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INDIRECT BONDING IN LINGUAL ORTHODONTICS - A REVIEW

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Abstract:
This is the era of adult orthodontics as more and more adult patients are willing to get done the orthodontic treatment and with this the demand for invisible bracket system and lingual orthodontics as increased considerable. Bonding of brackets in lingual orthodontics is the major concern owing to the fact of poor visibility leading to faulty bracket positioning, which may result in poor post treatment results. Thus indirect bonding is upcoming trend in lingual orthodontics and this article will review the same in detail.
Key words: Indirect Bonding, Lingual Orthodontics, Bonding

INTRODUCTION

It is difficult to visualize the lingual surfaces of the all tooth, in order to assess the exact Facial axis of the clinical crown (FACC point) . So no matter how accurately brackets are positioned on set-up models, it would be meaningless if these positions were lost during intraoral bracket placement. It is no exaggeration to say that incorrect bracket positioning leads to treatment failure. If lingual brackets were to be directly bonded, it would be difficult to visualize and accurately position the brackets. Indirect bonding is therefore the standard in lingual ideal setup for Lingual Bonding Orthodontics.

Disadvantages -

- Laboratory procedures are so complicated that accurate bracket positioning is difficult.
- Bonding trays are flexible and easily distorted when transferred to the mouth,
- If neighbouring teeth drift after tooth extraction, trays will no longer fit and must be remade.

Lingual Laboratory Procedures[1, 2]

Today's widespread use of edgewise or straight wire appliances makes it imperative that the brackets be positioned with 100% accuracy in order fully to exploit the potential of these devices. They rely on arch wires of different types and sections as the patient progresses through the stages of orthodontic treatment.

Years of practice in fitting pre-adjusted edgewise brackets onto lingual faces using the Kurz-Ormco method have provided much insight into dental morphology, confirming what the more abundant data on labial face bonding had already demonstrated; that tooth shape can alter the second and third-order inclinations (tip and torque) written into bracket slots or bases to the extent of significantly affecting appliance control and treatment out-come. There is just too much variation and irregularity in the lingual anatomy of human dentition for "mass-produced" standard tip, torque and rotation control values to satisfy the majority of cases.

Having observed this, and recognizing the need for greater accuracy in indirect bonding techniques, many lingual specialists have sought to improve the laboratory process: it is a vital partner.

In the last two decades of the twentieth century, lingual orthodontics saw the development and application of two major techniques, the TARG™ (Torque/Angulation Reference Guide) and the CLASS (Custom Lingual Appliance Set-up Service) Methods. The search for improved bracket positioning in the laboratory produced many modifications to or combinations of techniques. The most interesting recent developments are the New Hiro laboratory procedure and the Ray Set® Biaggini Bracket Positioner.

TARG: [1, 2]

The original TARG™ method uses the TARG™ machine, developed by Ormco in 1984 for lingual bracket positioning. Since this machine eliminated the need to make a set-up, the technician could save considerable time by placing lingual brackets directly onto the malocclusion model The machine's torque blades are used to define a horizontal plane for all teeth; using this the brackets can be placed at a vertical distance from the occlusal edges and in a central position on each tooth. The drawback, however, was that the original TARG machine did not allow pre-programming of in- and out-bends for individual teeth. **Didier Fillion**[4,5] improved this

method in 1987 by adding an electronic device to the TARG machine with the purpose of measuring tooth labial-lingual thickness. This improvement reduced the number of first-order bends in the wire, compensating for the difference in tooth thickness and making the distance from the slot to the labial surface uniform. Using his **DALI** (Dessin Arc Linguale Informatise) computer program he produces an individualized archwire template.

