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Research Article

Lingual Bracket Height with Relation to Torque on Posterior Teeth. What Prescription do we Need for Adult Cases?

Peter Sheffield*

Director and Partner at The Torque and Angulation Lab, Innovator of IN-tendo Precise Indirect Bonding Systems, Thailand

***Corresponding author:** Peter Sheffield, Director and Partner at The Torque and Angulation Lab, Innovator of IN-tendo Precise Indirect Bonding Systems, Thailand

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Introduction

Over the years there have been a few articles published which look at the Second and Third order problems in Lingual Orthodontics [1]. These have mainly concentrated on the anterior teeth, as this is the area with the most problems in finishing lingual cases. Doctors who want perfection are having to put third order and/or second order bends in the wires of nearly every system to get nice leveling with good aesthetics. Obviously this is because the upper incisors and particularly the central incisors are a major focal point for the patient. These are the most prominent teeth when they look in the mirror every day, and with lingual orthodontic treatment they are able to clearly see the changes taking place, the good, the bad and the ugly. All are exposed to the patients view in Lingual Orthodontics ~ [2].

The phenomenon of the 'Torque Trap', as described by Prof Earl Johnson in his article (AJO-DO 2013), or play between bracket slot and wire is something that effects both labial and lingual orthodontics, but the results are more profound in lingual due to the distance of bracket slot to the vestibular face being aligned. In this article I have measured (in a laboratory environment) the effects of placing brackets with the same vertical height setting and differing torques. You might ask why not use one standard set of torque values like the charts for labial such as Roth and MBT which don't differ much? I used to follow standard charts for lingual many years ago similar to those of the labial prescriptions, but once I had the versatile tools like the 'Tip and Torque Surveyor' and the 'Bracket Positioning Instrument' in our laboratory, it became apparent that there was no ideal set of values for tip and torque to be applied to all cases, especially adult cases where the occlusion was functional if not perfect and therefore Doctors would want to avoid making big changes in the posteriors. This is something Dr. Kokitch was lecturing about back in 2008 at the APOC meeting in Bangkok that I attended… "Adult Orthodontics in the 21st Century". Using these instruments every day over the past 12 years for our work measuring study models, mal-occlusion models and diagnostic set-up models to find the mesio-distal crown angulation (Tip) and the labio-palatal crown inclination (Torque) of teeth in order to individualize the Lingual Bonding prescription for each case (within the "IN-tendo" system) has given us an insight that many people rarely get in this side of Orthodontics. This has lead to changes in our thought process and later the techniques. We have measured thousands of different arch forms and made the necessary adjustments to minimize the relationship of second and third order problems in our lab work. By tailoring the bracket slot values to individual patient's arch forms and tooth morphologies we hope to minimize the wire bending needed. I say minimize because after all we are dealing with bio-mechanics and not pure mechanics, so there is always some unpredictability in orthodontics that Doctors learn to control through their experience.

Method

Using the instruments T.T.S. (The Tip and Torque Surveyor) and the B.P.I. (Bracket Positioning Instrument) (Figures 1 and 2) I measured the vertical bracket heights at different torque settings on 4 different posterior teeth from real malocclusion models. This was to simulate 5 various simplified prescriptions for Torque in the posterior teeth. Each tooth was cut from a real master cast and trimmed to be isolated on its own in a block of lab putty [3]. The LACC (Long Axis of the Clinical Crown) drawn with a 0.5 mm pencil and the FA (midpoint of the LACC) marked (Figure 3). The tooth and putty base were then placed on the adjustable survey base of the instruments mentioned (Figure 4) The T.T.S. was used to set the various torque settings shown in the results chart, [4]. y moving the 'blade' around until the digital screen showed those values. Then the adjustable base with the tooth was orientated until the LACC and FA points matched the blade's end with the torque finding the best average fit for the morphology of the tooth (Figures 4 and 5). The whole survey base was then locked and transferred over to the B.P.I. A suitable height chosen for the bracket slot near the middle of the tooth. In the premolars I chose 3 mm and in the molars 3.5 mm. from the functional cusps (Figures 6-10). Then for each new torque setting we measured the change in slot height either up or down. For each tooth the process was repeated.

Figure 1: Work station showing standard orthodontic charts for bracket prescriptions and an ergonomically designed turn table for surveying models at normal head height.

Figure 2: Digital calipers used for measuring the models and teeth.

Figure 3: Digital calipers used for measuring the models and teeth.

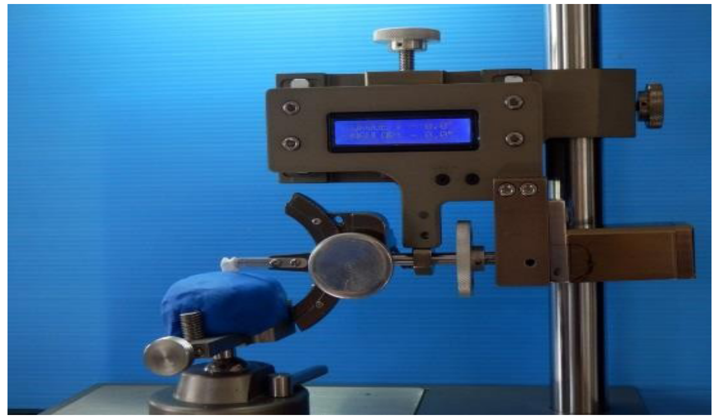

Figure 4: Instrument Tip and Torque Surveyor for measuring or setting Tip & Torque, showing zero position.

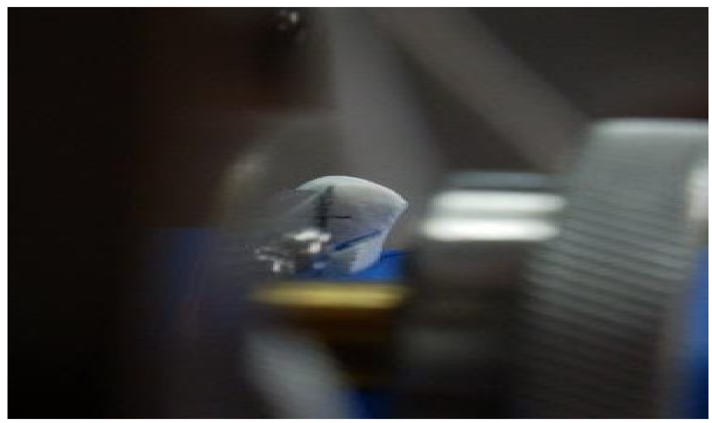

Figure 5: A tooth in stone showing the LACC (Long Axis of Clinical Crown and the FA point (midpoint of that axis).

