The “Bracket Positioning Instrument”.

This is a device for positioning orthodontic brackets to the surface of mal-occluded teeth on dental models or ‘set-up models’ used in lingual and/or labial orthodontic techniques.

The Bracket Positioning Instrument has an Anodized Aluminum base with a Stainless Steel working area plate, stainless steel column, and precision aluminum / stainless steel mechanical parts. The mechanical and electronic instrumentation assembly is adjustable along the vertical axis of the column. This assembly includes height and thickness measuring components plus LCD display for measured data. Both measuring components are adjustable for precise accuracy.

Technical Field:
The present invention relates to lingual/labial orthodontics.

Background of the invention:

TARG Ormco

Indirect lingual bracket bonding was done by Ormco using an apparatus called the TARG (Torque Angulation Reference Guide) developed in 1984. The TARG, despite anatomical variations of the lingual tooth surfaces, permitted the bonding of brackets in the laboratory at an accurate distance from the occlusal edge of each tooth with respect to a horizontal occlusal plane. The tooth orientation is made with a gauge or torque blade. The model is tipped on a surveyor base until the long axis of the labial tooth face aligns with the specific gauge curvature at the middle third of the tooth.

This orientation allows us to pre-program torque and angulation (tip) before starting the treatment. After the TARG horizontal blade is engaged into the bracket slot, it is moved towards the varnished plaster at the bonding level determined by the laboratory technician with respect to the prescription, function and anatomy of the teeth. The bracket is bonded to the plaster with filled resin, which allows the gap between the lingual tooth surface and the metal base of the bracket to be completely filled. A new resin base, which accurately follows the lingual anatomy of each tooth, is therefore integrated to each bracket.

Once all the brackets are bonded to the model, a transfer tray is fabricated.

Using only one unique malocclusion model, the TARG permits achieving a virtual set-up without the need to cut the teeth and mount them on wax. It is an accurate and quantified multi-dimensional system. The torque, angulation, and height measurements are registered by the technician. Nevertheless, it has been found that a correct alignment can only be obtained by adding a great number of first-order bends, because the TARG does not take into account the labio-lingual thickness of the teeth. One can note that the distance between the bottom of the bracket slot and the labial tooth surface varies for each tooth despite the fact that all the brackets are manufactured with specific, variable thickness.

The Tip and Torque Surveyor has the advantage over the TARG of being able to move around the teeth and measure them, not just setting them when we align the middle of the blade with the tooth’s FA points. The slightly curved blade helps us compensate for awkward tooth morphology.
Since the TARG is unable to compensate for the unequal distances between the bracket slots and labial tooth surface, Dr Fillion added a digital caliper to the TARG central axis and modified it to present two horizontal blades. The bracket positioning is made directly on the malocclusion model with the TARG (Ormco) and the Thickness Measure System (Fillion). By this way each bracket is bonded on the teeth according to 4 specific references defined by the orthodontist: Angulation, Torque, Bonding height and Thickness (distance from slot to the labial surface). The digital caliper is used to position the brackets, thus recording thickness from the bracket slot to the labial surface.
The macro-filled resin is applied to the bracket base; then the bracket, placed on the blade, is moved towards the plaster model until the selected thickness measurement appears on the display. The resin excess is removed before polymerization. By this technique thickness standardization is achieved while the brackets are each supported on different thickness resin pads. By achieving thickness standardization this eliminated the need for many first order bends in the arch-wire. This procedure invented by Dr Fillion is called the B.E.S.T system, or “Bonding with Equal and Specific Thickness”. In this system the master malocclusion model is used directly and not destroyed, giving the advantage of reference and re-mounting lost brackets. Everything is measured and registered: Angulation, Torque, Bonding Height and Thickness and quantifying this information allows custom-made brackets accurately positioned in three dimensions of space.

The Bracket Positioning Instrument - How does it work?

The Bracket Positioning Instrument (BPI) is an instrument for measuring the height of the slots in Orthodontic brackets from the occlusal edges of the teeth on dental models. It can also measure the distance from the slot to the vestibular surface of the teeth, thus being incorporated in the B.E.S.T. system from Dr. Fillion, Paris, France. It consists of an anodized aluminum base, including a stainless cover plate for the working area to reduce possible wear. It has a vertical stainless steel column and 2 main assemblies, which are:

**Height Adjustment assembly:** The model is placed on a surveyor base and the jaws of the BPI lowered to touch lightly the occlusal surface of the teeth to be bonded. The measurement is returned to zero using the button on the housing and then specific height measurements can be taken from this reference point. The LCD display shows the amount of height change to 0.1 mm, which is more than sufficient accuracy in Orthodontics. The precision accuracy is achieved using rotary encoders and, low backlash mechanical movement plus unique signal conditioning electronics.

