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# Evolution of Lingual Orthodontics – A Brief Review

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**Abstract:** *Today the main aim is to get good facial balance, and the development of orthodontic treatment is the balance between esthetic treatment, functionality & structural balance (Jackson's Triad) and patient's desires. Keeping particularly to skeletal orthodontic treatment plan in modern orthodontic philosophy is considered to be an error. The lingual technique has become more comfortable & sophisticated with advancement in technology; the same results can be achieved with lingual technique as we get with the best of conventional labial techniques.*

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## I. Introduction

The biggest challenges in orthodontics is to attain excellence in treatment with an appliance that is esthetic and comfortable [1]. From the esthetic point, it also provides the best option for complete treatment of majority of malocclusions.

A pleasant esthetic look increases people's self-confidence and provides encouragement when it comes to make personal contacts. It also helps interpersonal contacts, since usually initial contact is visual. To look good is always an advantage, particularly in relationships between adults. The better the person looks, more is the positive appraisal by others [2]. These patients have social and professional liabilities and can't accept "visible braces".

Today the main aim is to get good facial balance, and the development of orthodontic treatment is the balance between esthetic treatment, functionality and patient's desires. Keeping particularly to skeletal orthodontic treatment plan in modern orthodontic philosophy is considered an error.

At present, Lingual orthodontics is a complete system in itself and encloses accurate diagnosis, treatment protocols, laboratory &clinical procedures. The history of lingual technique has not been an easy one. Initially there was a period of euphoria as the lingual technique made its clinical debut followed by period of frustration and rejection.

Thanks to the efforts of several dedicated clinicians most of the issues regarding refusal lingual appliance have been overcome. We are now in a period of rejuvenation, the lingual technique has become more comfortable & sophisticated, and the same results can be achieved with lingual technique as we get with the best of conventional labial techniques [3].

## II. Evolution of Lingual Brackets

In the earliest days of lingual mechanotherapy, two designs of brackets were introduced by two different researchers.

1. **Dr. Kurz** developed brackets with horizontal slot.
2. **Dr. Fujita** introduced the ones with occlusal slot.

Work of **Dr. Craven Kurz** & his team at Ormco Company -

Working in conjunction with engineers at Ormco, Kurz initiated designs and studies on a near conventional edgewise approach to lingual mechanics. The initial criteria were:

1. To provide the same degree of control as is achievable with fixed appliances,
2. To make a smooth, low-profile appliance with minimumirritationto soft tissue, comfortable to the patients, and
3. To develop an appliance with the minimal deviation from known, well-accepted principle of labial edgewise, and also with straight-wire principle, if possible [4].

**Dr. C. Kurz** and his team at Ormco Company has developed seven generations of lingual brackets (Fig. 1).

**Generation # 1 – 1976**
**Generation #2-1980**
**Generation #3-1981**

**Generation # 4 - 1982-84**
**Generation # 5 - 1985 – 86**
**Generation # 6 - 1987 – 90**
**Generation # 7 - 1990 to present** [5]

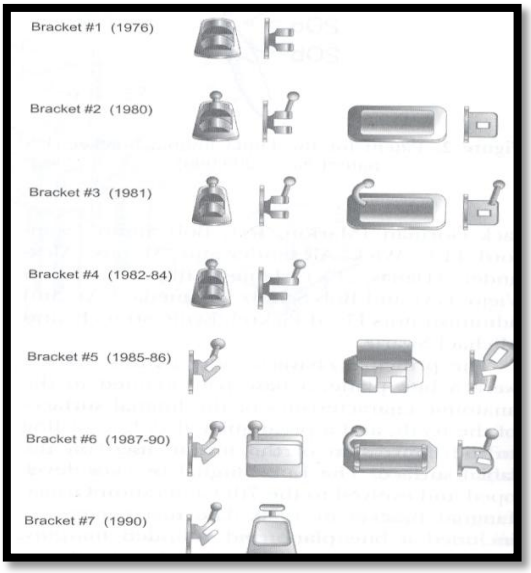



**Figure 1;** Evolution of the Craven Kurz lingual bracket.

## III. Fujita's Lingual Bracket System

**Dr. Kinya Fujita** in 1979, developed a bracket system with two main aims in mind,

1. Improving esthetics.
2. Preventing trauma during exercise.

His brackets had a slot set to the occlusal surface. He too believed that this enabled easy placement of the wire. The deformation of orthodontic wire can also be prevented at the time of insertion into the bracket.
The grooves were set mesiodistally (Parallel to the wire) for insertion of lock pins. To help in correction of the mesiodistal tipping of the teeth, auxiliary groove was set in the occlusogingival direction.