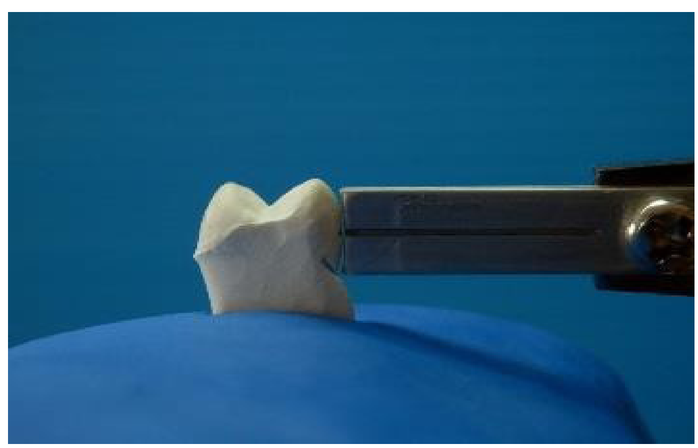

Figure 6: Blade of the TTS in relation to tooth morphology.

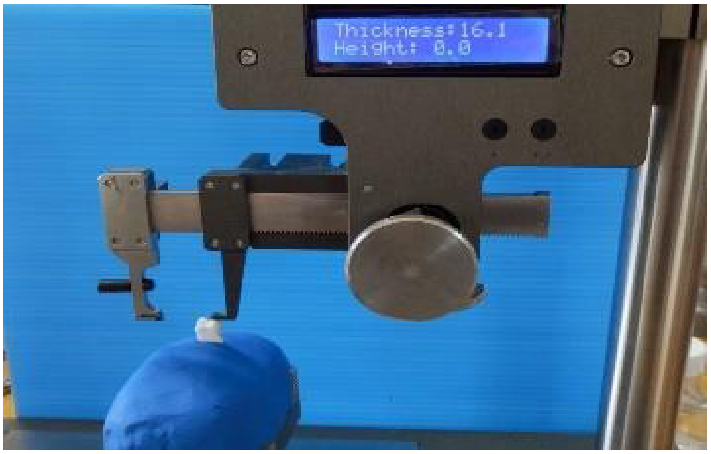

Figure:7 Bracket Positioning instrument (B.P.I.) being reset to zero height at the cusp tip.

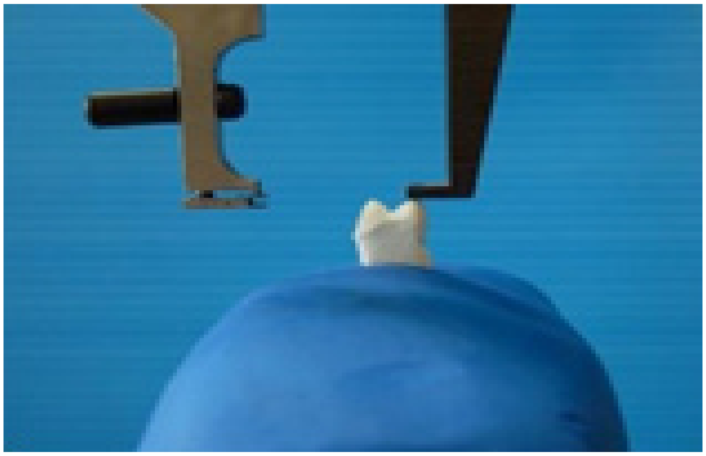

Figure 8: Bracket Positioning instrument (B.P.I.) being reset to zero height at the cusp tip close up.

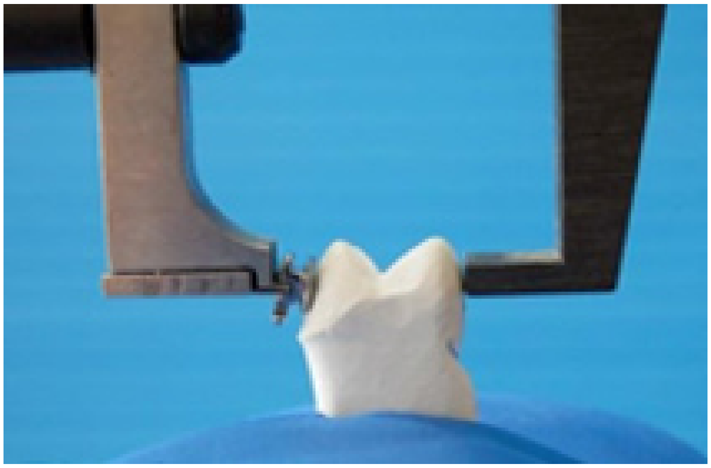

Figure 9: BPI holding the Lingual bracket at 3.0mm from the cusp height.

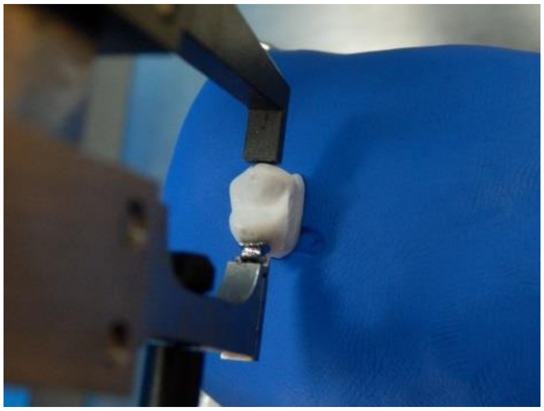

Figure 10: Alternate view of the bracket position.

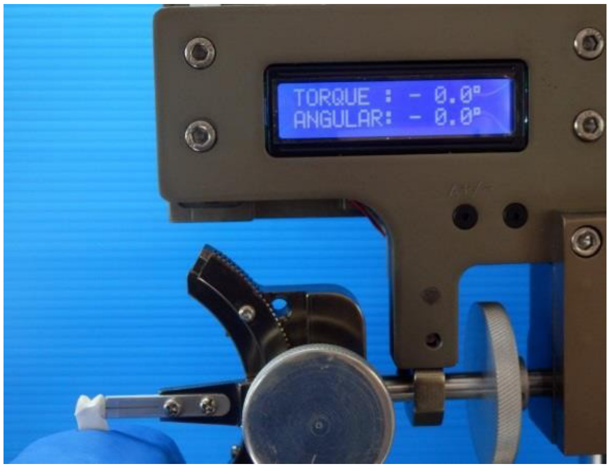

Figure 11: Instrument Tip and Torque Surveyor.

