THE MOVE TO **ENGAGEMENT**

IN ANTERIOR TEETH WITH PASSIVE SELF-LIGATION

By Dr. Tom Pitts & Dr. Duncan Brown

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Pitts21 PRO

The first of a series showing the scientific basis for the superior performance of the unique Pitts21 square wire progressive slot system developed by Dr. Tom Pitts.

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"If you can't explain it simply, you don't understand it well enough."
Albert Einstein

For years, Dr. Duncan Brown and I have encouraged a conversation that focuses on the need for **engagement** to gain control rather than marketing claims focused on resistance to sliding, low force, low friction, or manufacturing tolerances. Engagement occurs when the slop between the archwire and slot is eliminated. Control of 1st, 2nd, and 3rd order tooth movement requires the engagement of the bracket and wire. Given the significance of upper incisor inclination on arch length[1] and the importance of incisor inclination on smile attractiveness[2], it should not be surprising that understanding the "mating" of brackets and wires to deliver the desired torque (axial inclination) is critical. The clinical need for the bracket/wire combination to achieve engagement to attain 3rd order control will be **"the" hot topic of discussion** for the next several years.

The factors that influence the treatment outcome are complex: the pre-treatment position of the teeth, individual tooth morphology, the bonding technique, the O/G position of the bracket placement, manufacturing tolerances (bracket and archwires), corner radius of the archwire, and plastic deformation of the bracket assembly components during orthodontic loading.

PHOTO COURTESY: Dr. Wassim Bouzid

The common clinical practice of **"failing to fill"** the slot imposes an additional complication in that it adversely affects the control of 3rd order movements in anterior teeth. A frequently overlooked sequela of resorting to undersized wires is the requirement for **compensatory wire bending to attain engagement** for 3rd order control in both the anterior and buccal segments.

Research performed in Japan has demonstrated that "square slotted" orthodontic brackets attain engagement in 1st and 2nd order dimensions earlier than rectangular slotted appliances[4]. While not as effective as "square slotted" orthodontic brackets, 1st and 2nd order tooth movements with rectangular slots are acceptable. The actual "slop" in rectangular slotted systems resulting from oversized slots, undersized wires, and larger corner wire radii makes 3rd order torsional control especially challenging, and hitting a 3rd order esthetic position even harder[5]. The Pitts treatment philosophy departs from this common practice, as engagement between the wire and bracket slot is attained early.

The **Pitts21 bracket** with the progressive bracket slot, the Pitts21 Archwire Suite, and the Engage Early Archwire clinical protocols are designed to accomplish very early 1st and 2nd tooth movement.

Today, our goal, is to explore how an improved understanding of engagement will benefit the clinician.

Beyond SLOP to ENGAGEMENT - 3rd Order Control of AXIAL INCLINATION

3rd order **SLOP** within the system, caused by manufacturing variations and the common Orthodontic strategy of not filling the slot, reduces the clinical control efficiency of fixed appliances. Although **SLOP** has been the focus of discussion for decades, acknowledging that "slop" exists within the system does not improve clinical efficiency. To increase efficiency, clinicians need to know if there is 3rd order engagement developed in the slot or not[6]. Variables within the Orthodontist's control can be adjusted through case management to reach a desired occlusal/esthetic goal for tooth movement.

A "Pilot" Project on ENGAGEMENT

Research clearly demonstrates that **reliance on "mathematical models" to predict engagement is not wise**[4], as in-vitro testing of actual torsional slop is up to 2.5 times larger than the mathematical prediction in studies conducted on traditional ligation, active self-ligation, and passive self-ligation rectangular slot appliances.

To our knowledge, a simple way to demonstrate "engagement" parameters directed to achieve target/ torsion and the factors contributing to clinical efficiency have not been presented in the orthodontic literature. The **"Engagement Analyzer"** was developed to measure the engagement of bracket/wire combinations at various bracket positions.

This approach enables testing the **bracket positioning heights, the manufacturer's wire profiles, and the suggested timing of wire progressions** to assess efficiency. The Pitts21 and Pitts21 PRO were examined in relation to other Passive Self-Ligating Systems with rectangular slots using the "Engagement Analyzer" for their ability to deliver target and torsion when used "as directed" by the manufacturer. The Engagement Analyzer is the result of a collaboration between Dr. Duncan Brown and the engineering team at OC Orthodontics. The engineering team at OC Orthodontics conducted this study and assembled the data. This paper will focus on the

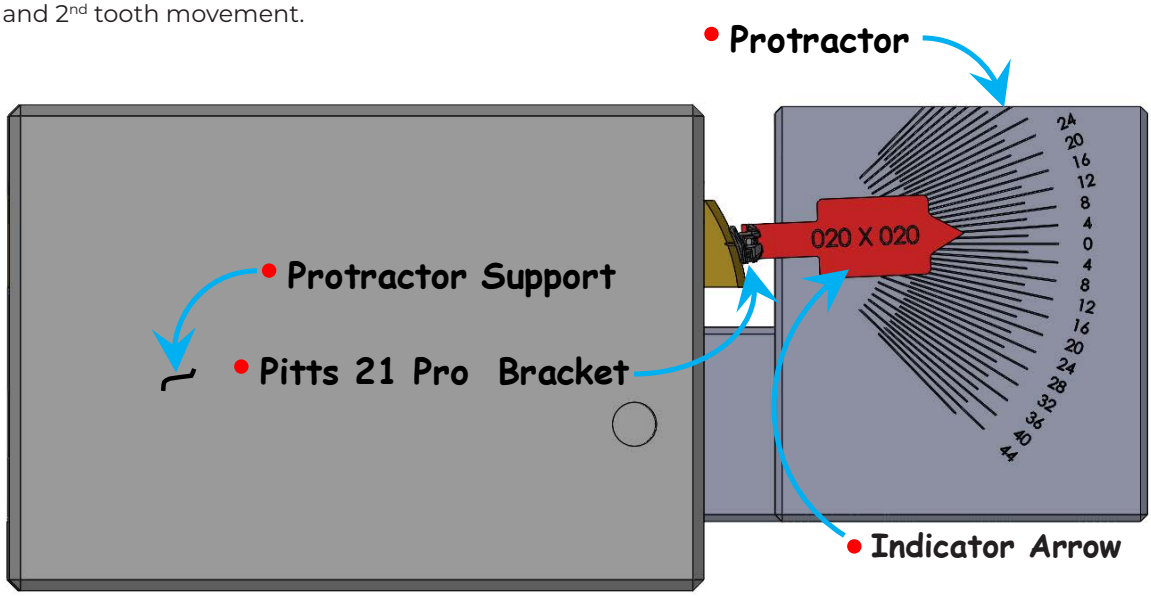


FIGURE 1A: The Engagement Analyzer

anterior teeth, with subsequent papers applying the same concepts to buccal segment control.

This study tested a single upper right central with the manufacturer's archwires using the suggested archwire progressions, and then the data was assessed relative to recommended appointment intervals. Bracket position was carried out from a "by design" approach (FA bracket positioning - slot in middle of crown), as suggested by the manufacturer or their Key Opinion Leaders, or a Smile Arc Protection approach. The measurement error in the methodology mirrored similar studies of 1-2 degrees[4], which is considerably smaller than the differences between the manufacturer's samples, so the methodology can be considered adequate for the study purposes. In the future the data set will be expanded to allow statistical validation of the results presented here.

The **TARGET** is the point at which slop is eliminated, and control through the engagement of the wire and bracket is initiated. In terms of the bracket prescription, **TARGET** should occur when the bracket is positioned at the position suggested by the manufacturer or their KOL's. Since the bracket prescription varies, each bracket/wire combination must be assessed relative to its bracket torque prescription.

To treat efficiently, the clinician should know when initial engagement occurs **(TARGET)** and the bracket wire combinations required to generate biologically active **"TORSION"**.

Biologically active **"TORSION"** occurs when the archwire is torqued (twisted) beyond the initial engagement at "TARGET" to provide an effective 3rd order correcting force.

