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Review Article

Lingual Orthodontics History Revisiting: A Review

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***ABSTRACT*:**
The history of lingual orthodontics has not been a smooth one. This article provides a brief history of lingual orthodontics while discussing its development as an esthetic alternative to conventional labial technique particularly focusing on its intial rise and fall in popularity followed by it renaissance, among the orthodontists.
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INTRODUCTION

Esthetic concerns were initially responsible for the development of the lingual appliance system and they continue to remain at the forefront for a significant segment of patients seeking orthodontic treatment. Appearance is undoubtedly the most important motivating factor for adults whether it is termed "facial appearance," "dental appearance," or "straight teeth." Since its introduction lingual orthodontics has had varying fortunes which have sometimes prejudiced its potential global diffusion. After the first enthusiastic phase of development of the technique, a kind of depression followed, partly due to problems which arose during early clinical trials and partly due to erroneous use.

HISTORY OF ORIGIN OF LINGUAL APPLIANCE

The idea of lingual appliance can be traced way back to 1726, *Pierre Fauchard*, who suggested the possibility of using appliances on the lingual surfaces of teeth.[1] *In 1841, Pierre Joachim Lefoulon* designed the first lingual arch for expansion and alignment of the teeth.[1] *In 1889, John Farrar* published the description of an appliance "Lingual removable Arch." The dental literature extolled the advantages of moving teeth with lingual appliances.[2] *In 1918, Dr John Mershon* published a paper entitled "The removable lingual arch as an appliance for the treatment of malocclusion of the teeth." The removable lingual arch is a wire of suitable size, to which auxiliary springs can be attached, adapted to the linguo-gingival surfaces of the teeth, and bent to conform to all the inequalities of the dental arch, produced by the irregularities of the teeth.[3] *In 1922, Mershon's* presentation on labial and lingual arches

with finger springs was reported as being a highlight of the meeting. The auxiliary springs were soldered to the main arch wire to produce individual tooth movement. Thus, the force necessary to produce the tooth movement with the lingual arch was obtained in three ways i.e. by straightening out the irregularities in the arch wire, by auxiliary springs soldered to the main arch and by stretching the wire by means of the wire stretching pliers. *In March 1942*, at a pan American congress in New Orleans, *Dr. Oren Oliver* gave a clinic on a labiolingual appliance.[4] *In mid 50's , Dr William Wilson* demonstrated a labio- loop lingual appliance that was a forerunner of the Wilson modular appliance system.[4] With time full banded multibracket labial appliances were used for complex tooth movements and comprehensive orthodontic treatment. Since then, numerous orthodontists have combined active labial appliances with lingual appliances such as the *Goshgarian (transpalatal bar), Ricketts (Quad-Helix) and Wilson (3D Modular Enhanced Orthodontics)*, but all these lingual appliances are partial appliances and are being used as adjunct to the labial appliance systems. As the esthetic concern grew, many attempts were made to make the labial appliances more aesthetic by using plastic and esthetic or tooth colored brackets. To further satisfy the esthetic concerns of orthodontic patient's multi-bracket appliances to be used on the lingual tooth surfaces came into existence. The idea of development of Current lingual treatment began at the same time i.e. the mid 1970's in two different countries, Dr Kinya Fujita (Kanagawa, Japan) and Dr Craven Kurz (Beverly Hills, CA, USA) who independently developed appliances that could be placed on the inner surfaces of the teeth.

HISTORY OF ORIGIN OF LINGUAL BRACKET SYSTEM

Dr. Kinya Fujita was an Assistant Professor in the Department of Orthodontics at Kanagawa Dental University Japan and he first submitted his concepts on a lingual appliance in 1968. In 1975, he started the manufacture and use of his lingual appliance system to move each tooth in three dimensions from the palatal or lingual side. He first reported on the development and use of a lingual multi bracket system using a mushroom shaped archwire in *1979* and a few years later he presented a variety of extraction cases, in children and adults, successfully treated using his appliance. He noted that despite the patients experiencing discomfort, disturbance to speech and increased treatment time, none of them opted to have their appliances removed for conventional brackets to be placed.[2] Salient features of his brackets were occlusally facing slot which resulted in arch wire insertion, seating and removal easier, and the grooves for insertion of lock pins were set mesiodistally, parallel to the wire. Auxillary groove were set in the occlusogingival direction to facilitate correction of the mesiodistal tipping of teeth.[2]

In 1970, Dr.Craven Kurz, whose clientele was dominated by public figures, felt the need for an orthodontic system which is invincible or would not expose the brackets. With the help of his colleague Dr.Jim Mulick, Dr. Kurz developed the true lingual appliance. The appliance had plastic Lee Fischer brackets bonded to the lingual aspect of the anterior dentition and metal brackets to the lingual aspect of the posterior dentition. The plastic anterior brackets were selected due to the ease of recontouring and reshaping them to avoid direct contact with the opposing teeth. Two initial hurdles encountered by them were, high bond failure rate and brackets being uncomfortable and irritating to the patient's tongue.

