Lingual orthodontics and the dental lab

Ian Hutchinson, BDS, FDS, RCSEd, MOrth, MSc, discusses the orthodontist's all-important relationship with a dental technician when undertaking the lingual technique

CURRENTLY there is a rapid growth in adults wanting an attractive smile. For those not wishing to want to sacrifice their healthy teeth by having them prepared for crowns or veneers, then orthodontics provides the obvious solution.

An additional benefit of orthodontics is that once the malocclusion is corrected, provided the client continues with the retainer, then unlike crowns/veneers, which need replacing, there is no real major ongoing expense.

The only real downside to orthodontics is having to wear fixed appliances. The advent of tooth-coloured brackets and wires has resulted in appliances that are certainly more discreet.

Some clinicians may advocate aligners, of various descriptions, but let's be honest, they are not truly invisible and we are at the mercy of the patients who may not wear them as much as they should as they are removable. There is only one answer for a truly invisible brace that requires minimal patient compliance, and that's the lingual technique.

Lingual appliances are not new; they have been around for many years. The late 70s saw a surge in popularity followed by a rapid decline due to the difficulty in finishing/detailing the cases and the introduction of ceramic tooth-coloured brackets.

With improved manufacture of equipment/materials and advancements in technology, lingual appliances are back with a vengeance. Their unique advantage is that they are totally invisible. In addition, the labial enamel remains untouched so there is no potential for scarring or damage on bracket / composite removal.

Since the possibility of de-calcification is eliminated (van der Ween *et al*, 2010), one could argue that lingual appliances are the optimum system for teeth-straightening.

Differences in appliances

Returning to labial appliances, they do have one advantage in that the reasonably uniform contour of the labial surface and easy visibility allows for direct placement of the orthodontic brackets. When this is combined with pre-adjusted "straight-wire" systems, it allows the clinician to place a wire straight from a packet and achieve a reasonable result. Not so with lingual appliances.

The difficulty in access and vision when working on the lingual surface and the huge variation in morphology of the lingual/palatal surface of the teeth can mean direct bonding is extremely difficult. Indirect bonding is preferred as it can significantly reduce chairside time and facilitates a superior final end result.

Apart from establishing a good functional occlusion, the aim of the lingual appliance is to align the labial surfaces of the teeth. However, as mentioned earlier, the teeth vary greatly in thickness. Consequently there are no "out of the packet" pre-adjusted lingual systems available.

It is possible to simply direct-bond the brackets onto the teeth, and indeed some very skilled orthodontists are able to do so. However, they are masters of wire bending, as this is needed to introduce the in/out, tip and torque movements required for a good result.

So how can the clinician treat more complex cases that require full mouth appliances easily? That's where our technician colleagues can help. The aim of this article is to give an overview of the various laboratory techniques available to facilitate lingual orthodontic treatment.

There are two basic concepts to lingual laboratory assistance. The first is that the malocclusion models are duplicated and sectioned and then the teeth aligned. The second is that the malocclusion model remains intact but is measured and brackets placed directly onto it.

First we will discuss the sectioning of the malocclusion models.

CLASS

In the CLASS approach, the malocclusion model is duplicated and then each individual tooth sectioned from the model. The teeth are then placed into a wax "framework" and are mounted on an articulator and aligned to the instructions of the clinician (**Figure 1**).

The technician uses a surveyor that has a blade to which the prescribed lingual brackets are attached. When the brackets are offered to the corrected malocclusion model, the void between the model and bracket is filled with composite resin (**Figure 2**). There are two blades, a straight one for the posterior teeth and a curved one for the anterior teeth. By keeping the height of the surveyor locked, all the brackets can be placed on the same plane.

On a similar theme, the HIRO system does away with the surveyor/blade and instead has the technician bend an archwire that adapts as closely as possible to the corrected malocclusion model.

The brackets are then attached to this archwire and, like using the blade, the brackets have composite attached and "bonded" to the corrected malocclusion model (**Figure 3**). Therefore, if a bracket is positioned on the tooth in that exact same position and that specific wire is inserted, then the wire will force the tooth into that position so that the wire is then passive.

Now, the only question with both CLASS and HIRO is how to transfer the bracket from the corrected malocclusion model (**Figure 4**) to the patient's tooth.