Many orthodontists are surprised to learn their appliance of choice rarely develops **"TORSION"** within the slot when using the suggested bracket/wire combinations and the positioning of the brackets dictated by their case management strategies. It should be evident that attaining efficient **TORSION** within the appliance system should be an **appliance goal** to enhance clinical efficiency.

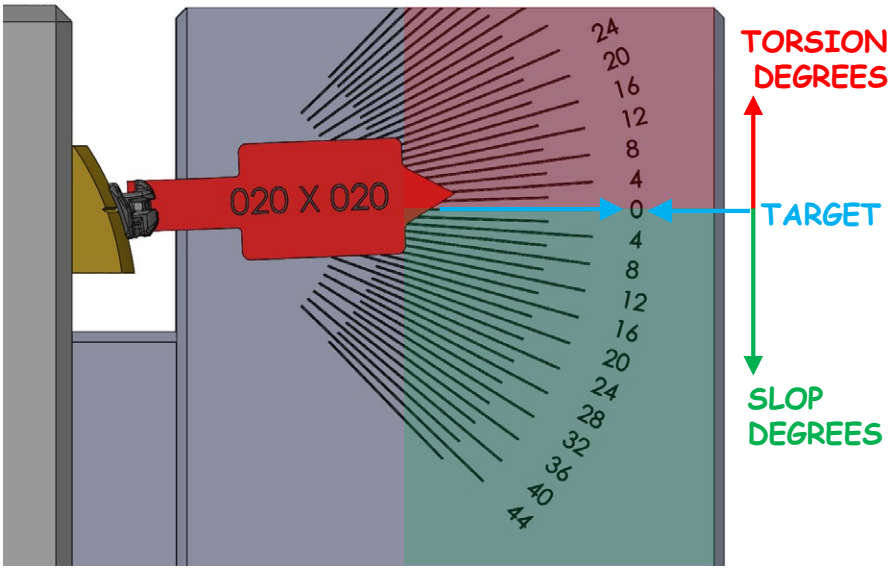
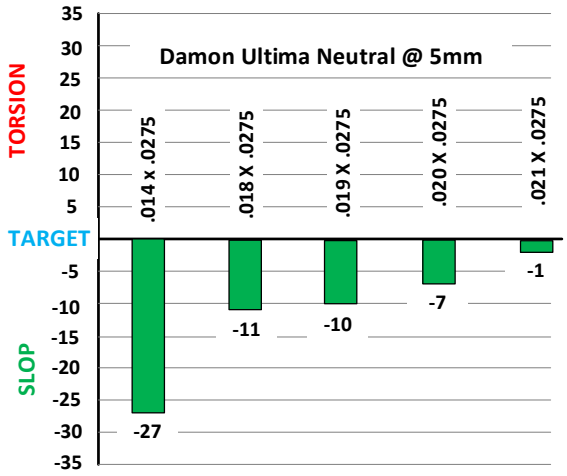


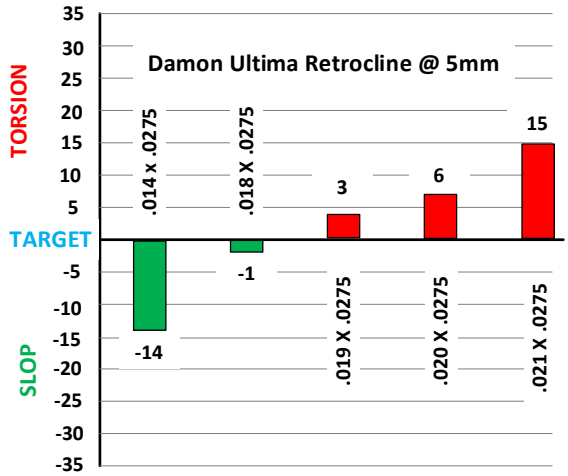
FIGURE 1B: Engagement Analyzer demonstrating Slop/Target/Torsion. 3rd Order Control through slot engagement is only possible when Target/Torsion is attained

Engagement Analyzer Results

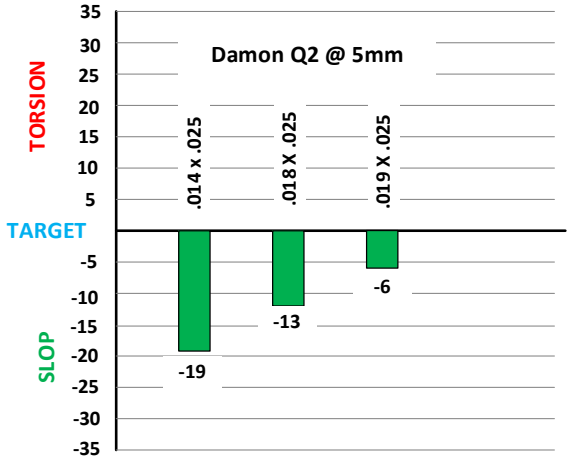
BRACKET RX MEANS NOTHING UNLESS THE WIRE IS ENGAGED WITH THE SLOT!

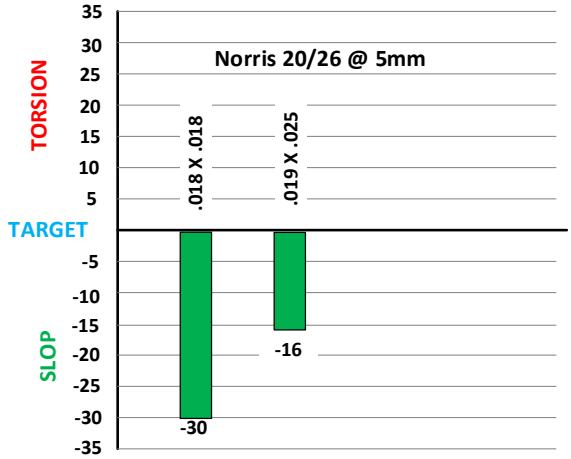
ONLY "OVERDRIVE" ARCHWIRES WITH RETROCLINE BRACKETS ATTAIN 3rd ORDER TORSION





NO TORSION ACHIEVED WITH DIMENSIONAL ARCHWIRES





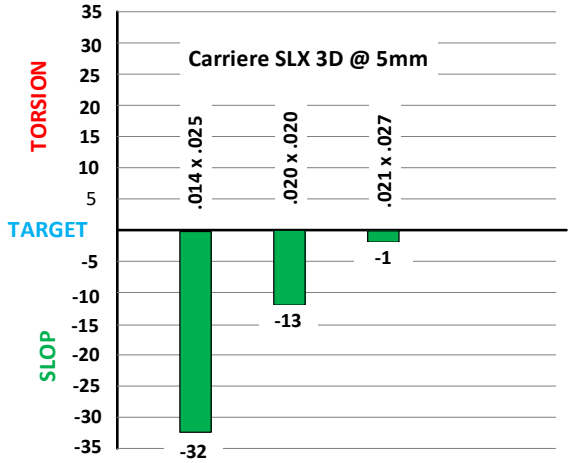
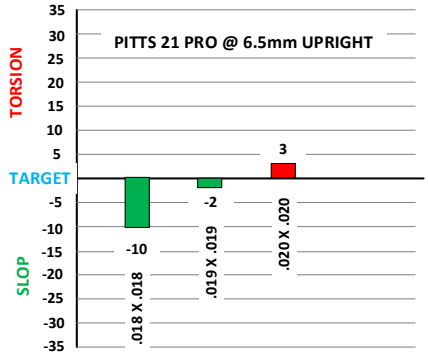
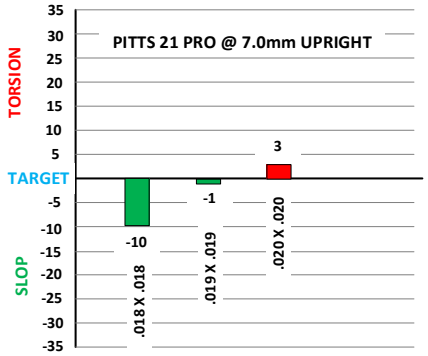
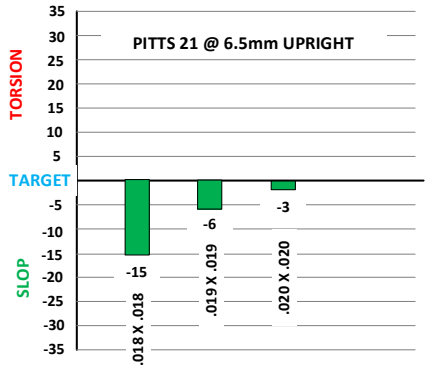