CLASS (Custom Lingual Appliance Set-up Service)[1,2]

The CLASS technique was designed for laboratory bracket placement with a degree of accuracy exceeding that of the TARG method. A pre-treatment diagnostic set-up is manufactured and then used as a template for definitive bracket fitting. By determining ideal anterior tooth position in the setup, the technician can then place the brackets in their correct pre-programmed position. When placing anterior brackets using an arch radius with the CLASS system, the in-out discrepancies along the arch are compensated for by filling the gaps between the mesh pads and the lingual surfaces of the teeth with composite material. In terms of posterior tooth bracket placement, however, there is little difference between the CLASS and TARG systems. Once the custom bases for each bracket have been made, all the brackets need to be transferred from the set-up back to the malocclusion model, where the silicone or thermoplastic transfer tray is made. As a result of the number of laboratory procedures involved, this system ends up being more complex, more costly, yet less accurate.

An evolution of the CLASS method is the BASS (Basetta Alveolare Sistema set-up), which allows a more precise transfer from the set-up to the mal-occlusion models.

The Hiro System[1,2]

The Hiro System uses a set-up procedure which doubles as a kind of virtual treatment, giving not only the orthodontist but also the technician good insight into the potential difficulties of each case. This method aims to make the laboratory process as easy as possible, avoiding the need to purchase costly instruments or electronic devices, and comes much closer to a straight-wire system. Since this modified CLASS technique does not use a TARG device for bracket positioning, the set-up is different from the usual diagnostic set-up. Because we use a full size ideal wire .018 x .025 stainless steel as a transfer tool, all over corrections have to be preprogrammed in the set-up.

After completing the set-up the technician shapes an ideal arch and fits all the brackets to this wire, keeping them as close as possible to the lingual surfaces. Once it has been ascertained that all brackets are positioned correctly, single rigid transfer trays for each tooth are fabricated.

The relative simplicity of this method means that no second transferred set-up to the malocclusion model is necessary, which minimizes the risk of error and allows easier and more precise re-bonding.

Ray Set[2]

The Ray Set® is a further evolution in indirect bracket bonding devices. Its stated mission is to take each tooth as an individual unit, virtually to isolate it from the arch end place it at the center of a 3-D control system in which it's respective first, second and third-order values are determined.

The device itself is a three-dimensional goniometer control system consisting of the RTT (rotation, tip and torque) cast-holder base and PRC (plane rotation control) template essential for preliminary analysis of the first-order positions of the teeth.

To do this properly, it should be understood how torque is defined under three sub-headings: anatomical, bracket and clinical crown torque.

Anatomic torque (AT) is the angle between the line tangent to point H (bracket slot height) on the crown's long axis and the whole tooth's axis and crown root. Looking at each tooth in isolation, this value is obviously constant and defines the relationship between the precise facial axis of the clinical crown and the main crown-root axis of the tooth.

Bracket torque (BT), written in and measurable, is therefore a key factor in achieving correct tooth inclination. Having established bracket height on the tooth's buccal longitudinal axis, the next value read is clinical crown torque (CCT), the angle between tangent T and the vertical line perpendicular to the occlusal plane intersecting point H (ideal bracket-slot height).

The need for a precise individualization of brackets, whether lingual or buccal, has led to the production of a calculating machine which uses an analytical and calculated set-up to reach a precise number of objectives. In analytical terms these can be listed as follows;

- To identify the tooth's initial position in terms of tip and torque.
- To evaluate Incisor torque value against the tooth's crown-root axis.
- To evaluate orthodontic movement in terms of treatment aims, within anatomical and functional limits.

- To calculate the set-up from the planned angulations on second- and third-order planes compared with their initial positions.
- To evaluate the incisors' pre and post-treatment positions with reference to the Frankfort Plane and mandibular plane, bearing over corrections in mind.
- To assess the amount of orthodontic movement from the first cast to the set-up model, and to double-check crown-root axis-inclination planning.
- **Calculations and practical objectives can be listed as:**
- Positioning of the bracket, particularly in lingual orthodontics, in total compliance with the authors' prescribed second-order (tip) and third- order (torque) values.
- Calculation and use of correct symmetrical tip values where it is necessary to odd anchorage not written into the bracket itself
- Calculation and reinforcement of torque in extraction cases.
- Compensation for torque values lost by rectangular wire being slack in the slot (ensuring effective torque).
- Straight forward accurate replacement of loose brackets (in buccal treatment).
- The actual procedure hinges on the careful planning of three-dimensional crown movement: evaluation of pre- and post-set-up values allows the clinician to predict the effects of bracket prescriptions and make any necessary adjustments. In other words, the Roy Set, assesses the amount of orthodontic movement on the set-up model, thus checking crown-root axis inclination and comparing the initial cast with the set-up.