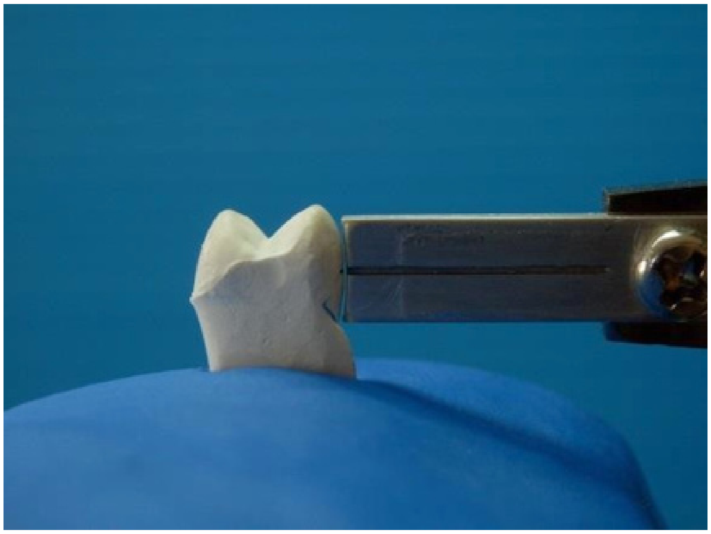

Figure 12: Blade of the TTS in relation to tooth morphology close up.

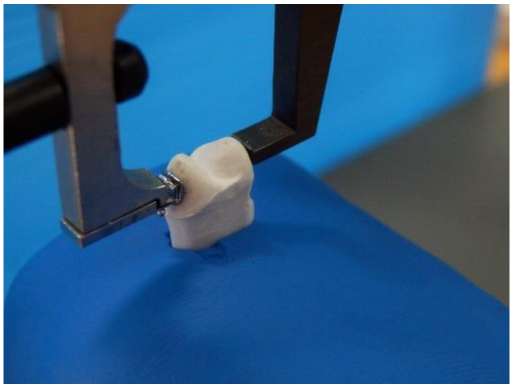

Figure 13: Premolar lingual bracket at 3.0mm.

Above: The #25 at Zero torque setting (Figure 11), showing the bracket position in the middle of the lingual surface at 3 mm vertical height setting (Figures 12 and 13).

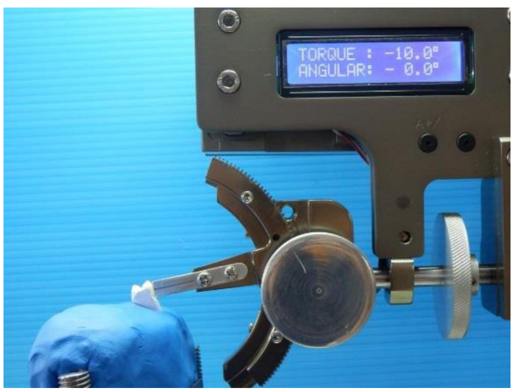

Figure 14: T.T.S showing -10 Torque setting.

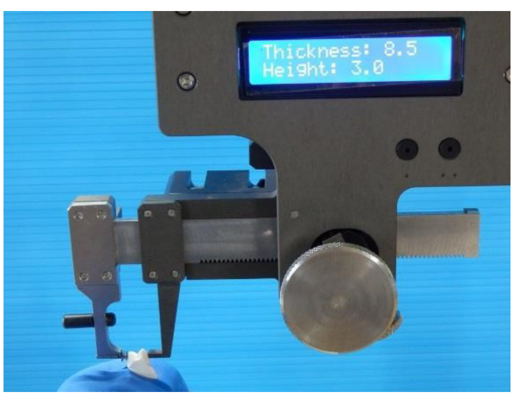

Figure 15: New bracket position at -10 Torque setting but same height 3.0mm.

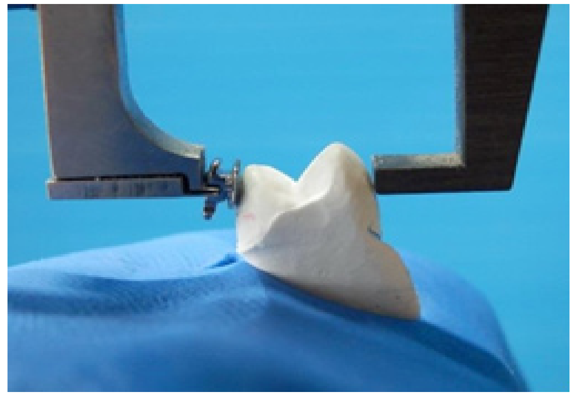

Figure 16: New bracket position at -10 Torque setting but same height 3.0mm close up.

Above: The same upper premolar now at -10 degrees' torque setting (Figure 14) and we can see the new position of the bracket at 3 mm from the buccal cusp (Figure 15 and 16). Below we see setting for -15 degrees' torque on the left (Figure 17 and 18) and + 5 degrees on the right both with resulting bracket positions (Figure 19 and 20).

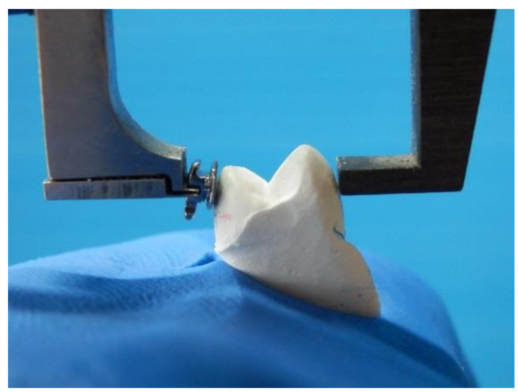

Figure: 17 15-degree torque setting.

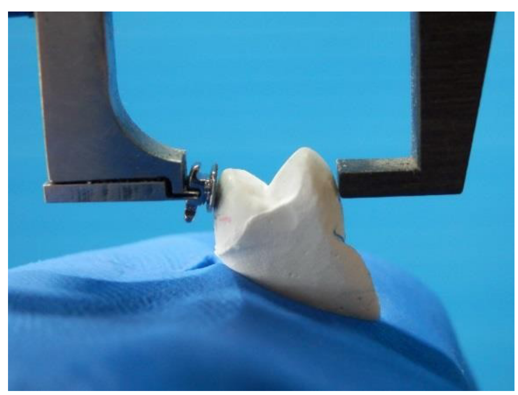

Figure:18 New bracket position at -15 degrees' torque.