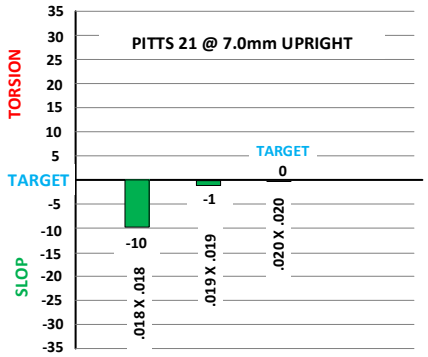
Table 2: Study Sample - Engagement Performance

PITTS21 - LOWEST SLOP & DELIVERS 3rd ORDER TORSION

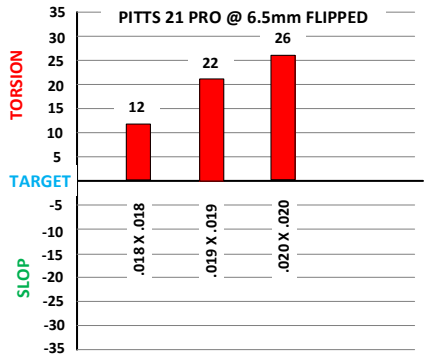


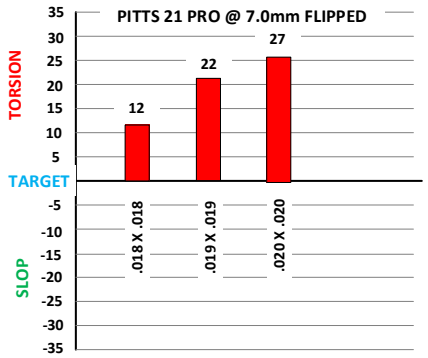


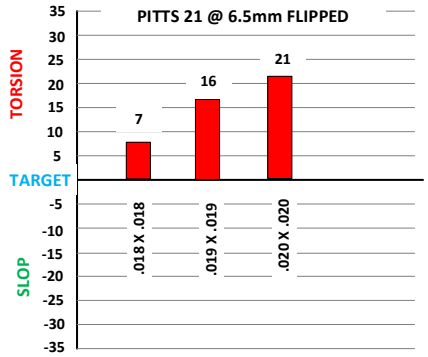


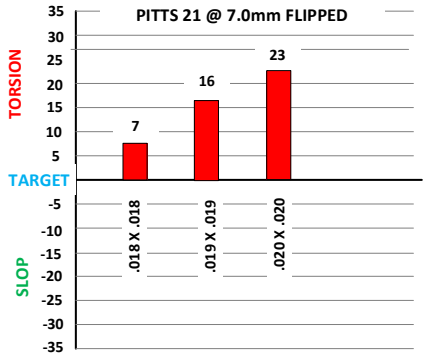


PITTS21 FLIPPED - IMMEDIATE 3rd ORDER TORSION









By looking strictly at "ENGAGEMENT" results, we can bypass much of the "THEORETICAL NOISE" related to brackets, wires and bracket position.

Table 2: Study Sample - Engagement Performance

Product	No. of Rx	Rec/Square AW Profiles	No. of Rec/Square AW to Target	No. of Rec/Square AW to Torsion	Timing to TARGET Months	Timing to TORSION Months	Bracket Inversion**
Pitts21	1	3	2-3 Upright	2 Flipped	2-3	2-3	Yes
Carriere SLX 3D	1	2	Never	Never	Never	Never	No
Damon Q2	3	3	Never	Never	Never	Never	No
Damon ULTIMA	3	5	4-5	4-5	6*	9*	No
Norris 20x26	1	3	Never	Never	Never	Never	No

* Damon ULTIMA retrocline
** As recommended by the manufacturer or KOL

Damon Q and Damon ULTIMA are registered trademarks of ORMCO. Carriere SLX3D is a registered trademark of Henry Schein Orthodontics. Norris 20/26 is a registered trademark of Dynaflex.

"Engagement Parameters" that Contribute to Clinical EFFICIENCY

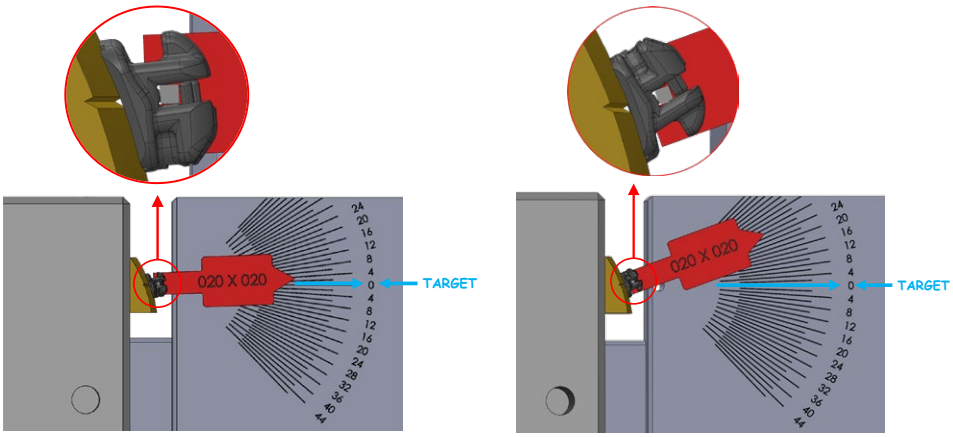
The parameters that Orthodontists desire in 3rd order control influence their preferred fixed appliance decisions.

More control can be attained in 3rd order movement with **FULLER** engagement of the wire/slot. The **"EARLIER"** engagement is initiated, the earlier the control can be attained. Dr. Pitts developed a very effective strategy using bracket inversion ("Flipping/Flocking")[5] to achieve effective lingual crown torsion in cases where it is indicated. The Pitts case management strategy of inverting the bracket introduces anterior torsion very early in treatment (Pitts case management with brackets flipped is extremely important to not get too much labial root torque).

Additionally, the bracket assembly and archwire system should deliver biologically active **"GENTLE FORCES"** that are comfortable for the patient. The **"RATE"** at which forces develop, and the ability for the clinician to **"ADJUST"** the force levels delivered to suit the patient's need, are also important considerations. By incorporating **"variable modulus"** orthodontic principles into archwire selections, it is possible to select the archwire alloy to deliver biologically active forces yet gentle in torsional movements[7] in fully engaged appliances.

Finally, the greater the **"SIMPLICITY"** of the mechanical system, the greater the likelihood of adopting the system. The Pitts21 system uses a single Rx that predictably delivers target/torsion earlier in treatment, and a full suite of 4 archwires profiles formulated with variable modulus alloys that is simple and requires minimal inventory. The variable modulus principle is an approach for force control developed by Dr. Charles J. Burstone. The principle allows archwire size to remain constant by selecting the appropriate archwire material to tailor the force output based on the clinical requirements. The Pitts21 square archwire cross-section is ideal for leveraging the benefits of the variable modulus principle.

PITTS INVERSION STRATEGY FOR LINGUAL-CROWN TORSION



Pitts21 Upright @ 5mm

Pitts21 Flipped @ 5mm

The Clinical Impact of The Study

The dataset is presented in a graphical format, with the X-axis being time in months and Y-axis representing **SLOP/TARGET/ TORSION** in degrees. Data points were arranged on the horizontal timeline using "anticipated" archwire insertion intervals by the manufacturer.

