loidl and C. Schendell from Germany developed a self-ligating lingual bracket called Evolution LT (Adenta).Introduced in 1999, after using self-ligating TIME bracket for several years, these brackets were used with the same self-ligating clip mechanism for a lingual bracket.

7. **CONCEAL SYSTEM**

It was introduced by Thomas Creekmore[6] in August 1989 conforming to the principles of an ideal lingual orthodontic appliance system that included the following key elements namely, a method for positioning brackets precisely to create a SWA on the lingual side and a consistent and accurate indirect bonding technique with specially designed pliers (Conceal system (Unitek Corp.). This design had the wire slot opening towards the occlusal rather than the lingual aspect.

8. **FRICTION FREE BRACKET**[7]

It was introduced by Kazuto et al in 1994, to reduce the friction between the bracket slot and archwire. The slots were modified such that the ligature did not press the archwire against the friction free bracket.

9. **ELAN AND ORTHOS SYSTEM**

It was introduced by Craig Andreiko in 1994. These were the two new appliance systems that used CAD CAM technology for appliance design in the orthodontic field.

ELAN SYSTEM

This was the first system to integrate treatment plan and appliance for a specific patient by digitalizing the skeletal and dental anatomy of the patient. The system then proceeded to design an occlusion based on the practitioners treatment plan and on algorithms developed to mate the three dimensional positioning of the dentition to the skeletal framework. The medullary center of the mandibular bone was determined and was converted into a mathematical equation called Mantrough. The mandibular teeth were placed on the curve such that the crown long axes were at specified inclinations. The maxillary teeth were then placed in occlusion with the already set mandibular teeth. The maxillary posterior teeth were placed with respect to centric stops and the anterior teeth were placed from calculations to provide either group function or cuspid rise parameters. Based on all these specifications the system designed and fabricated the brackets, wires and bracket positioning devices that were essentially engineered to formthe desired final results for that individual patient.

ORTHOS SYSTEM

This system was a new average prescription and the appliance design was based on norms and averages of more than 100 cases derived from Elan technology. Its features included lower anterior brackets with reduced facio-lingual dimension, mandibular posterior segments with less negative torque than prior design and molar rotations calculated from the actual anatomy. The other additional features incorporated were that the mandibular arch had more progressive tip to aid in root paralleling, bicuspids had distal root tip to level marginal ridge contacts and upper posterior segments had more buccal root torque to prevent the dangling lingual cusp from causing balancing interferences.

10. **INCOGNITO BRACKETS**[8]

It was introduced by Dr. Dirk Wiechmann of Germany in 2009 (3M Unitek).The 3D geometry of each arch was calculated with CADCAM software and archwire bending robots were used to make the arch wire sequence. The pre-determined wire sequence advocated was Superelastic NiTi 0.014-inch, 0.016 x 0.022-inch and 0.018x0.018-inch titanium molybdenum alloy wire.

11. **STEALTH Brackets (Second generation American Orthodontics)**

It was the chip off the old generation lingual brackets made by American Orthodontics. It was a simple bracket with poor rotation control without the use of an auxillary. It also had a vertical slot to insert an uprighting spring to compensate for the inadequate control caused by the too small slot dimension.

12. **IN OVATION-L BRACKET FROM GAC**[9]

The small dimension of this bracket provided better patient comfort and increased inter-bracket distance. It could be placed in the deepest portion of the lingual fossa adapting better to the anatomical contours of the dentition. The forked design built into the base allowed the base pad to be easily bent to fit the complicated lingual shape of the cuspid securely. It also had a self-ligating clip that remained interactive and in constant activation which eliminated the need to change the ligature ties.The only disadvantage was that the small size made it difficult to visualize the clip and as the bracket base of the lower anteriors were wider, it created difficulty in bonding to smaller teeth.

CONCLUSION

Various lingual bracket systems have evolved over time providing better handling by the orthodontist, efficient biomechanics and improved tolerance by the patient. Lingual orthodontics has undoubtedly come to occupy an integral part of invisible orthodontics opening up new vistas in adult orthodontics.

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