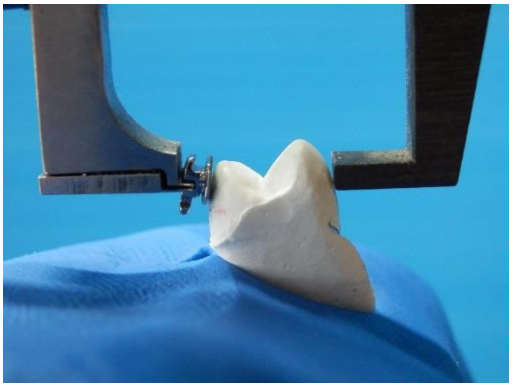

Figure:19 TTS showing a $^{+}$5-degree torque setting.

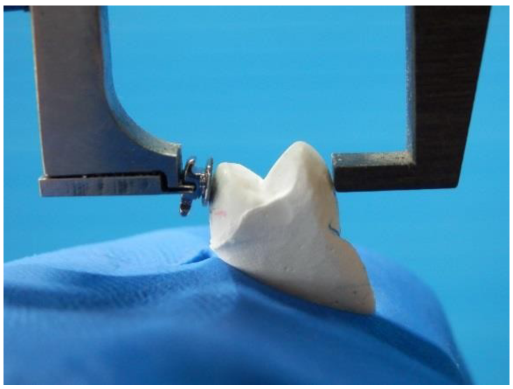

Figure 20: New premolar lingual bracket positioning for +5 degrees' torque but still at 3.0 mm measurement.

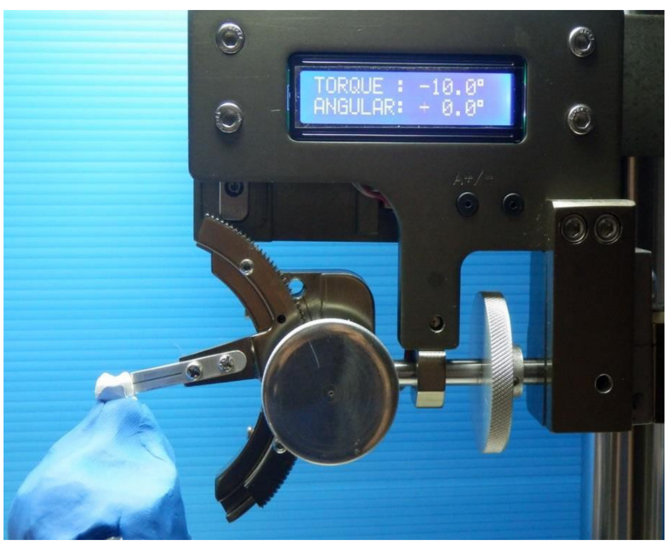

Figure 21: Torque setting -10 degrees on the tooth.

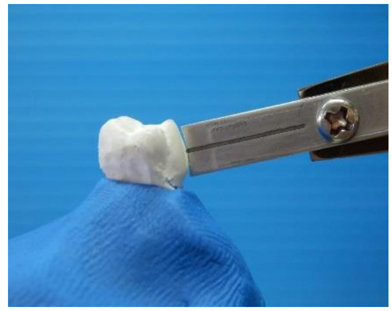

Figure 22: Cone beam imaging of another case which was done via a CAD CAM lingual bracket system.

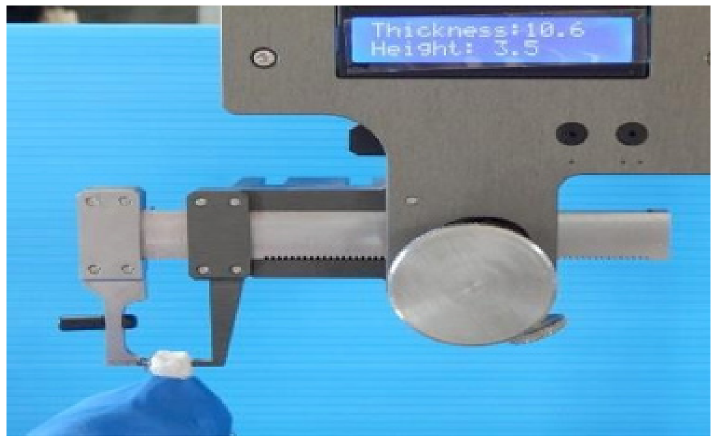

Figure 23: B.P.I. showing the height and thickness measurement for the lingual bracket on #46.

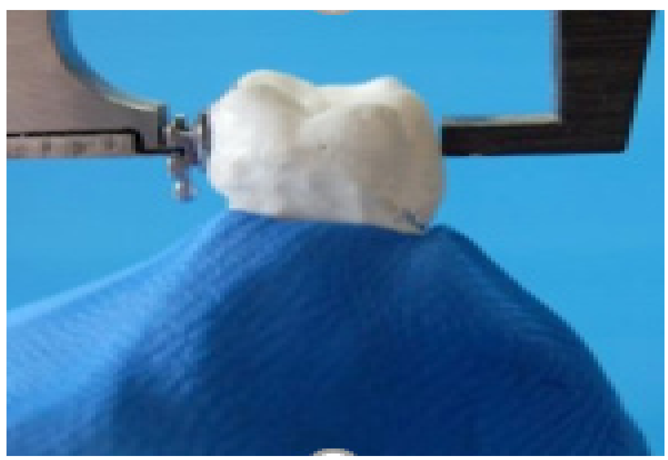

Figure 24: Close up of bracket position on #46.

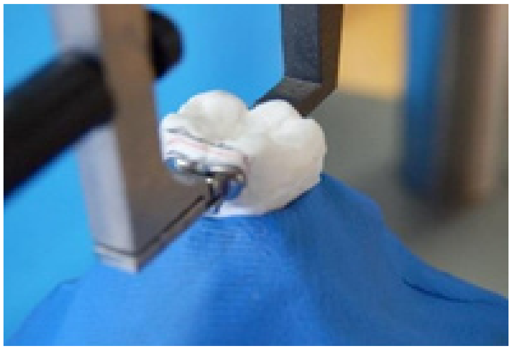

Figure 25: Same as Close up of bracket position on #46.