Constructing the set-up

This section describes the steps necessary in set-up preparation, bracket placement ideal arch bending and the construction of transfer trays in order to fulfill the orthodontist's prescription, with the addition of any necessary over corrections.

Impressions

First and foremost it is essential that the impressions be as accurate as possible, which is why the best materials such as high-quality alginate or silicone should be used. Not only is the entire bonding security of the case dependent upon the models, but their security also a directly influences the number of wire-bending compensations required.

Models

The models should be poured with hard plaster and then duplicated so as to have a reference malocclusion cast during the set-up process. The hardened models are first reduced to a height of 8 mm from the base to the gingival margin.

The technician then grinds two retention slots on the bottom corresponding to the first and second molars, to allow better repositioning of this section.

The bottom of the model is then isolated and a complementary base produced. Finally the backs of the models are levelled. There should be no unevenness between the model and the base.

The finished models are mounted in the articulator with the help of a facebow. If there is a centric relation and centric occlusion (CR-CO) discrepancy exceeding 1 mm the models should be mounted in centric relation. Any articulator is suitable providing it can accept a hinge axis and be adjusted to immediate Bennett side shift, progressive Bennett side shift and the protrusive path.

Marking the long axis of teeth:

The long axes of all teeth are marked on the buccal face, and the lines extended onto the base, according to Andrews' method.

This record of the original positions of the teeth on the model facilitates the monitoring of changes made in the set-up.The teeth to be reset must be numbered with a pencil for identification. The technician and orthodontist should confer to check in advance whether a tooth movement is realistic or not. Marking the correct midlinesof both maxillary and mandibular dentition, gives another useful reference as the technician must be informed of any midline changes. Panoramic x-rays are useful in establishing root position.

Evaluating rotation, tip and torque (RTT)

The trimmed cast is put on the Ray Set® RTT base, aligned with the posterior reference marks and gripped with the lingual arm. The Ray Set® template is used to read the model's first-order degree of rotation, necessary in order to place the tooth at the center of the RTT base's second and third-order system of movements. The compass rotating base is turned by the angle established above so that its tip and torque values can be calculated.

Zero tip assessment incline the tooth on the third-order plane until the vertical rod fitted to the mandrel is tangent to potential bracket height. Align and superimpose the vertical rod on the crown's long axis, and zero the tip goniometer.

Tip assessment*;* tilt the RTT base - and hence the tooth on the second order plane according to the prescribed

degree of tip; check this value against the goniometer and lock the base into this position.

Determination of bracket height; the bracket holder (without the bracket) is fitted to the device and the vertical precision gauge used to determine slot height at the appropriate distance from the incisal edge or working cusps in the posterior segments. This Q-point is marked on the tooth's long axis with a fine pencil, and it is advisable that it be checked again later following calculation of torque value.

Assessment of zero torque: use the vertical rod and laser beam to read tooth position corresponding to zero torque. To correct till the base and hence the tooth on the third-order plane until the laser beam is tangent to the slot height point. Zero the torque goniometer.