- Presently available Fujita system has multiple slots –

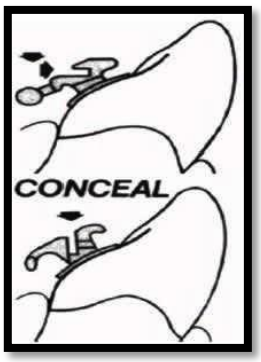
➢ Anteriors and premolars brackets have 3 slots: occlusal, lingual, and vertical.

➢ The brackets for molar having5 slots: one occlusal, two lingual and two vertical. [2]

## IV. Bracket Systems

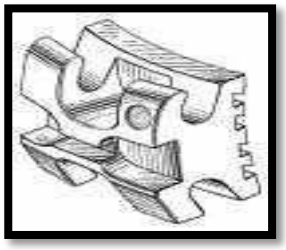
Several lingual brackets have been designed and modified over a period of time for patientscomfort, mechanical efficiency and accurate positioning of tooth (Fig. 2).

1. **Conceal:Thomas Creekmore [5, 6].**
2. **STb (SCUZZO- TAKEMOTO bracket):Designed by Dr. Scuzzo and Dr. Takemoto (sold by ORMCO) [5, 7].**
3. **Forestadent:**These are available as 2D-brackets for treatment of less complicated and 3D-brackets for complicated cases [8].
4. **Stealth Brackets:**They have small dimension & greater inter-bracket distance which provides better patient compliance [8].
5. **Philippe Lingual Brackets (Self Ligating):**These bracketsprovide only 1st and 2nd order movements & directly bonded to the lingual surface of tooth because they do not have slots [9].
6. **Kelly Bracket (UNITEK): Horizontal Insertion Bracket:**These brackets have two point of contact between the bracket and wire, gives best control in rotations [7].
7. **Adenta Brackets (1999):**After using the self-ligating TIME Bracket for several years, Dr. HattoLoidl approached Adenta GmbH with an idea to use the same self-ligating clip mechanism for a lingual bracket [7].
8. **In – Ovation - L Bracket:**They have small dimension & greater inter-bracket distance which provides better patient compliance. For better adapting to the anatomical contours, it can be placed in the deepest portion of the lingual fossa.
9. **Ibraces (Incognito):**This bracket is low profile, comfortable to the patient and gives exact finishing [7].





Conceal System STb Brackets Forestadent

Stealth Brackets Phillip Self Ligating Brackets Kelly Brackets



Adenta Brackets In-Ovation - L Brackets Ibraces

**Figure. 2** Various bracket system.

## V. Diagnosis and Case Selection

Case diagnosis is conducted in a manner similar to established procedures. As we are dealing primarily with the non-growing adult patient, additional diagnosis might be needed from the periodontist, restorative dentist, and orthognathic surgeon, also some additional psychological awareness on the part of the orthodontist.

The treatment plan is based on the diagnosis, the advantages and limitations of the various modes of treatment, the cost and time factors, and, of course, the patient's desires. A common problem is to allow the patient to dictate the treatment plan. Patients who previously would not accept orthodontic treatment in any mode frequently demand to be treated with invisible braces regardless of whether they are suitable candidates for this approach.

In some instances, it is difficult for the orthodontist not to acquiesce, since this was the patient's primary motivation for seeking orthodontic care. It takes considerable discipline to convince many patients that they should have orthodontic therapy, but that their problem cannot be treated best with the lingual approach. The selection and management of patients have thus become key factors in lingual orthodontics.

## VI. Patient Selection

The prospective lingual patient must be made aware that this is a new approach and, as such, will require significantly greater chair time. While the expertise of the clinician &staff will improve rapidly, lingual therapy is demanding on both the patient & the office.The key factors in patient selection for lingual therapy seem to be their personalities and reasons for seeking treatment.