Above: Tooth #46 at -10 degrees' torque (Figures 21 and 22) showing the bracket at 3.5 mm from the buccal cusps in the middle of the crown (Figures 23-25). Below: The same tooth at -20 degrees' torque (Figures 26 and 27) and 3.5 mm has the bracket much higher near the occlusal on the lingual surface (Figures 28-30). This large difference of around 2.2 mm is due to the 'thicknesses of the tooth.

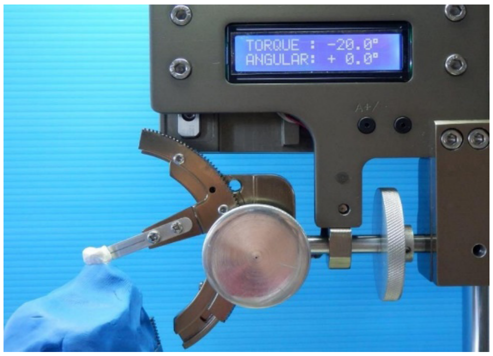

Figure 26: T.T.S setting at -20 degrees' torque.

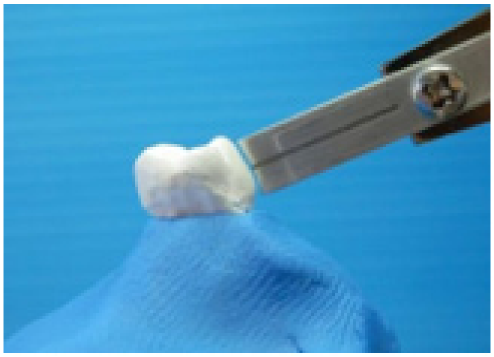

Figure 27: Showing blade relationship at -20 degrees' torque.

Figure 28: B.P.I showing height at 3.5mm for -20 degrees' torque.

Figure 29: B.P.I showing height at 3.5mm for -20 degrees torque close up.

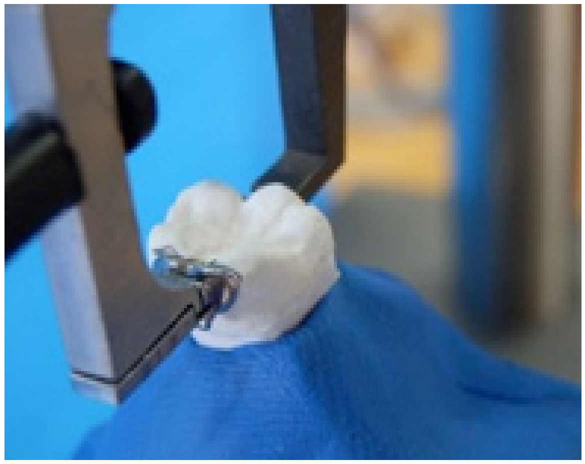

Figure 30: A different view of B.P.I showing height at 3.5mm.

Results

The chart below shows the changes we measured in bracket height on the lingual surface (bonding surface) when keeping the vertical bracket height [5] controlled by the BPI at a constant 3 or 3.5 mm according to the tooth. As torque became more negative the bracket moved more occlusal because the point of reference for the zero mark (the buccal cusp on all teeth except the upper molars) moves upwards. This can be seen in the previous images clearly. The changes seem to be pretty standard as we have to account for possible error in our technique, however morphology of the teeth also plays a part. The curvature of the buccal and lingual surfaces have more effect than a more 'straight' sided tooth. We can see this between the two premolar samples. The #45 being a much straighter shaped tooth, yet despite it's 'thickness' being 0.2 mm more than the #25, the amount of height change was less, averaging 0.4 mm per 5 degrees of torque change, whereas the #25 was around 0.8 mm per 5 degrees (Table 1).

Note* The #16 Upper Molar is an exception to the rule as the point of reference for the height measurement was the mesio-lingual cusp as we feel that on the upper molars, this should be used for the measurement of the slotplane.

Tooth	Heightof Bracket in mm	Width of Tooth in mm	Torque in Degrees.	-5	-10	-15	-20	5
			Bracket Movement.	Up	Up	Up	Up	Down
#25	3	8.3		0.7 mm	0.7 mm	0.8 mm	/	0.9 mm
#16	3.5	11.2	Note*	0.4mm	0.2 mm	0.4mm	0.4mm	0.4mm
		8.5		0.5mm	0.4mm	0.4mm	0.4mm	0.4mm
		10.4		1.2mm	1.2mm	1.0mm	1.1mm	

Table 1: The Lower and Upper Molar.

We will discuss this in the conclusions. The #46 was not tested at +5 degrees of torque as this is a very unlikely setting for a lower molar. The #25 was not measured at -20 degrees' torque as this also is an unlikely setting and by starting our height of 3 mm in the center of the lingual crown surface, the bracket was already half way past the tip of the lingual cups at -15 torque.

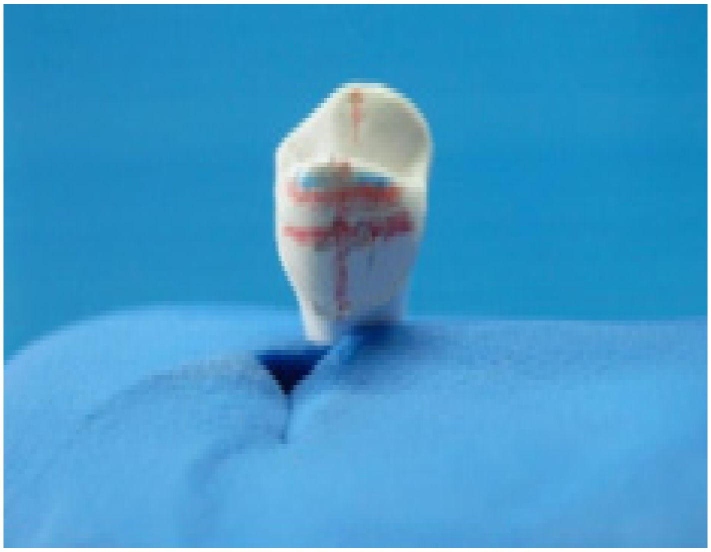

Figure 31: Showing the bracket height change marked on the upper premolar.