Torque *determination*: the base, and thus the tooth, is tilted according to prescribed torque and the angle checked with the goniometer. The base is then locked into this position; slot height distance from the incisal edge is checked again and any minor adjustments are made

Model trimming:

All the teeth from second premolar to second premolar in the mandibular arch are sawn off from the bottom with a fine ribbon saw blade. Avoid sawing the contact point, which should be broken off as naturally as possible. Trim individual teeth proximally, being careful not to damage the contact points: this proximal trimming is particularly important when correcting rotated teeth. I he bottom of each tooth should be reduced by 4 mm. The molar segments are not cut until later, as their vertical and sagittal dimensions must be maintained. After trimming the mesial side of the first molars below the contact point, all four molar segments are repositioned on the models in the articulator and fixed with a small dab of wax. Finally, the front segments of the models are coated with a thin layer of wax.

Setting the mandibular arch

After repositioning all molar segments and checking the occlusion in the articulator, the technician can start preparing the actual set-up. The first step here is positioning the mandibular incisors, bearing in mind that all cephalometric evidence seems to point to the fact that IMPA (the ideal incisor to mandibular plane angle) should be as near as possible to 90°. Having carefully set the midlines, the technician can proceed with a meticulous evaluation and setting of tip and torque values according to the prescription using the Ray Set®

Following completion of the incisors comes positioning of the lower canines. Care must be taken to ensure that the transversal inter-canine distance (ICD) is maintained, and that the canine's labial surfaces are 90° in a first-order view (to avoid root impaction in the lingual or labial cortical bone). Again, angulations depend on treatment objectives. Only when the anterior segment is finished are the molars set straight. Set-up of the second premolars depends on arch-length discrepancy, and in cases with crowding the second premolars should not be set at this point. Finally, the molar segments are removed and trimmed in the same way as the other teeth to complete the lower arch.Above all it is important to maintain inter-molar distance, flatten the curve of Spee and produce only a very slight Wilson curve.

Setting the maxillary arch

The maxillary teeth are now cut off and set in idea relation to the mandibular teeth. Any discrepancies such as peg shaped laterals or first bicuspids being wider than second bicuspids should be analyzed and quantified to optimize the maxillary/mandibular tooth relations. Maxillary anterior torque is defer-mined according to the treatment plan using cephalometric analysis as a reference before assessing and setting the teeth following the Ray Setting® procedure. A general guideline is an inter-incisal angle of about 125°.

A key point to bear in mind, when setting the maxillary anteriors is that they must function during protrusion without interfering with the protrusive path determined by the patient's glenoid fossa. The role of the protrusive path in setting the upper anterior teeth is twofold: it determines not only the torque of the upper anteriors' lingual surfaces, but also the proper overjet/overbite relationship as related to the occlusal plane. If the protrusive path is overly steep in relation to the occlusal plane, overbite needs to be reduced, and vice versa. The average protrusive path value can be estimated at 40°, and this should be set in the articulator. The maxillary laterals must be set so that on the protrusive path they gently hit the mandibular laterals and cuspids, with the lingual slope of the upper set giving a smooth glide with no abrupt movements.

Prior to setting the maxillary posterior teeth it is important to analyze the buccal and lingual cusps of the bicuspids and molars. Normally the lingual and labial cusps of the first bicuspids are equal in length, while the lingual cusp of the second bicuspid is higher than the labial. Looking at the first molar and second bicuspid, the former's lingual cusp is higher than the letter's. In addition, the second molar's lingual cusp is higher than its buccal cusp, while the first molar's lingual cusp is lower than that of the second molar.

From these anatomical considerations we can conclude that the longer lingual cusps must not be set too low, as this could cause interferences in balancing and protrusive paths. On the working side there should be no contact with the posterior teeth either buccally or lingually. Cuspid or group function should be established. On the balancing side there should be absolutely no contact at all.

The amount of overbite is adequate when all the posterior teeth arch clear in the protrusive position. If the clearance is too abrupt or too heavy, the overbite can be lessened. If there are protrusive interferences from posterior teeth, the overbite must be increased. The maxillary and mandibular models can now be mounted into a dual cast, which should articulate fully. Only when there is maximum intercuspation of all posterior teeth with no pre-contacts, sliding or skidding of the mandible into eccentric positions, and the jaws close into satisfactory centric occlusion, can the set-up be considered ready.