Inadequate personality screening, and failure of patient to understand the possible side effects and the necessity to adjust to the presence of unfamiliar hardware on the lingual surfaces, can result in having to remove the appliance. When the orthodontic problem is minor and primarily cosmetic, the adjustment to speech changes, loss of chewing efficiency, and tongue soreness may be more than the patient had bargained for.
Since additional chair time will be required, particularly during the initial learning period, it is important to begin with patients with whom you and your staff will enjoy spending a great deal of time. Personality type is a prime factor in case selection and should be ascertained as early as possible. This may mean that the orthodontist should plan on spending 10 to 15 minutes more at the initial examination of the patient.

**Time and Cost Factors**

- Examination, diagnosis, consultation, and planning of treatment time will be increased by 30 to 45 minutes.
- Lab procedures for the setup of indirect appliance will considerably increases the cost of fixed appliance.
- Overall chair side time will increase by around 30-50%.
- A fully articulated positioner appliance may be required for detailing the lingual case.

Patients seeking invisible braces as a result of news media attention are aware of the additional cost factors and, by and large, are prepared to compensate the practitioner for his or her additional time land expense. Each clinician must evaluate these cost considerations individually. Lingual orthodontics will tax the skills of the practitioner to the utmost, and appropriate compensation commensurate with the additional time, costs, and tribulations seems to be in order.

**Ideal Cases for Lingual Mechanotherapy**

**Non-extraction Cases :**

• Deep bite, Class I with mild crowding, good facial pattern.
• Deep bite, Class I with generalized spacing, good facial pattern.
• Deep bite, mild Class II, good facial pattern.
• Class II div. 2 with retruded mandible.
• Cases requiring expansion.
• Cases of midline diestema.

**Extraction Cases :**

• Class II, upper first premolar and lower second premolar extractions.
• Extractions of upper first premolars only.
• Mild protrusion of maxilla and mandible with four first premolar extractions, wherein anchorage demand is minimum.

**Difficult Cases :**

• Surgical cases.
• Class III tendencies.
• Class II, four first premolar extractions.
• Mesiofacial patterns and/or average mandibular plane angles.
• Cases requiring multiple restorations.

**Contraindicated cases:**

• Acute temporomandibular joint dysfunction.
• Mutilated posterior occlusions.
• High angle/dolichofacial patterns.
• Extensive prosthesis with anterior.
• Short clinical crowns.
• Critical anchorage case.
• Severe Class II discrepancies.
• Compromised oral hygiene or periodontal involvement.
• Too much apprehensive patients [10].

**Bonding Technique**

The two widely used methods for bonding in lingual orthodontics are -

- Direct Bonding Technique
- Indirect Bonding Technique

**Direct Bonding Technique**

Introduced in 1984 by Dr. Michael Diamond.

He come up with device called as **Peri/Reflector** to remove the complexities of direct bonding in the maxillary arch (Fig. 3).

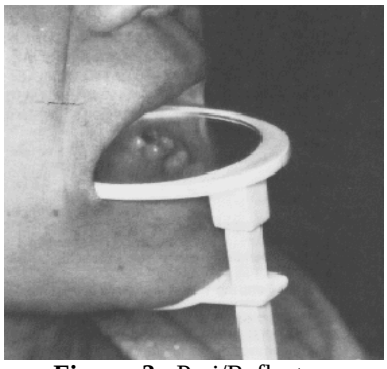


**Figure. 3** : Peri/Reflactor.

It is a combined mirror, tongue retractor, and saliva ejector that can makes bonding procedures in the maxillary arch easier. It isolates the working field, increases brightness, and enables one to see the entire area while keeping both hands free [11].

**Indirect Bonding Technique**

Indirect Bonding procedures are two components mix systems like ENDUR, concise and no mix systems like system 1 and Instabond. Although these indirect bonding procedures have proven to be reliable and practical, many innovative modifications have been introduced [2].

Newer modifications are –

- Bonding in CLASS system [2].
- HIRO'S method [2].
- Bonding with equal specific thickness (BEST) system [12].
- Customised indirect bonding method [13].
- New customised indirect bonding method [14].
- Lingual Bracket Jig[15].
- The Ray Set System [2].
- The Mushroom Bracket Positioner[2, 16].
- Korean Indirect Bonding Set-Up (Kis) System [12].
- Convertible Resin Core System [17].
- Hybrid Core System [12].
- Orapix System [8, 12].
- Incognito System.