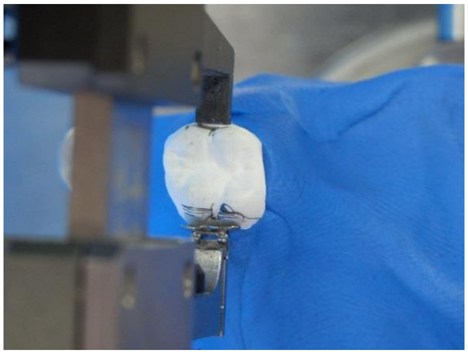

Figure 32: A 'Birds eye View' of the bracket positioning on the Upper Molar.

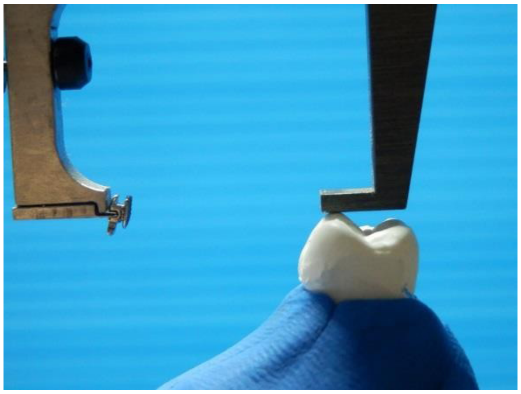

Figure 33: Showing setting the B.P.I to Zero at contact with the mesio-lingual cusp.

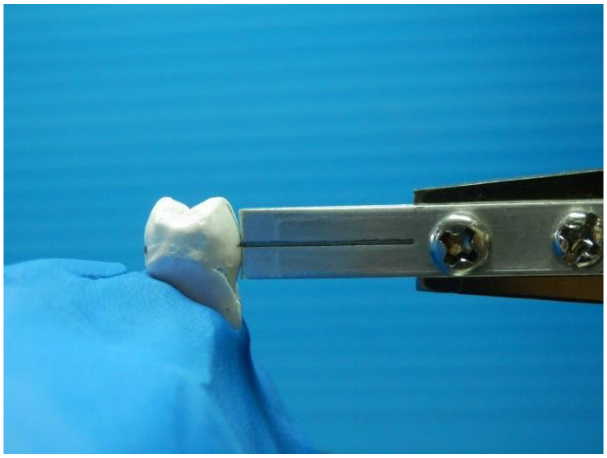

Figure 34: Blade v's Morphology relationship.

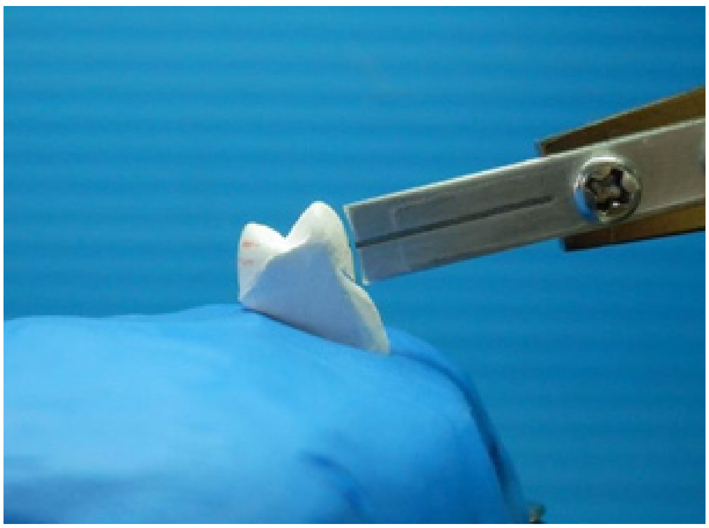

Figure 35: Again blade of T.T,S. with morphology at a negative torque on the premolar.

Conclusions

The results clearly show that if the wrong torque setting was chosen for a particular tooth in lingual orthodontics, then by simply following the old systems of manual instrument bonding following a 'Standard Chart', then we could have a big difference in actual height the bracket is bonded at. The amount of height difference depends on two factors; the width of the tooth and distance of the slot to the vestibular face…in lingual known as 'Thickness', and the amount of degrees the torque changes. In the tests I kept the changes to an even 5 degrees so we can easily calculate the error involved [6]. Also then we can also start to look at 'play' between the wire and slot, however it should be noted that the amount the buccal cusp moves with each 5 degrees is not the same as the bracket in the results chart. The amount of movement of the vertical height of the cusps depends on the morphology also and I have decided not to discuss this yet. Because keeping things in the 'Bio" environment, we should also look at the effects of occlusion and other forces which will determine the final positioning of the posteriors, not just wires in slots.

Note*

In the past most manual techniques like the TARG and B.E.S.T for lingual bonding were using the buccal cusp of every tooth as the reference point as where to start the height measurements from for the bracket slots and therefore the 'Wire Plane'. This caused leveling problems for many clinicians as it seems that by simplifying the techniques in order to be understood, they had overlooked some important factors. For example when we do our set-up models to a flat plane, it should be the functional cusps of the upper than meet the plane. Thus for both upper molars this is the mesio-lingual cusp. Now from our chart and considering the 'Thickness v's height' problem when torque changes it would indicate height errors in the old systems of between 0.6 and 1.2 mm for bracket slot v's wire plane.

Considerations in the Treatment Plan

I feel we should talk more about possible errors in the treatment plans, from either a purely mechanical system of bonding using instruments, or by using standard chart values for torque whilst using a computer software system. As previously mentioned in the introduction, lingual orthodontics is mainly dealing with 'adult orthodontics'. Therefore, according to the late Dr. Kokitch and some other top clinicians, we should be considering the actual positions of the posteriors when forming a treatment plan. Therefore any bonding chart for IDB, in either labial or lingual orthodontics should take this into consideration. One way to do this is to survey the models of the malocclusion model for the actual values and then see how much we need to move the teeth …if at all! This will ensure that when we bond the brackets to the models [7]. Then will be bonded with relation to the final outcome desired. Obviously if we use a 'set-up' model and the 'Hiro' technique of bonding with a flat wire, then this is automatic, but in doing so the anterior torque loss cannot be compensated using that method. Below I will show an example of a real case where the Doctor had ordered a "Standard Prescription" such as the B.E.S.T chart with no set-ups or diagnostics involved. However on receiving the case I could see that because the lower was not being treated (and actually the posterior occlusion was good on a 40 year old patient), then really we should not disturb the upper posteriors too much and that the brackets were just being used as anchorage. There were some minor tip problems and rotation that could help achieve a maximum inter-cuspidation, but really minor so It made me do a test to see what would happen if I applied the -9 degrees of standard upper molar torque to the #26 for example…