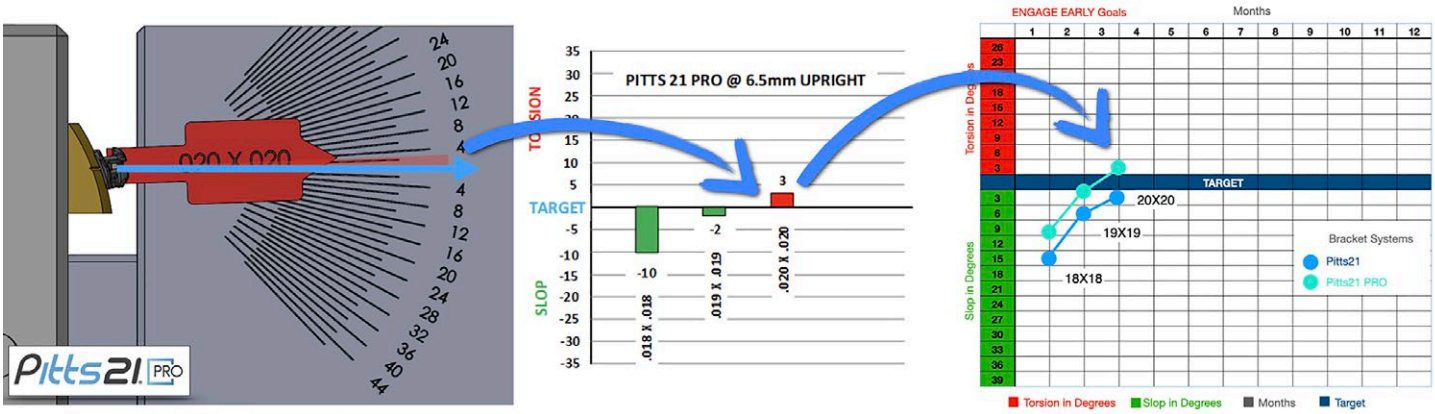


Figure 3: Data from Engagement Analyzer is plotted collated in Excel, then presented graphically to evaluate Clinical Implications

For simplicity, the results are discussed in the context of Pitts21/Pitts21 PRO versus the rectangular slotted Passive Self Ligating systems. The results demonstrate that the Pitts21 and Pitts21 PRO combined with the "Engage Early" archwire progression attains ENGAGEMENT (TARGET) earlier and delivers TORSION earlier than any rectangular PSL systems included in the study. This early ENGAGEMENT and TORSION have the potential to dramatically improve efficiency in a clinical setting.

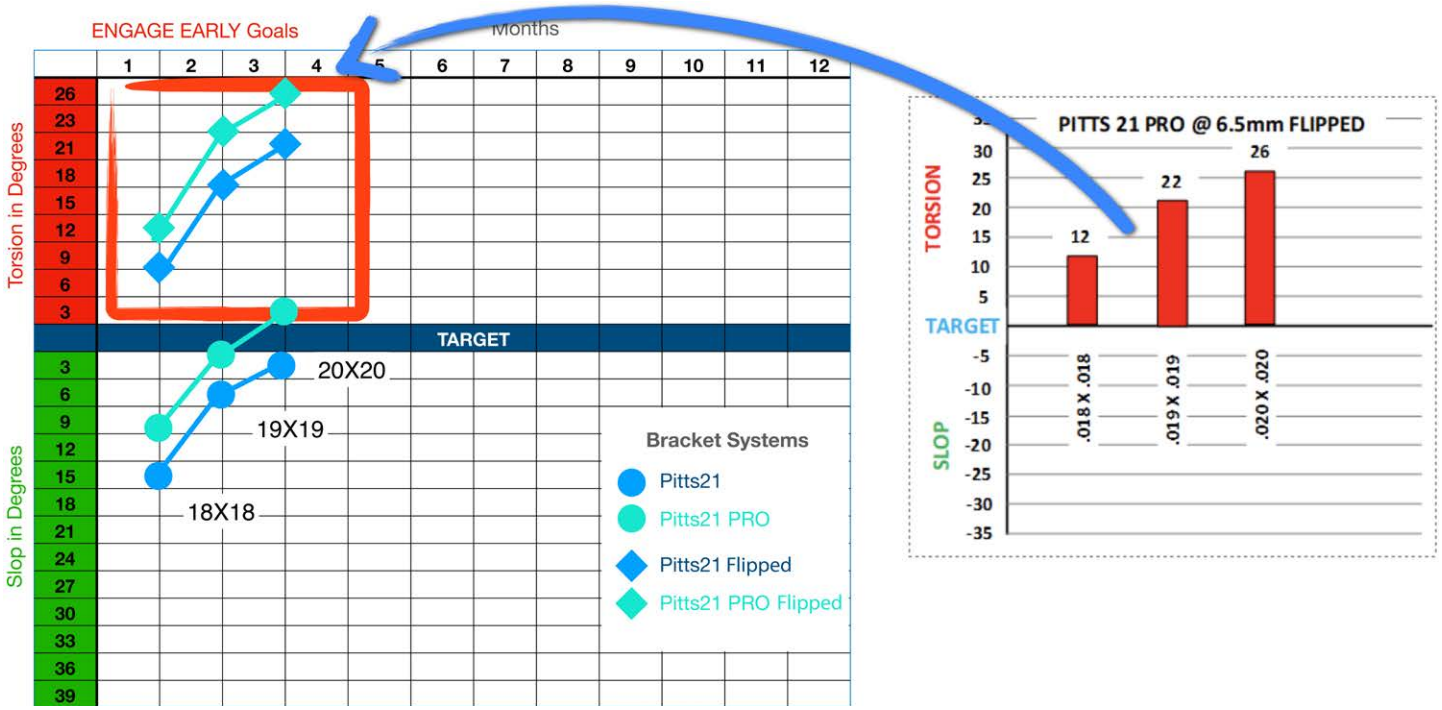
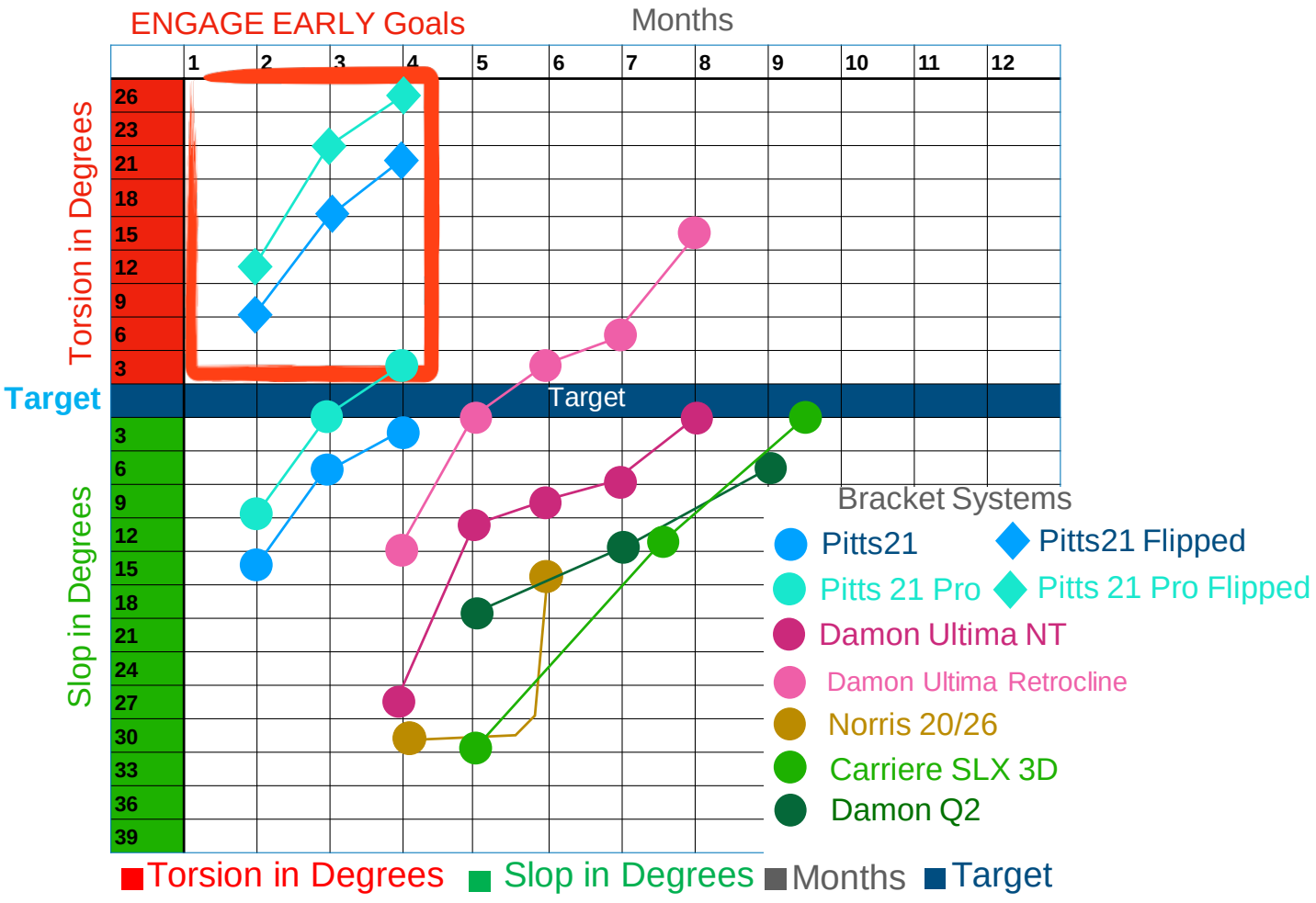