For the HIRO system, the technician makes an individual tooth transfer tray out of acrylic. However, this tray is damaged on removal after bonding.

The Convertible Resin Core System uses hard acrylic, e.g. Duralay, but this time the undercut is blocked out so that the resin tray can easily be removed and re-used if a bracket should debond during treatment (**Figure 5**).

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FIG 1 – CLASS set-up single arch

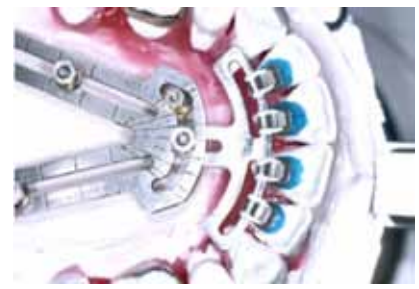

FIG 2 – CLASS and surveyor blade

FIG 3 – brackets positioned n CLASS set-up

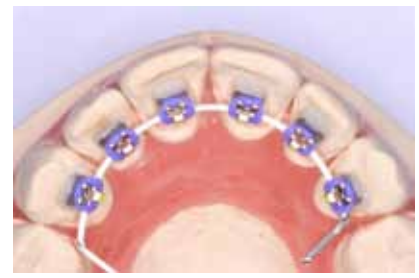

FIG 4 – HIRO archwire adapted to CLASS set-up and brackets bonded to plaster

FIG 5 – individual tooth bracket transfer jigs

Terminology

CLASS	Customised Lingual Appliance Setup Service
HIRO	A CLASS set-up but using archwires and individual tooth transfer trays
KIS	Korean Indirect Bonding Set-up System
TARG	Torque Angulation Reference Guide
DALI	Dessin de l'arch linguale informatise
BEST	Bonding Equal Specific Thickness
TAD	Torque Angulation Device
BPD	Bracket Positioning Device

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An elastomer module is used to hold the bracket in place. Other clinicians prefer to use silicone materials that are flexible – there is a lot of individual preference. Both of these require each tooth to be bonded on an individual basis. This can take a little longer clinically; however, the flip side is that moisture control is much easier.

An alternative is to bond several brackets at a time or the whole arch in one. To achieve this, the brackets must be placed on the original, un-corrected, malocclusion model.

Individual trays are produced as described above and the brackets bonded to the malocclusion model. Then the model and the brackets are covered in a silicone impression material.

When set, the silicone is removed, taking the brackets with it. Then, the tray can be used to bond all the brackets in one go in the patient's mouth (**Figure 6**).

KIS

A set-up is constructed, similar to CLASS and then the torque and angulation are checked with a device similar to the TAD in an attempt to improve precision.

The advantage of the CLASS, HIRO and KIS system is that both the patient and clinician can see the proposed end result. In some cases the clinician may request over-correction, e.g. rotations, but this must be explained to the patient.

This approach is also ideal for ortho-restorative cases as then the restorative dentist can plan post-orthodontic treatment, as they will know the final position of the teeth. However, due to the numerous steps involved in the process, errors may creep in, e.g. damage to the model teeth so that the acrylic transfer trays do not fit.

The next section will discuss the second possibility that is simply measuring the malocclusion model to determine bracket positioning.

Simple approach

A simple, basic technique is to place the brackets onto the model and then transfer then to the mouth using a transfer tray which may be made from something as simple as a Hot Glue Gun, as advocated by Scuzzo.

Although bracket positioning is far easier on the model than directly in the mouth, this approach still requires wire bending to compensate for the various tooth thicknesses, etc.

TARG

This approach to bonding uses a TARG instrument to measure each individual tooth on a malocclusion model. A "blade" is positioned against the labial surface of the tooth and the base altered so that the correct torque and angulation are determined and then the bracket is "bonded" to the malocclusion model.

Each tooth has its own torque and angulation reference and this can be modified to take into account the treatment plan; for example, the angulation values may be increased on the teeth adjacent to an extraction site to help facilitate root paralleling.

Although torque and angulation are determined, the in/out or horizontal distance from the bracket slot base to the labial surface is not measured. This is reliant on the clinician's wire-bending skills.