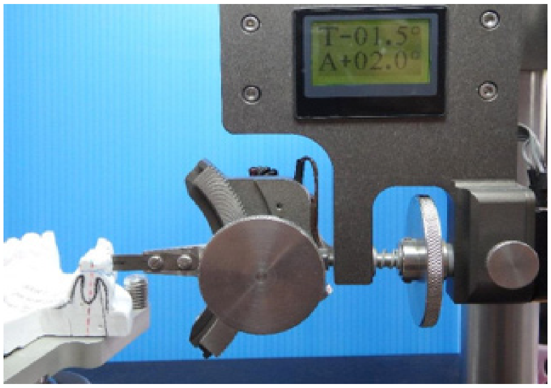

Figure 36: An example case which had good posterior occlusion and the Doctor did not want to change it. Measuring to see the values.

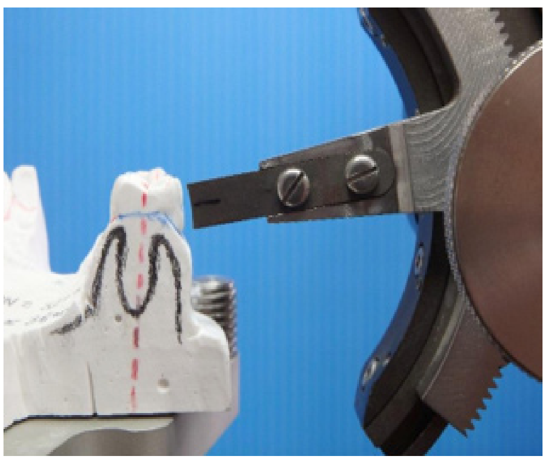

Figure 37: Showing the torque error if we set the T.T.S. to a common standard torque for a lingual case upper molar.

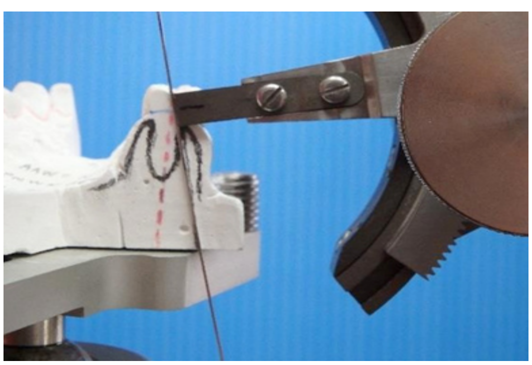

Figure 38: With the model set back at the OP setting for survey we now project the error in root angle if we apply -9 degrees of ‘standard’ torque.

Figure 39: Setting the model at -9 degrees for the #26 using the adjustable surveyor base.

Figure 40: Showing the bracket height on the B.P.D.

Figure 41: Showing the bracket height on the B.P.D. other version to BPD.

In the image on the top left (Figure 36), I positioned the model flat to the survey base and relative to the occlusal plane. Most teeth contacted the plane of the articulator and I thought it was a fairly easy case. But due to the ‘Curve of Wilson’ present I could see that torque would not be standard. So using the T.A.D. (we have the old and new instruments in our lab) I measured the torque of the #26. The model used was a duplicate and I sectioned it so we could see clearly from the distal aspect for this test. I also decided to sketch the possible bone root relationship and a dotted red axis line through the center of both. Torque in relation to clinical crown morphology was -1.5 degrees, which is a long way from the -9 on the B.E.S.T. chart for lingual or the -14 of Roth and MBT. So what if I turned the instrument blade to represent -9, how would it look? In the image (Figure 37) you can see. This case was a 'narrow basal arch' case and as the patient was 40 years old, I thought we should be careful about putting the wrong torque (Figure 38). This Image is an attempt to show the possible deflection of the root when -9 torque is expressed in a case like this. The above sequence of images (Figures 39-41) are what will happen to the bracket when we use the standard torque setting of -9 degrees. The sequence below (Figures 42-44) show the bracket being positioned at the same height but to the original torque of -1.5 degrees.

Figure 42: Back to the original OP (Occlusal plane) for the patient.

Figure 43: Showing the 3.5 mm height of the lingual bracket on the #26.

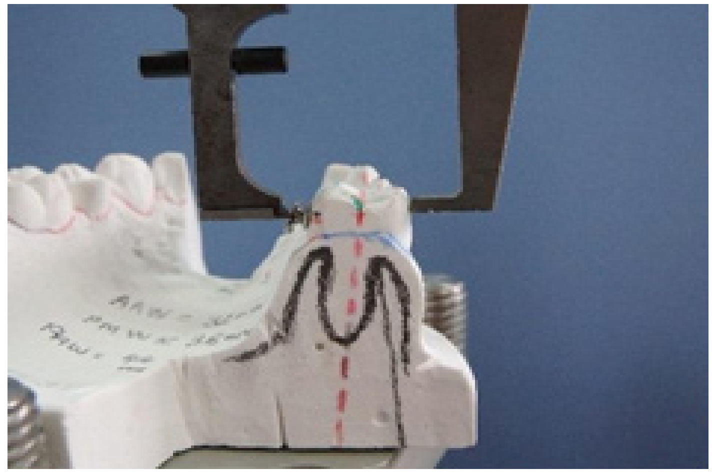

Figure 44: Showing the 3.5 mm height of the lingual bracket on the #26 Close up.

Also the thickness changed from 11.32 to 11.38 mm which could affect in / out positioning of course there is a simpler way to solve the challenges presented here. For example I offer my clients a bi-dimensional technique for cases such as this, but also with bonding at the correct torque so height is not affected. With 022 slots in the posteriors there is no way the torque can cause adverse side effects, due to the massive play between bracket and slot! On the left (Figures 45 and 46) you can see images of an actual CAD CAM Lingual case from one of the well-known systems. Which we p [refer not to name), where the torque in the bracket slot obviously wasn't tailored to the case for the molar. These images were kindly supplied by Dr. Mauricio Accorsi of Curitiba, Brazil. He is a Specialist Orthodontist, doing both Lingual and Labial work. He is also a specialist in Digital Orthodontics and Cone Bean imagery. The root of the molar can be seen coming out of the bone during treatment after rectangular wires were inserted to effectuate torque. But looking at the Cone Beam imagery we can also see problems with the upper left anterior sector and the premolar root.