Figure 2: Pitts21 3rd order data set demonstrating target/torsion with the "Engage Early" archwire progression and Smile Arc Protection bracket placement

SUMMARY

- 8-12 WEEKS TO TARGET/TORSION
- INITIAL ENGAGEMENT SOONER
- FULL ENGAGEMENT SOONER
- TORSION MUCH SOONER
- GENTLE BUT EFFECTIVE FORCES
- GREATER SIMPLICITY



The Clinical Result - In-Vitro Findings Translated to In-Vivo Application

The following cases will demonstrate the clinical application of the concepts in the study.

Case 1: Dr. Wassim Bouzid

This beautiful young woman presents with minimal crowding and upright upper anteriors with a Class 1 malocclusion. Esthetic concerns of inadequate Vertical Incisal Display, inadequate Smile Arc, narrow Maxillary Transverse Dimension, and poor tooth proportionality. Upright upper incisor brackets controlled unwanted flaring with unraveling of crowding (Figure 1a, 1b). Smile Arc Protection bracket position, protected the smile arc with transverse arch development (Figures 2a, 2b, 2c). Beautiful artistic photography showcases a beautiful result (Figures 3a, 3b, 3c, 3d)

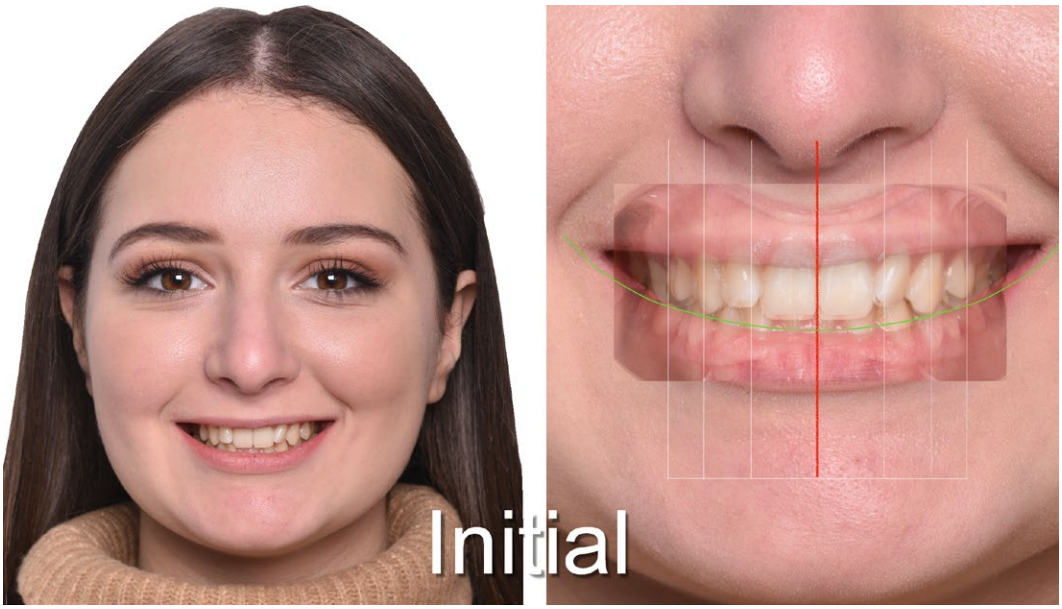


Figure 1a: Minimal Crowding, Flat Smile Arc, Inadequate Maxillary Transverse Dimension, No Gingival Display

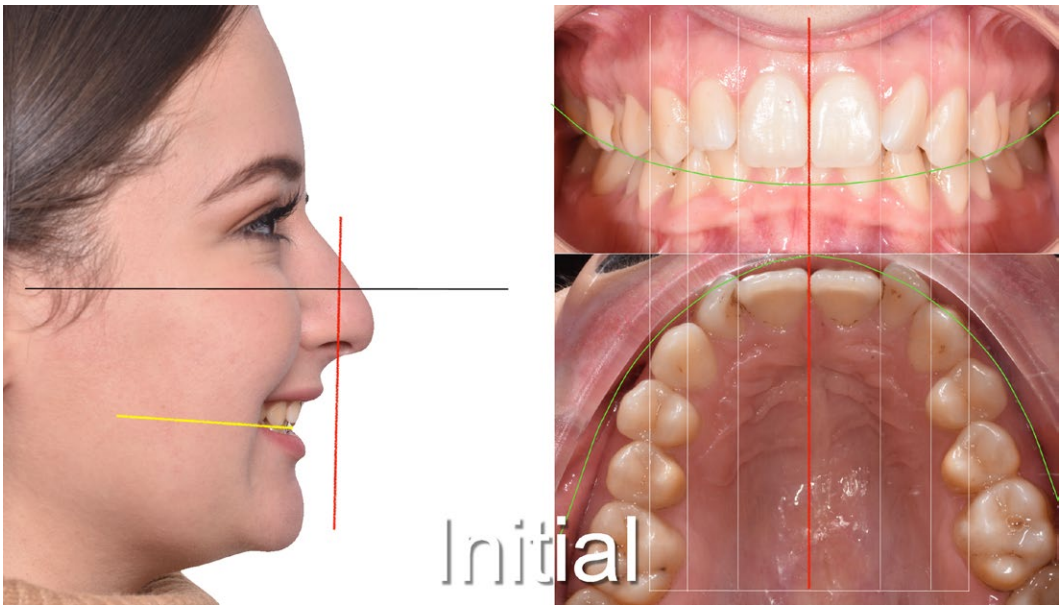


Figure 1b: Good Cant of Occlusal Plane, Retroclined Upper Incisors, Narrow Maxillary Transverse Dimension

PHOTO COURTESY: Dr. Wassim Bouzid

Figure 2a: Great progress, improved Smile Arc, beautiful flow

Figure 2b: Good esthetic progress, with improved Smile Arc, Maxillary Transverse Dimension