## VII. Incognito System

This bracket system basically differs in both designing and manufacturing methods for existing appliance. The two individual processes of bracket production & bracket positioning are fused to one unit by the use of CAD/CAM technology.

The primary step in the manufacturing process is to take a 2-phase standard silicone impression. The casts made by this impression is used to make a customized desired setup (Fig. 4). Non contact scanning of the therapeutic setup is performed with a high-resolution optical 3D scanner (GOM, Braun schweig, Germany). As with human perception, the 3-dimensional (3D) scanner must examine the model from numerous perspectives to make a complete 3D representation. The outcome is a compound surface consisting thousands of minute triangles (standard triangulation language, or STL surfaces) that can be turned, observed, and processed on a computer with appropriate design software. Prior to further processing, the arch to be bonded is aligned optimally to the later slot plane [7].

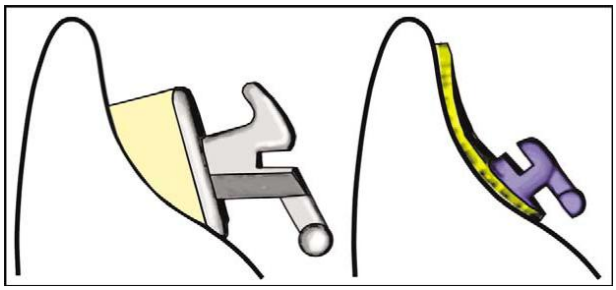


**Figure. 4:** Conventional lingual bracket (left) and customized bracket.

**Lingual Technique In Orthognathic Surgeries**

Orthodontists have now been able to put lingual appliances in patients requiring surgical intervention for Dentofacial deformity.

By using Rigid Internal Fixation (RIF) as a means of surgical retention of the skeletal segments which are mobilized in surgery, it not necessary as in past, to provide intermaxillary fixation at the end of surgical operation. This allows orthodontist to use lingual technique in the pre and post treatment of these pathologies.

The purpose of pre-surgical orthodontic therapy with the lingual mechanotherapy is same as those using a labial technique to prepare the dental arches prior to manipulation of the skeletal bases. Therefore, it is essential to first eliminate the dentoalveolar compensations and leaving only malformed skeletal components to be corrected by maxillary surgery.

**Orthodontic Protocol**

- The goal of presurgical orthodontics is to align maxillary & mandibular dental arches and eliminate dento-alveolar compensations.
- The lingual brackets are applied indirectly with the help of transferring marks constricted by means of articulated mounted casts, surgical- orthodontic VTO, set up of dental casts (CLASS method) and are indirectly bonded.
- Alignment and leveling is done with flexible wires and then followed by stronger wires like 0.016' * 0.022' S.S. and 0.018'* 0.025' S.S.
- The maxillary & mandibular incisors are placed in correct axial inclinations to the respective skeletal bases, so at the end of presurgical preparation, the sagittal discrepancy at the interincisal level corresponds to the sagittal discrepancy on the skeletal bases.
- The occlusal set-up of the dental casts and the preparation of the transferring masks are required for efficient presurgical orthodontics and valid structural and esthetic results.
- In case of crowding, the extractions proceed as required.
- The dental set up for the presurgical phase will differ depending on whether expansion is to done or not.
- If expansion is not needed then only one presurgical set up is needed, with the help of which the lingual brackets are bonded and alignment of arches is achieved.
- If expansion is needed in the case, then there are two treatment options.
- If the transverse expansion is accomplished in the presurgical orthodontic phase with a Quad helix or a Rapid Palatal Expansion appliance, the impression for the lingual appliance is taken only after this first expansion phase is completed.
- Surgical expansion can be accomplished together with re-positioning of the maxillary components with intermaxillary disjunction Lefort I osteotomy technique. In this case, the initial set up of the dental casts will be for the presurgical non-expansion orthodontic phase.
- Once the orthodontic preparation is completed, a second presurgical set up will be constructed with which the intermaxillary correction will be planned. On this set- up, a surgical splint will then be constructed, and this will serve as the guide for correct repositioning of skeletal maxillary segments.