Figure 45: Cone beam imaging of another case which was done via a CAD CAM lingual bracket system.

Figure 46: Cone beam imaging of another case which was done via a CAD CAM lingual bracket system root problem.

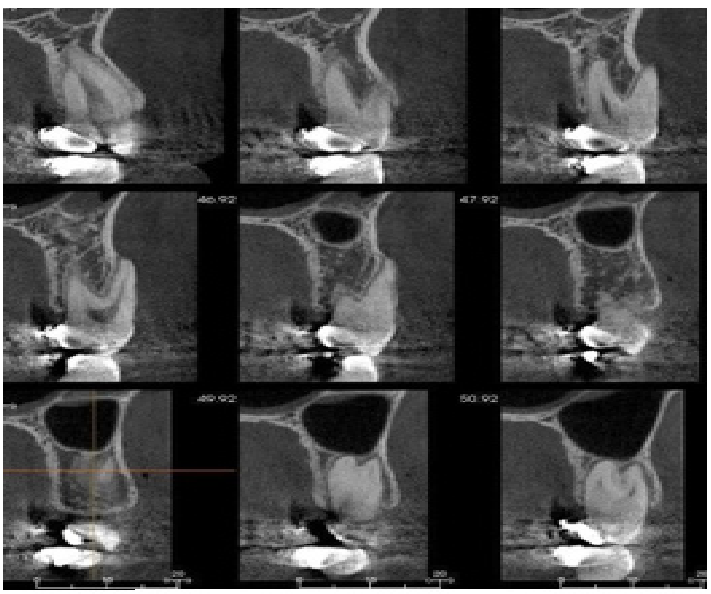

Figure 47: Progressive x-rays of the root problem incurred in the #17 from the CBT images.

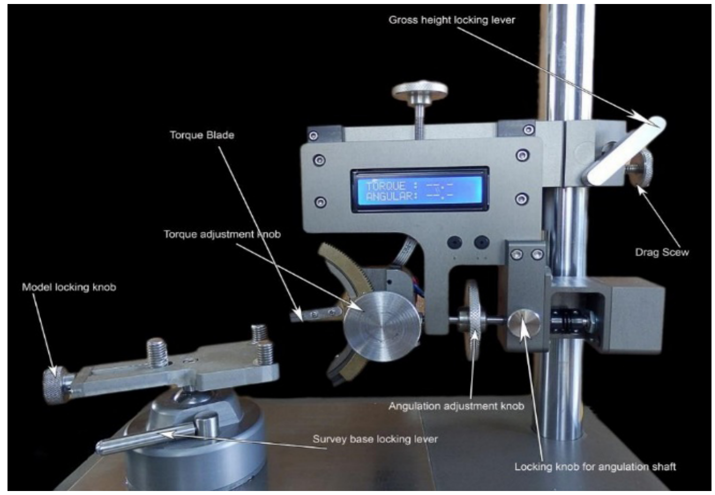

Figure 48: The Electronic Tip and Torque Surveyor (T.T.S.).

The Tip and Torque Surveyor (Figure 48) is an electronic measuring device using a special design which includes digital rotary encoders to measure Tip and Torque of teeth on dental casts in fractions of a degree (0.1 degrees). The idea was based on the old manual TARG instrument and technique from Ormco from 1984. However due to the current design it is much more precise and can actually measure, where the TARG was just used to 'set' Tip and Torque, before bracket placement. With emphasis being placed on removing possible errors in the moving parts and increasing the 'ease of use' for the operators, thus making it also much quicker to use. More details can be seen at www.intend-ortho.com. (Figures 45 and 46) you can see images of an actual CAD CAM Lingual case from one of the well-known systems Which we p[refer not to name), where the torque in the bracket slot obviously wasn't tailored to the case for the molar. These images were kindly supplied by Dr. Mauricio Accorsi of Curitiba, Brazil. He is a Specialist Orthodontist, doing both Lingual and Labial work. He is also a specialist in Digital Orthodontics and Cone Bean imagery. The root of the molar can be seen coming out of the bone during treatment after rectangular wires were inserted to effectuate torque. But looking at the Cone Beam imagery we can also see problems with the upper left anterior sector and the premolar root (Figure 48). We can see from the images presented in this article that the question of 'Torque Prescription' for Adult Orthodontics needs further investigation and considerations for Lingual Orthodontics. How torque is calculated and then applied needs good planning and careful thought to avoid the possible side effects. Traditionally this has always been tackled within the hands, skills and experience of the Orthodontist, usually through bending wires. But from a lab system point of view, we should be looking at how to individualize the bracket prescriptions for the patients that can possibly minimize the work load of the clinicians. I really believe this is now possible using a blend of techniques and information available, from digital analysis of cases before and during treatments, to good treatment planning and good communications to the lingual set-up providers.

This article was written by Peter D. Sheffield, Technical Director of the Torque and Angulation Lab and Innovator of the INtendo system. Dec 2017.

References

1. S Thomas, tamm, D Weichmann, H Achim, E Ulrike (2000) Relationship between second and Third Order Problems in Lingual Orthodontic treatment. Journal of Lingual Orthodontics 1: 5.
2. S Giuseppe, T Kyoto (2010) Lingual Orthodontics a New Approach Using STb Light Lingual System & Lingual Straight Wire. Quintessence Publishing 2: 264.
3. Johnson E (2013) Selecting Custom Torque Prescriptions for the Straight Wire Appliance. AJO-DO 143: 161-167.
4. Fillion D (1989) Lingual orthodontics: a system for positioning the appliances in the laboratory Orthod. FR 60: 695-704.
5. Mestriner MA, Enoki C, Mucha JN (2006) Normal Torque of the Buccal Surface of the mandibular Teeth and its relationship with Bracket Positioning; A Study in Normal Occlusion. Brz Dent 17: 155-160.
6. Andrews LF (1976) The Straight –wire appliance origin, controversy, commentary. J Clin Orthod 10: 99-114.
7. Smith RN, Brook AH, Karmo M (2009) The relationship between the mid-point and the most-prominent point on the labial curve of the upper anterior teeth. Open Dent J 3: 167-172.
8. SD Thomas, S Norman, JP Hatch, JD Rugh (2007) Practised- based comparison of direct and indirect bonding. AJODO 10266: 010-052.