To help reduce this and to give the clinician a template to bend the wire from, the DALI program was introduced by Didier Fillion (founder of the British Lingual Orthodontic Society). This system uses an electronic calliper to measure the in/out distance from the bracket slot to the labial surface and is printed from the computer. Again errors may creep in, e.g. the blade may not accurately fit the labial surface of the teeth.

BEST

This combines DALI with TARG principles using the torque angulation device (TAD) and bracket positioning device (**Figure 6**). The clinician dictates the torque and angulation required for each specific tooth. This is dialled into the TAD and then the malocclusion model is positioned against the blade by adjusting the base of the model holder. Once this is locked, the model is transferred to the bracket position device that measures the height of the bracket and also the thickness/in-out dimensions.

This approach has the advantage in that the in/out dimensions can be adjusted to help minimise wire bending; for example, in/out bends to compensate for the thickness of the canines when compared to the incisors can be eliminated by simply increasing the thickness of the composite as opposed to bending the wire.

Computers in lingual laboratory processes

The advent of computer-aided design has led to the incorporation of computers into lingual orthodontics. Several different applications are possible and systems that use computers include:

Incognito

Incognito uses a manual CLASS set-up; then this is scanned with an optical scanner. The virtual set-up has computer-generated brackets positioned onto the virtual teeth and the design is adjusted to ensure that the brackets are as low profile as possible.

These virtual brackets are then made in wax using a wax printer. This allows the wax brackets to be invested and then cast in gold. The advantage of using gold is that there is no oxidation so that the brackets do not need to be polished.

The absence of oxidation means that the brackets do not need to be polished and therefore a layer of metal is not lost so that they are much more accurate in slot dimensions. The brackets are designed to be as low profile as possible.

So the wire must be bent to compensate for the various tooth thicknesses. As the brackets are computer-generated, the exact dimensions of the bends are known. This allows a robot to bend the archwires.

Orapix

Orapix again uses a CLASS approach but this time it is the malocclusion model which is scanned and the teeth are moved virtually.

This virtual set-up then uses scanned actual brackets, e.g. STb, placed on the virtual set-up.

The position can be adjusted to minimse wire-bending, like the BEST technique. Once the position is set, a jig is constructed, like the HIRO individual transfer tray, using CAD/CAM reverse engineering.

This jig is then used to either bond the bracket to the tooth on a tooth-by-tooth basis or to the malocclusion model and from this a silicone whole arch transfer tray can be constructed and the whole arch bonded in one go.

Lingualjet

Lingualjet uses a scan of the malocclusion model to undertake a virtual set-up (like Orapix). Then, individual brackets are designed and positioned onto the computer model (like Incognito). These brackets and wires are then fabricated similar to the Incognito approach.

Other systems

Plain wire

Often called lingual straight wire (**Figure 7**), this approach uses a U shape, with no bends, to correct the malocclusion.

As the determining factor is the buccal surface to slot dimension and as the wire cannot be bent, the only variable is the thickness of the composite between the tooth and bracket – a so-called filler.

The advantage of this system is that there is no wire bending needed and it is ideal for sliding mechanics where the various in/out bends can hinder. However, the brackets are proud of the teeth and encroach into the tongue space so soreness and speech difficulties may arise.

FIG 6 – Memosil bonding tray

FIG 7 – the bracket positioning device

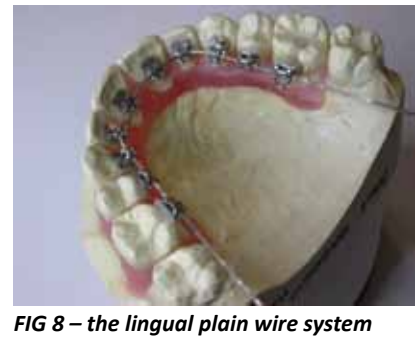

FIG 8 – the lingual plain wire system

Summary

For those of us in the British Lingual Orthodontic Society, the wealth of lingual systems and diversity of approach make life endlessly fascinating and challenging.

The lingual approach is not for the faint-hearted but if you are a specialist who believes in giving your patients the best possible option for correction of their malocclusion, regardless of age, we would encourage you to take a bite and have a go.

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