**Surgical Protocol**

- Before surgery the orthodontist applies vestibular buttons with an esthetic material (like polycarbonate, glass, or ceramic) to offer the surgeon an anchor during the operation.
- The anchors should be symmetrically positioned on both sides of arch on the canines, first premolars and incisors.
- These anchors will also allow application of intermaxillary elastics during post-surgical phase.
- In case of maxillary surgical expansion, the lingual orthodontic patient will be treated from two sectional arches to facilitate the intermaxillary disjunction.

- The occlusal splint can be removed quickly post operatively or at least, 7 to 10 days post-surgically and a continuous arch wire is placed.
- Rigid internal fixation with the use of plates and screws eliminates the need for postsurgical intermaxillary blockage **[18]**.

**Key to Success in Lingual Mechanotherapy**

There are various keys to get success in lingual mechanotherapy
- Patient Selection.
- Bracket Placement Accuracy.
- Indirect Bonding.
- Vertical and Transverse Control of Buccal Segments [19].
- Double over ties on anterior teeth.
- Buccal and molar attachment.
- Correcting rotations.
- Arch form and archwire sequence.
- Archwire stiffness and torque control.
- Enmasse Retraction.
- Light flexible wire for detailing.
- Gnathologic positioner and retention [20].

**Advantagesof Lingual Mechanotherapy**

**1.** Facial surfaces of teeth do not get damaged from bonding, debonding, adhesive removal.
**2.** Gingival tissues are not affected greatly.
**3.** Facial contours are truly visualised since the contour and drape of the lips are not deformed by prominent labial appliances.
**4.** Inter bracket width is greatly reduced on most teeth because of the smaller lingual arch radius. This becomes less of a problem when more flexible archwires are used.
**5.** Most adults & young patients would prefer invisible appliances if costs, treatment times and results were comparable to those of labial appliance.
**6.** The bite plane effect of brackets will allow the intrusion of incisors and limited extrusion of molars [7].
**7.** Position of lingual brackets places the slot near to centre of resistance of the incisor teeth, the result is reduced undesired tooth movement and more predictable bodily tooth movements during space closure and bite opening[21].

Four different situations are seen where these appliances may become more effective as compared to labial appliances due to their distinctive mechanical characteristics-

➢ Intrusion of anteriors.

➢ Maxillary arch expansion.

➢ Mandibular repositioning therapy simultaneously with orthodontic movements.

➢ Distalization of upper molars[18].

**Intrusion of anteriors**

Brackets in the lingual therapy are placed near the centre of resistance compared to labial bracket placement. Important aspect of this design is that the intrusive force vector is directed through the centre of resistance of the tooth. As the lower anterior tooth occludes with anterior horizontal plane of the upper anterior brackets, a bite plane effect is produced. The net effect seems to be light, continuous, intrusive forces.

**Maxillary arch expansion**

Some possible factors are –

- The centrifugal force is developed, from the inside towards outside of the arch. The same phenomenon happens with quad helix & rapid palatal expansion devices.
- The thickness of the brackets, which interpose themselves between the tongue and lingual wall of the teeth can contribute to this expansive effect.
- The shorter inter bracket distance may plays an important role in this effect.

**Mandibular repositioning therapy simultaneously with orthodontic movements**

The primary phase of treatment addresses the temporomandibular dysfunctions and associated pain symptoms.

The second clinical phase of treatment addresses change in occlusion as a result of new mandibular position.

Labial appliances are placed in single arch and positioning splint is placed on the opposite arch to maintain the maxillomandibular relationships. This is then reversed.

**Distalisation of upper molars**

It is possible that molar distalisation through lingual techniques produce more bodily movement of the tooth and less distal tipping. Clinically, this can be accomplished by an open coil spring between the first and second molars. To counter the mesial movement of first molars, a vertical loop is incorporated against the lingual twin bracket.

In today's clinical orthodontic practice, the lingual appliances can offer many advantages over labial appliances to both patients and the practitioner. Enamel surfaces are protected, some treatments like deep bite corrections can occur faster, molar distalization appears to take place more efficiently and TMD patients can proceed with orthodontic treatment in a timely manner.

**Disadvantagesof Lingual Mechanotherapy**

- The technique is more demanding, sensitive.
- Tissue irritation.
- Speech difficulties.
- Difficulty in correction of rotations.
- Compromised oral hygiene.
- Cost factor [2].
- Reduction in the inter bracket distance inadvertently increases the stiffness of the archwire.
- Variation in the tooth morphology add to the difficulty of bonding lingual brackets.