PHOTO COURTESY: Dr. Wassim Bouzid

Figure 2c: Greatly Improved Smile Arc

Figure 3a: Wonderful esthetic change

Figure 3b: Artistic photography showcasing a beautiful esthetic result

PHOTO COURTESY: Dr. Wassim Bouzid

Figure 3c: Artistic photography showcasing a beautiful esthetic result

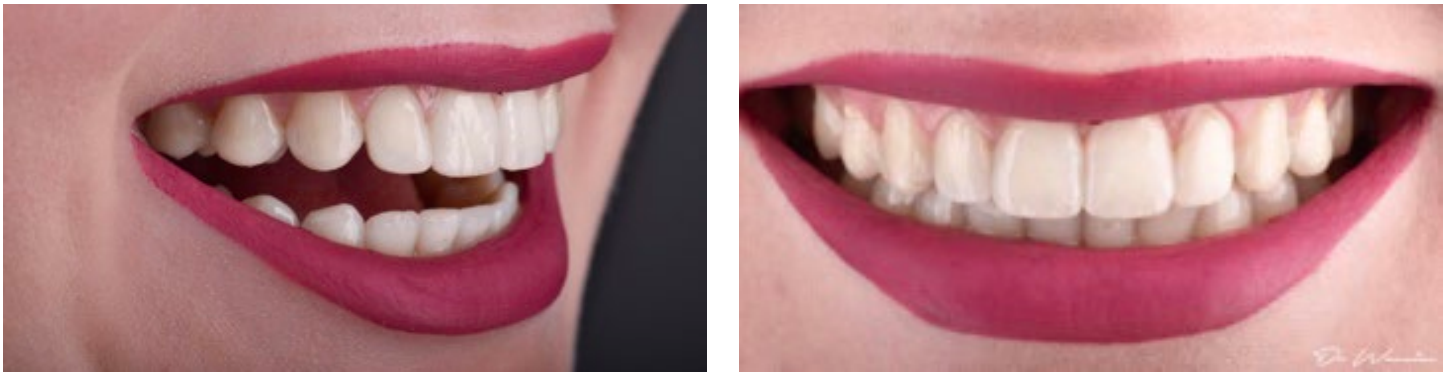


PHOTO COURTESY: Dr. Wassim Bouzid

Case 2: Dr. Duncan Brown

This lovely adolescent presents with Anterior Open Bite, moderate crowding, class III tendency, and proclination of the upper incisor. Esthetic concerns of lack of Smile Arc, inadequate Vertical Incisal Display, no Gingival Display, flat Cant of Occlusal Plane, and incisor proclination (Figures 1a, 1b, 1c). Inverting the upper anterior brackets ("Flipping") created torsion within the appliance very early in treatment, and the Smile Arc Protection++ bracket position, posterior disarticulation, and Immediate Light Short Elastics, Through The Bite class III, and anterior rainbow elastic, contributed to improvement in Smile Arc, and Cant of Occlusal Plane (Figures 2a, 2b, 2c). Improved Smile Arc, Maxillary Transverse Dimension, Gingival Display, and flow resulted in greatly improved esthetic presentation. Improved Cant of Occlusal Plane, and axial inclination, combined with improved Maxillary Transverse Dimension produced a great esthetic result (Figures 3a, 3b, 3c, 3d, 3f, 3g).

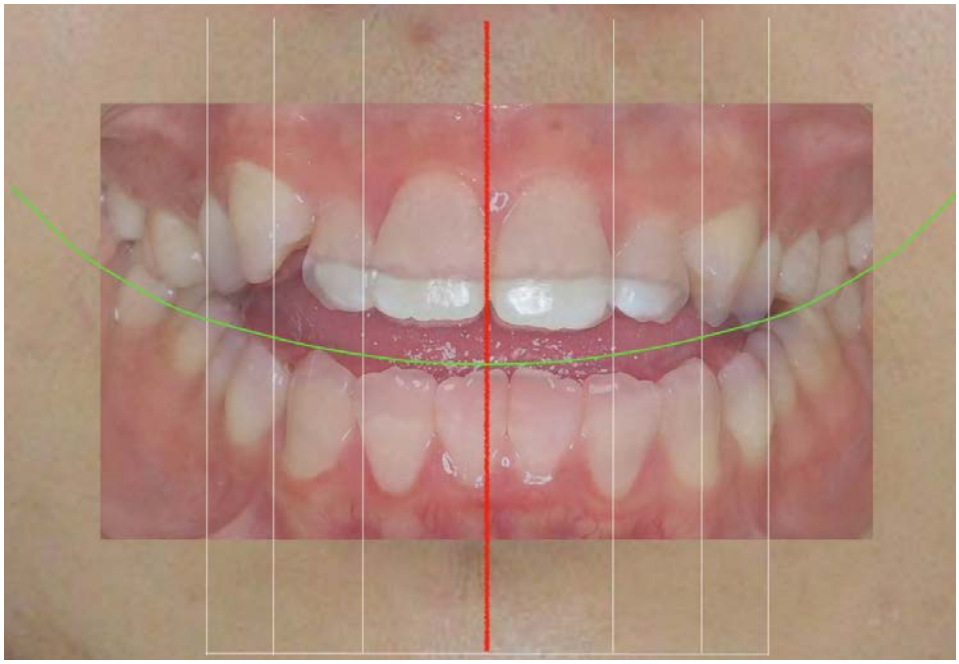
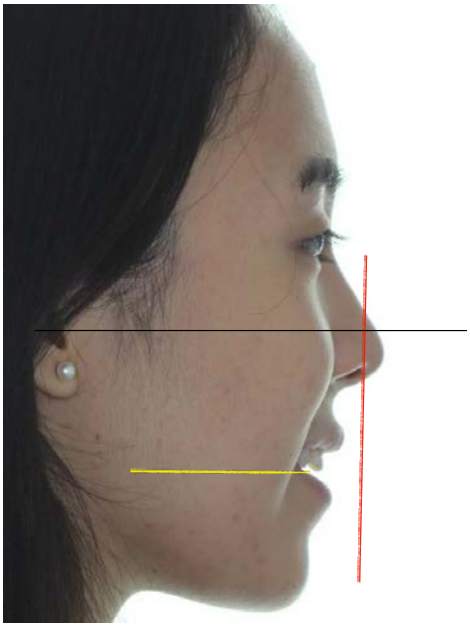


Figure 1a: Significant crowding, inadequate Vertical Incisal Display, no Gingival Display, inadequate Smile Arc



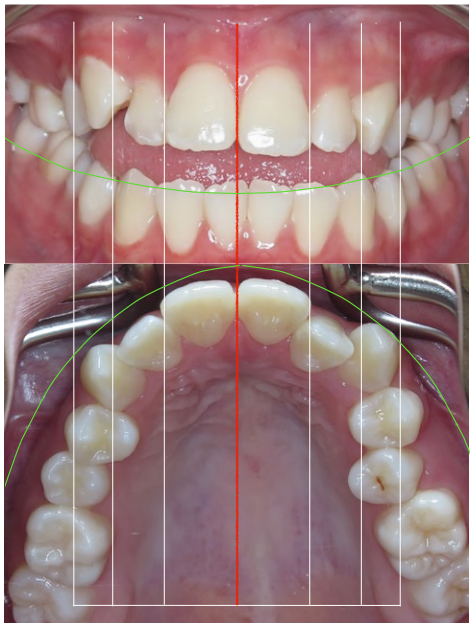


Figure 1b: Crowding, proclined incisors, flat Cant of Occlusal Plane

Figure 1c: Proclined upper incisors, flat Cant of Occlusal Plane, inadequate Vertical Incisal Display

PHOTO COURTESY: Dr. Duncan Brown

Figure 2a: Progress in Vertical Incisal Display and Smile Arc

Figure 2b: Improved Cant of Occlusal Plane and upper incisor inclination

PHOTO COURTESY: Dr. Duncan Brown

Figure 2c: Improved Smile Arc

Figure 3a: Very nice esthetic change, improved Smile Arc, Gingival Display, Maxillary Transverse Dimension, and flow