**Thickess adjustment assembly:** On the height assembly is the thickness measurement calipers. These have a sprung ‘jaw’ on one side to receive most commercial orthodontic brackets, and a fixed jaw on the other side which should come into contact with the vestibular surface of the teeth to be measured. A large Knob is a gear wheel connected to rack guide that slides the calipers in and out via a straight movement. Turning the adjustment knob moves the jaws in and out and helps position the bracket accurately at a specific thickness measurement from slot to vestibular surface. The LCD display shows the torque measurement to 0.1 mm. The precision accuracy is achieved using rotary encoders and, low backlash mechanical movement plus unique signal conditioning electronics.

**LCD display assembly:** This comprises of the BPI microprocessor PCB, LCD display, power supply & USB interface cable. The microprocessor PCB inputs height & thickness encoder-position that is fed into a signal conditioning and translation circuitry. The main microprocessor takes the encoder-position information and turns this into measured data in degrees, which is then shown on the LCD display.

On the ‘Advanced Version’ there is an ‘Interactive Measurement Head’ and pressing the save button connected to the PC (via USB interface) actively captures the current settings and you use a visual interface on the screen to navigate around the teeth. I.e. you click on a particular tooth on the display and then move the measurement head to that tooth. When the measurements are set correctly you click a save button on the screen. The PC can record all the height and thickness history for each Job No.

+5V DC Power is provide either by a special USB cable (with voltage protection) connected to a power block. Or a standard USB cable connected to the PC providing +5V DC.
Goal of Invention:
The goal of the Bracket Positioning Instrument is to provide precision accuracy to 0.1mm for height and thickness measurements by utilizing smart technology and innovative design thus removing the inaccuracies of today’s orthodontic devices. The BPI’s unique flexible design now gives the orthodontist the option to do individual prescriptions with ease and accuracy. This high precision reduces the errors from indirect lingual/labial bonding techniques, which significantly reduces the chair-time for orthodontic procedures. Reliable, repeatable, strong, compact and easy of use, plus very low maintenance was paramount to give the orthodontist or laboratory confidence when working.

Division of Technology within Invention:
- Precision mechanical machined parts
- Rotary position encoders
- Electronics microprocessor card providing signal conditioning/translation/control/measured data display
- LCD display for torque and angulation measured data

Reason for Invention of the ‘Bracket Positioning Instrument’:
We wanted to make easy and precise height and thickness measurements to improve the accuracy of lingual/labial techniques, giving the orthodontists access to information needed to modify their prescriptions.
How the Invention can be used in Orthodontics:

1. Is where the orthodontist or laboratory technician wishes to place labial or lingual orthodontic brackets on a prepared study model or Diagnostic set-up model, in which case the surveyor base is set to Horizontal Occlusal Line, or a specific Tip and Torque using the ‘Tip and Torque Surveyor’ and an adjustable survey base. The Tip and Torque Surveyor is set to a pre-determined tip and torque, the surveyor with mal-occlusion model is locked, then bonding the brackets can be done accurately at a specific height and thickness. Thus providing the orthodontist with precise digital measurements of the bracket positions so he or she can come up with a suitable prescription for the treatment.

Unique Features of the Invention:

- 0.1 mm precision accuracy.
- Utilizes smart technology and innovative design
- Quick learning time and easy to use
- Precision increments using the fine adjustment controls
- LCD display to clearly show measured data
- Reliability, repeatability, strong, compact and low maintenance
- Fast technique time
- Saving of height and thickness data via USB interface to PC ( later )
- PC can record all the height and thickness history for each Job No. ( later )
- Orthodontics prescriptions completed with precision
- Flexible design now gives the orthodontist the option to do individual prescriptions

Summary of Invention:

Our aim is to provide an affordable and simple to use device, which is well engineered and can either: fit an existing system of ‘Bracket Placement’ directly onto diagnostic set-up models, or be used in conjunction with the “Tip and Torque Surveyor” so that orthodontists can achieve their own prescription, thus allowing the orthodontist to customize their prescription in favour of their patients.

Therefore the market target is not just laboratories involved in ‘Bracket Placement’, but also the orthodontists themselves.

For more info visit: www.pi-bonding.com

Peter D. Sheffield
Chiang Mai
Thailand