Patients with peg shaped laterals, severely attrited teeth, partially erupted or fractured teeth are poor candidates for lingual appliances [18].

## VIII. Conclusion

It's been over 36 years since the inception of Lingual orthodontics. In the quest for developing an orthodontic modality that is more sensitive to patients' needs, the Lingual researchers have surmounted innumerable hurdles in the form of applicability of technique and materials, but most of all criticism from the global conventional orthodontic community.

The will of these clinicians was too strong to be subdued by these criticisms, and they continued in their quest. Right from its introduction, constant research and trials have led to evolution of lingual bracket systems that are much precise, refined and more patient friendly.

## References


[1]. Dr. John Buckley:**Lingual orthodontics: an illustrated review with incognito fully customized appliance**, Journal of Irish Dental Association; 2012; 58(3):149-155.

[2]. Dr. Anurag Gupta, Dr. VS Kohli, Dr. P V Hazarey:**lingual orthodontics – a review**, Journal of Indian Orthodontic Society; 2005;38:46-54.

[3]. Pablo Echarri: **Revisiting the history of lingual orthodontics**: A basis for future; Seminar in Orthodontics 2006:12(3)-153-159.

[4]. Kurz C, Swartz ML, AndreikoC:**Lingual Orthodontics: A status report: part 2: research and development.** Journal of Clinical Orthodontics 1982; 16(11): 735 -740.

[5]. Vasumurthy S, SarithaT:**Lingual Orthodontics**, Indian Journal of Dental Association; 2009;1(1):31-37.

[6]. CreekmoreT:**Lingual Orthodontics – It's renaissance**. American Journal of Orthodontics and Dentofacial Orthopedics,1989; 96(2):120 – 137.

[7]. Reddy A et al:**Indirect bonding with various systems in lingual orthodontics**, Annals and Essence of dentistry; 2012;4(2):98.

[8]. Romano R:**Lingual Orthodontics.** Germany quintessence 2011.

[9]. Aldo Macchi et al, Philippe:**Self-ligating lingual brackets.**Journal of Clinical Orthodontics,2002 ;36(1) : 42-45.

[10]. Gorman JC, Hilgers JJ, Smith JR:**Lingual Orthodontics a status report, part 4: diagnosis and treatment planning.**Journal of Clinical Orthodontics ,1983; 17(1) : 26 – 35.

[11]. Diamond M:**Improved vision and isolation for direct lingual bonding of the upper arch.** Journal of Clinical Orthodontics, 1984;18(11):814 – 815.
[12]. Laura Buso- Fost and Didier Fillion**: An overall view of the different laboratory procedures used in conjunction with lingual orthodontics**. Seminar in Orthodontics2006 ;12(3) :203-210.
[13]. Ryoon Ki Hong: **Customised indirect bonding method for Lingual Orthodontics.** Journal of Clinical Orthodontics ,1996; 30(11): 650-652.
[14]. Ryoon-Ki Hong, Yong- Hwa Kim and Je- Young Park: **A new customized lingual indirect bonding system.**Journal of Clinical Orthodontics,2000 ;34(8) :456-460.
[15]. Silvia Geron**: Lingual bracket jig.**Journal of Clinical Orthodontics,1999 ;33(8) :457-463.
[16]. Kyung, Park,Sung: **The Mushroom bracket positioned for lingual orthodontics.** Journal of clinical orthodontics, 2002;36(6):320-328.
[17]. Taeweon Kim, Gi Sun Bae, JaehyungCho:**New indirect bonding methods for lingual orthodontics.** Journal of clinical orthodontics 2006;33(6): 348-350.
[18]. Romano R:**Lingual Orthodontics**. London, BC Decker. 1998.
[19]. Smith JR, Gorman JC, Kurz C, Dunn RM **Keys to success in lingual therapy – part 1.** Journal of Clinical Orthodontics,1986 ;20(4):252-261.
[20]. Gorman JC, Kurz C, Smith JR, Dunn RM:**Keys to success in lingual therapy – part 2**. Journal of Clinical Orthodontics, 1986; 20(5):330-340.
[21]. Kah Chai Poon, Aart AR Taverne:**Lingual Orthodontics: A review of its history**, Australian orthodontic journal,1998;15(2):101-104.

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