PERIOD OF RISE IN POPULARITY AND EUPHORIA

Very soon, research and development into the lingual orthodontic technique was taken over by ORMCO, a company in California, which formed a team consisting of Mr. Frank Miller, Mr. Craig Andreiko and Dr.Kurz. The team started analyzing the reason for bond failure. It was found out that it was due to the shear forces acting on the maxillary anterior brackets. The solution for all the problems regarding bond failure was the incorporation of an anterior inclined plane. It converted the shear forces to compressive forces applied in an intrusive and labial direction.The original lingual task force was developed to provide beta test sites for the appliance. The task force included in addition to Dr. Kurz included Dr. Jack Gormen, Dr. Bob Smith, Dr. Richard Alexander, Dr. Moody Alexander, Dr. James Hilgers and Dr. Bob Scholz.[7] *In 1982-83, ORMCO* organised a task force of two doctors from every country in Europe. By 1983, the lingual orthodontic technique was introduced to Europe. The task force conducted regular seminars on lingual appliance in Newport Beach, California as there was high demand in dental fraternity for its use. The lingual task force was developed with the aim of helping refine bracket design *(dimensions, torques, angulations, thickness, etc)*, developing mechanotherapy techniques, creating arch wire design, discussing treatment sequences and determining case selection criteria. *In 1984 the TARG* machine was launched *by the ORMCO* society as an important aid to the laboratory technique. It allows the accurate placement of the brackets at a precise distance from the incisal and occlusal surfaces of the teeth as well as making it possible to prescribe the torque and angulation for each tooth individually. *In 1986, Didlier Fillion* developed *precise measuring device* to the original TARG machine to allow compensation for the different thickness between the teeth called as the *Electronic TARG*.[8,9]

THE PERIOD OF DECLINE AND MISCONCEPTION ABOUT LINGUAL APPLIANCES

In 1987, at the American Association of Orthodontists' annual meeting in *Montreal, Canada*, lingual orthodontic therapy was discussed, as it was seen that many clinician faced difficulties in finishing cases to same standards as with labial appliance. Enthusiasm for lingual therapy waned in the profession, and commercial interest also declined. The original Ormco Task Force was reduced to just three members by *1988, Drs. Kurz, Gorman, and Smith*. They restructured the group and were renamed *KGS Ormco Task Force Number Two*. Their new objective was to define the problem and develop possible solutions to these problems which they identified as: 1. The lingual appliance had been made available to the public before testing was complete. 2. Orthodontists inadequately trained with lingual therapy were treating patients in record numbers. 3. The public had high expectations from this treatment and demanded it from the profession immediately.

PERIOD OF RISE OF LINGUAL APPLIANCES / RENAISSANCE PERIOD

The Societies and the Education

The TASK force formulated the solution to have smaller classes taught by more experienced lingual practitioners, longer courses were developed with a hands-on workshops and continuing education was stressed, with support provided by study clubs, journals, and professional meetings.