Overcorrections in extraction cases

Extraction patients will require overcorrection: in some cases this will be done through the setup models while in others it may be decided to use brackets with overcorrection written in. To maximize the correction potential, parallel the roots, reduce the chance of relapse and compensate for mechanical problems it is necessary to add individual torque, in-out values, over angulations and over rotations to the set-up, which will also reduce the bends in the wires.

Previous set-up procedures relied on the clinician's personal experience, artistry and clinical sensitivity to shift the teeth, within reason, into the desired position, even to the extent of personalizing each case with a distinctive touch. Today, by using the Ray Set® tip and torque, over corrections can be calculated and executed in a way that takes the guesswork out of it.

This does not imply total depersonalization: once the set-up is ready and particularly when it includes over corrections - only the orthodontist can control the process. Not only must he monitor and guide arch form and tooth position corrections, but he can and should also express personal evaluations in relation to each individual patient. He will be the one making final determinations of torque, tip and in-out, so as to ensure that the two arches are kept coordinated.

Over corrections which depart from an ideal setup will give the lingual archwire sufficient initial force to ensure that the appliance produces correct torque and tip angulations.

Torque

As a general rule Class II patients treated by bicuspid extraction require extra anterior labial crown torque to their maxillary incisors (10°-12°) beyond the desired outcome) and additional torque on the mandibular anteriors [5°-7° more] to compensate for lingual axial inclination due to space-closure mechanics. Maxillary and mandibular cuspids need extra positive torque (0°-2°) in order to avoid cortical bone impaction.

Tip (angulations)

The angulations of teeth adjacent to the extraction site also call for the overcorrection. Additional angulations in distal root tipping is needed for the maxillary cuspids (5°-6°) to facilitate the distal translatory movement during space closure. The maxillary second premolars need mesial root tipping by 5°-6° and the first and second molars also require tipping backwards 3°-5° in order to increase posterior anchorage, prevent a vertical bowing effect due to space-closure mechanics and achieve parallel roots. Generally in extraction cases we also alter the tip of anteriors to ensure proper root paralleling: we give 2° distal root tip to the maxillary central incisors and 2°-4° distal root tip to the lateral incisors.

Rotation[2]

Excessively rotated teeth must be overcorrected 3°-6° primarily in the set-up, to let the lingual bracket force the tooth into correct position.

Overbite[2]

Ideal overbite is generally programmed into the set-up, averaging 1 -2 mm with variations according to the patient's pretreatment overbite: this correction value will increases or decreases respectively for open bite or deep bite. Where there is cross bite of the upper laterals (a common occurrence in Asian patients) all four incisors are set on one vertical level in order to prevent relapse.

Over corrections on the occlusal plane may be necessary in cases of vertical eruption or intrusion of specific teeth. In general the maxillary occlusal plane is largely dictated by the lower arch and the gnathological fit of the teeth.

Over jet[2]

Normally there is contact between the lower incisal edges and the upper bracket bite planes. This tends to procline the upper incisors and intrudes the lower incisors, thus increasing overjet. Although this fact should be recognized, it does not directly affect the set-up and must be managed with bracket placement, mechanics and bite-plane control.

References

1. Romano R; Lingual Orthodontics. London, BC Decker.1998.
2. Scuzzo G, Takemoto K: Invisible orthodontics: current concepts and solutions in lingual orthodontics. Germany, Quintessence 2.

3. Silvia Geron, Lingual bracket jig. J Clin Orthod 1999 (33):457-463. PMid:10613139
4. Fillion D, a la researche de laprecision en technique a attaches linguales. Rev orthopdento faciale 1986; 20:401-413

http://dx.doi.org/10.1051/odf/1986025
5. Fillion D, orthodontie linguale: systeme depositionnement des attaches au laboratorie. Ortho Fr 1989; 60.

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