PHOTO COURTESY: Dr. Duncan Brown

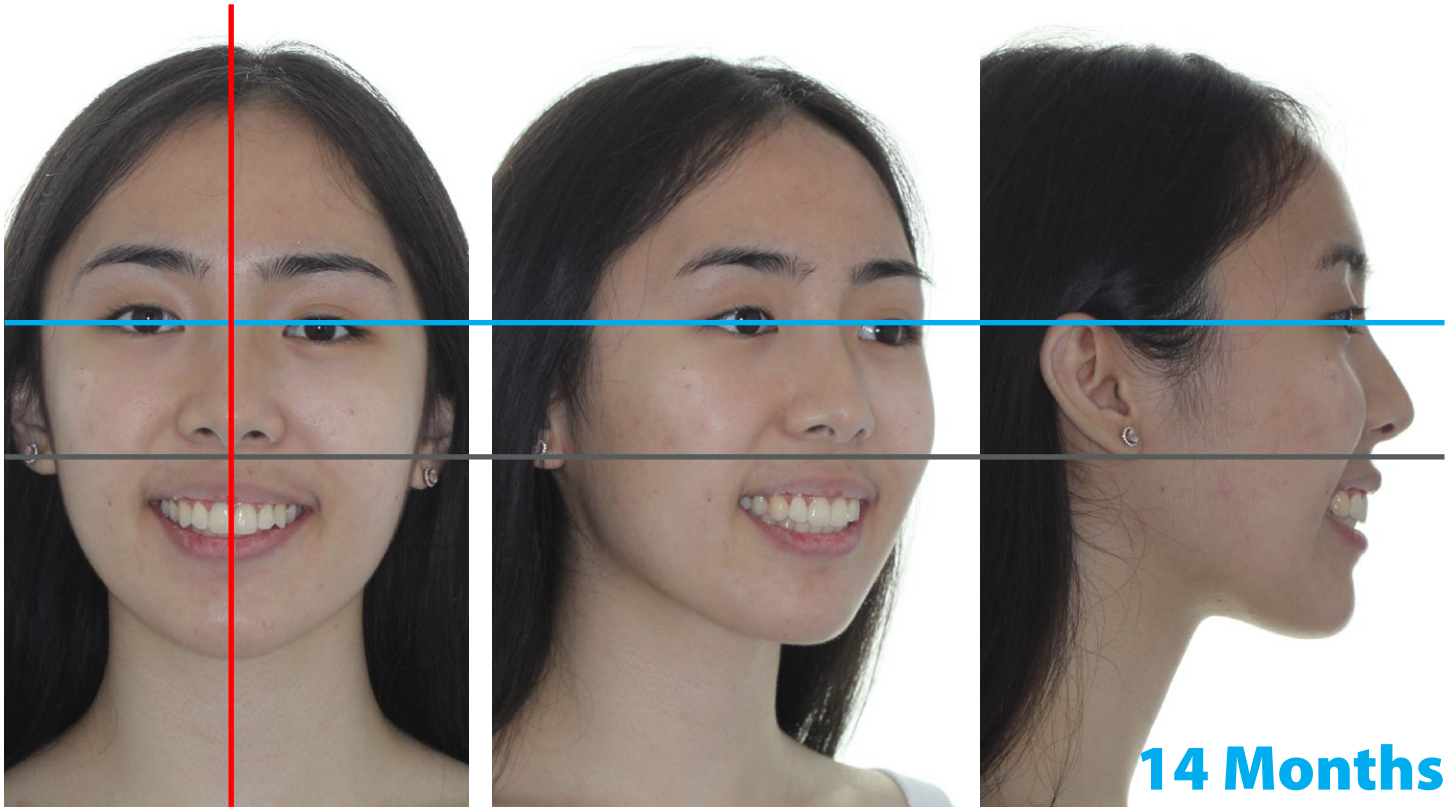


Figure 3b: Very nice esthetic change, improved Cant of Occlusal Plane and idealized axial inclination