The American Lingual Orthodontic Association (ALOA) was established on November 14, 1987, by a core group of six hundred American orthodontists and conducted yearly conventions and professional lectures. The first annual meeting of ALOA was held in Washington in 1987, and in Palm Springs the following year. Additionally, a Dental Lingual Assistant Association was formed to provide support for staff members employed by lingual orthodontic practitioners. The new professional associations were smaller than the original groups but remained active in their support of lingual therapy. Continuing educational programs were offered in Europe and Japan by the KGS group which led to rise in Enthusiasm for lingual therapy. Some European and Japanese university programs offered training in lingual therapy and these were soon followed by courses in Korea, South America, Mexico, and Denmark. The European Society of Lingual Orthodontics (ESLO) was founded in 1992, in Venice, Italy, and hundreds of people participated in the first European lingual association congress in Venice. In the same year, an Italian society was founded; the Associazione Italiana Ortodonzia Linguale (AIOL) or the Italian Association of Lingual Orthodontics. *In 1996*, Lingual Study Group, in *Denver, Colorado* was founded, with the aim of relaunching lingual orthodontics, especially in the United States, by *Craven Kurz* together with other clinicians. The *American Lingual Orthodontics Association (ALOA), founded in 1987* which had been inactive for a number of years, was reactivated in 1997 by Mario Paz, John Napolitano, and FrankAndolino.[10] The *Japanese Lingual Orthodontics Association (JLOA) founded in the year 1988*. *Toshiaki Hiro*, developed the technique of creating *individual indirect bonding trays for each bracket*. The *Hiro system* was *created by Toshiaki Hiro and improved by Kyoto Takemoto and Giuseppe Scuzzo.*[1] Fillion has played an important role in the development of *European Society of Lingual Orthodontics (ESLO), Societe Frangaise d'Orthodontie Linguale (SFOL) in 1992, British Society of Lingual Orthodontics (BLOS) in 2002, and the World Society of Lingual Orthodontics (WSLO) in 2004. In Israel, Silvia Geron*, developed the *Lingual Bracket Jig (1999)* for direct and indirect bonding in lingual orthodontics, and Rafi Romano, who edited a book presenting an update on the state of the art of lingual orthodontics.[10,11] Tae Weon Kim founded the Korean Society of Lingual Orthodontics (KSLO) and developed the Model Checker, a bracket positioner, and CRC Ready-Made Core Trays which together form the Korean Indirect Bonding Setup System (KIS System)[8]. *Korean Lingual Orthodontics Association (KLOA) was founded by Hee-Moon Kyung.* He also developed the *Individual Indirect Bonding Technique (IIBT)*, the *Mushroom Bracket Positioner*, as well as the *Lingual Straight Wire Technique*. He is also well known for the development of the *micro screw implant*, a major advance in the provision of bony anchorage for both lingual and labial orthodontic techniques.[8,12]

Advances in Bonding technique and Bracket design

The variability of lingual surface, difficulty of access and lack of adequate visualization made it difficult to bond successfully to lingual surface. This led to the development of various indirect bonding techniques, latest being the use of CAD/CAM system, the base of bracket was contoured to fit the lingual anatomy of teeth, which has also improved the accuracy of bracket positioning. Bracket design incorporating inclined palne as in Dr. Kurz brackets reduced the debonding incidence dramatically. Customized brackets also solved the problem of reduced interbracket distance as the bracket size was reduced according to individual specifications, which helped in correcting the rotation correction more effectively and provided better biomechanical control for the appliance as well as helped in the use of straight wire appliance with reduced wire bending. The wire bending robots also

eased the use lingual appliances, which involved sometimes complex wire bending.

INDIAN CONTRIBUTION TO LINGUAL ORTHODONTIC

First Indian Lingual Orthodontic Convention was held in Delhi, in the year 2013 and *Dr. Sanjay Labh* was its Organizing Secretary. He was also the Scientific Chairman of the lingual summit, held in Delhi in the year 2014.

The first CAD/ CAM based customized 3D- lingual Bracket System- Lingual Matrix was invented by Dr. Praveen Shetty. *Dr. Tushar Hegde*, promoter and ardent practitioner of Lingual Orthodontics, is actively involved in simplifying the technique and making it economically viable. He uses precision specific apparatus like "Torque Angulations & Bracket Positioning Devices" for indirect bonding of Lingual brackets in his laboratory (Saffron Precision Orthodontic Laboratory). The persistent efforts of *Dr. Benoy Mathew* resulted in the development of a complete CAD CAM System in India. He is currently the CEO of Berininov Advanced Orthodontic Systems and is involved in the continued development of Lingual Orthodontic Armamentarium. Berininov is presently emerging as one of the world's best Interactive Lingual CAD CAM systems with continuing research and development facility. *Dr. Manjula Jain*, a co-patent owner of Lingual Matrix - a customised CAD CAM 3 D Lingual Orthodontic System and a partner at Smile Align Digital Aligner System is also considered as one of the founder member of Lingual Orthodontic Society India.

CONCLUSION

The lingual orthodontics will continue to evolve and emerge as an effective esthetic (invisible) alternative to conventional labial orthodontics. Increase in demand of invisible braces will encourage more and more clinicians to learn the technique as well as at the same time also encourage the commercial companies to invest in research and development of better bonding techniques, materials, auxilaries and brackets for lingual surface which are more effective and easy to use by an orthodontist but also more comfortable for the patient while performing the normal orofacial functions.

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