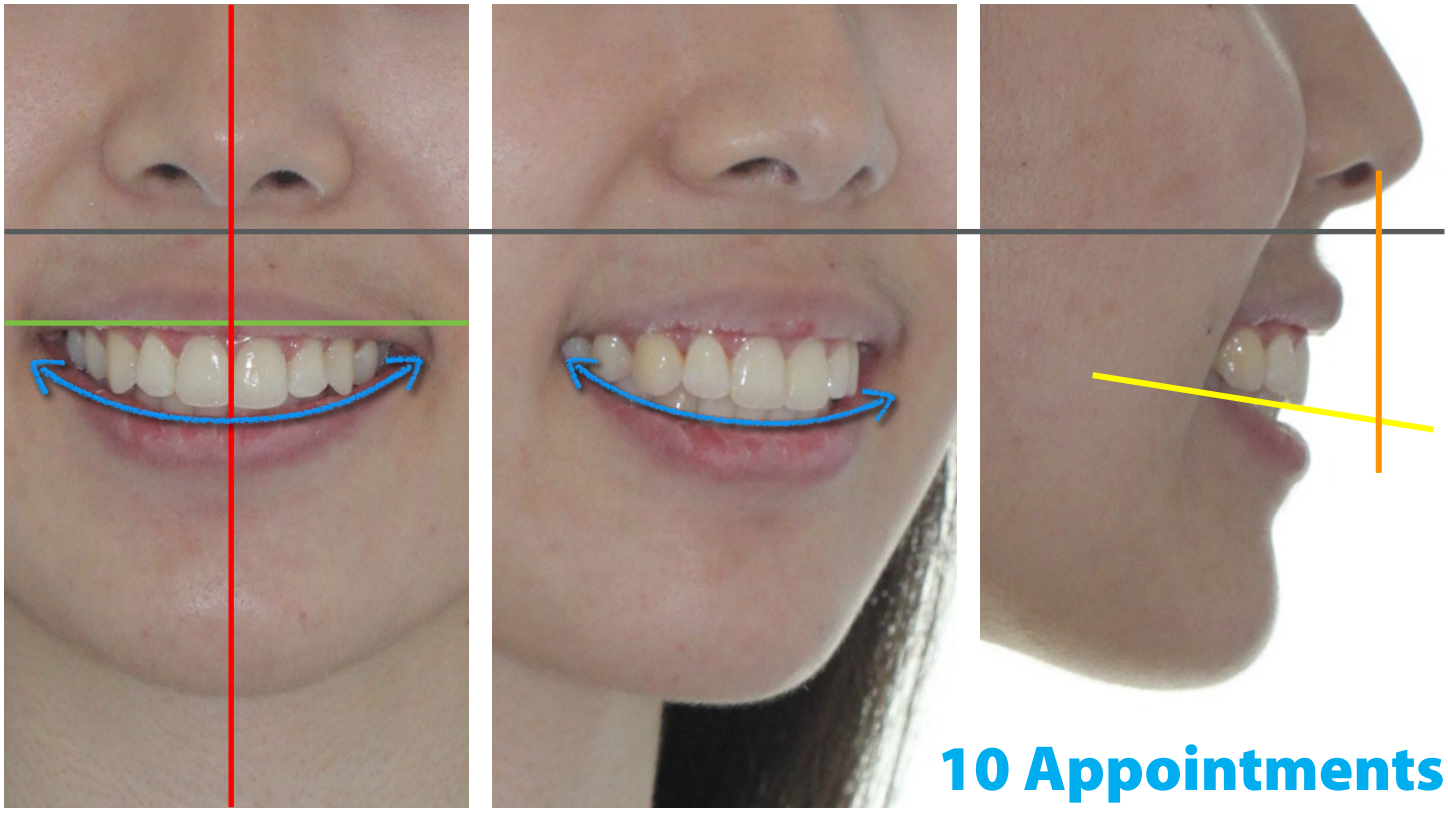


Figure 3c: Esthetic tooth positions post-treatment

PHOTO COURTESY: Dr. Duncan Brown




14 Months

Figure 3d: Greatly improved occlusion

Final

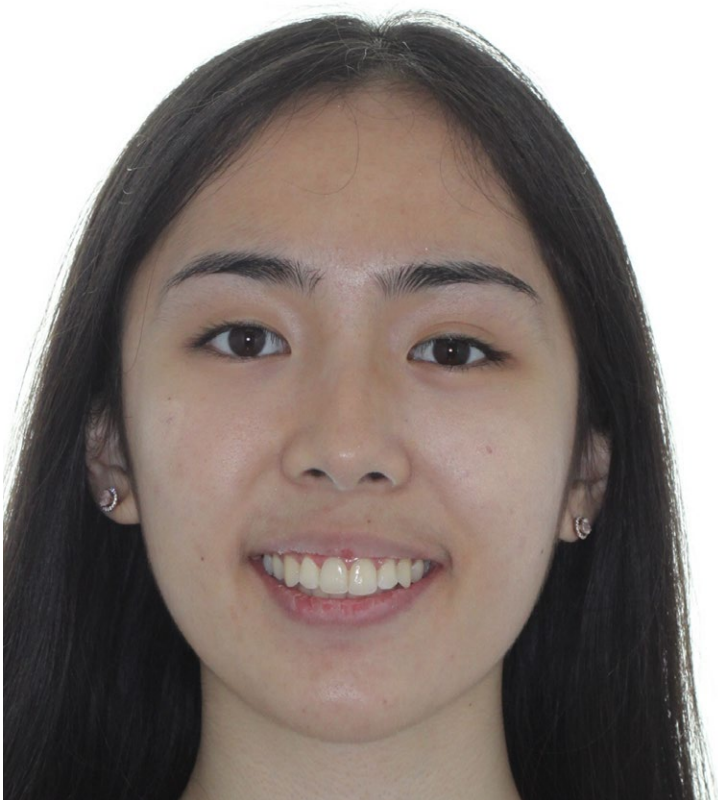
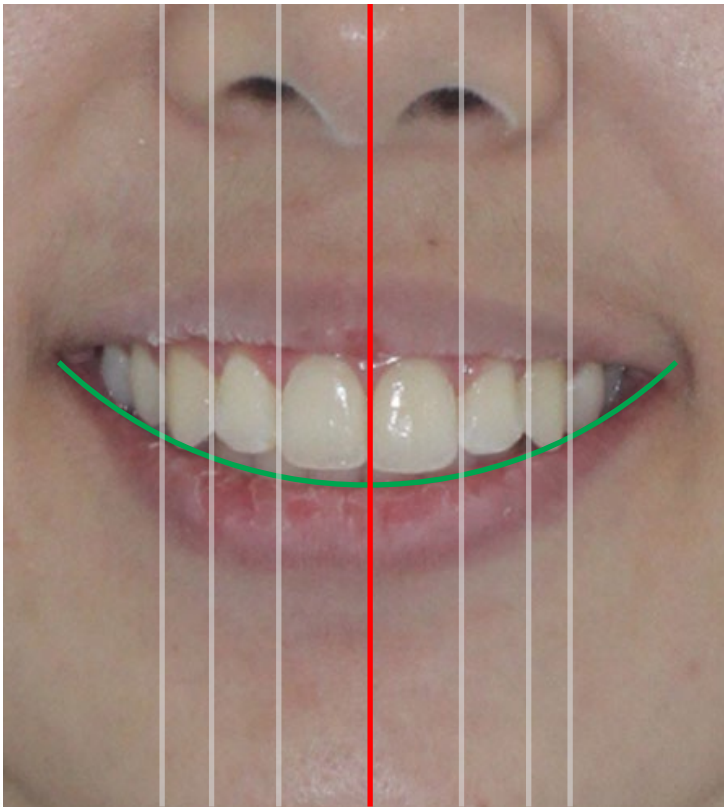



Figure 3e: Greatly improved smile esthetics

PHOTO COURTESY: Dr. Duncan Brown

Final

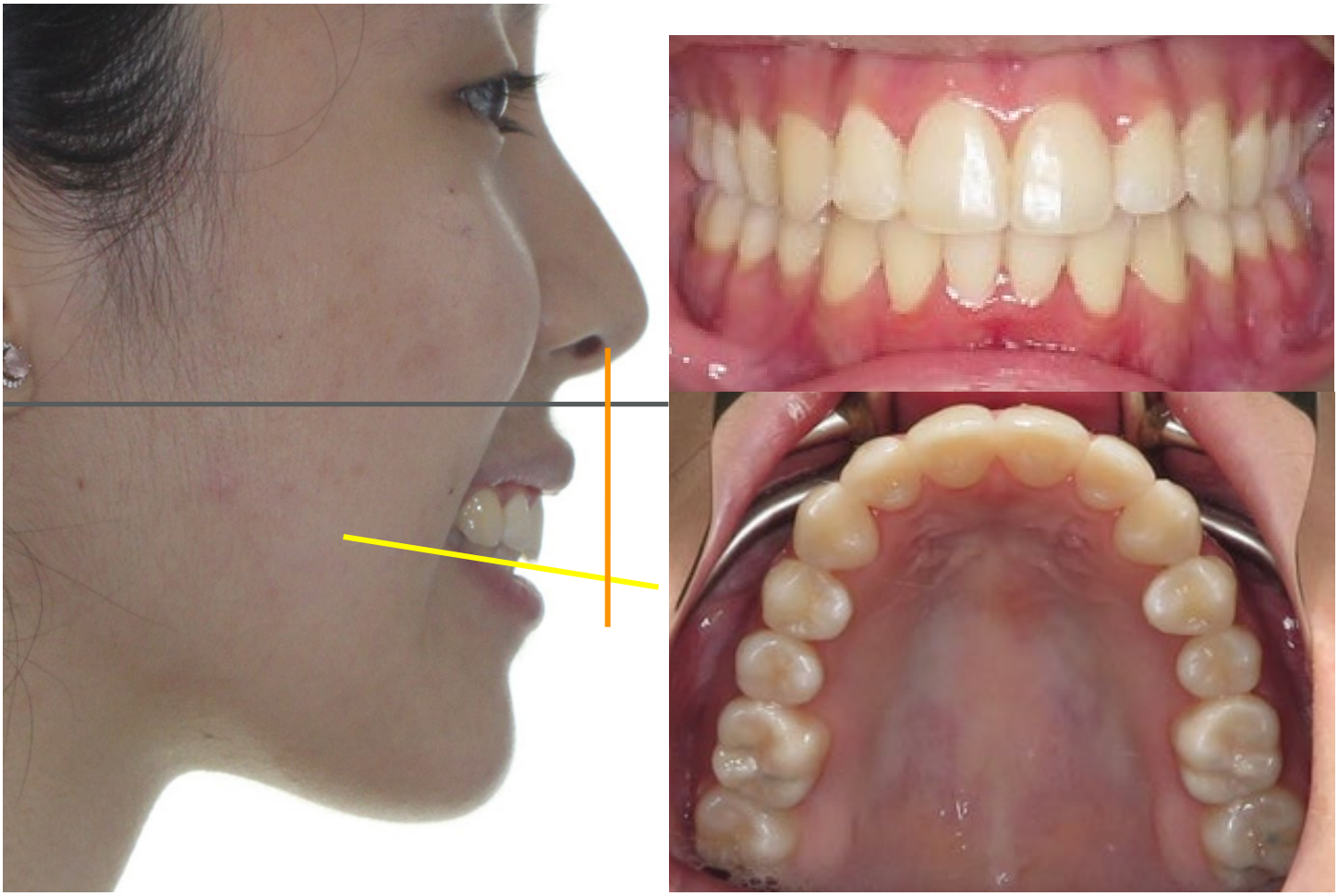


Figure 3f: Greatly improved axial inclination, Maxillary Transverse Dimension, flow, and tooth proportionality

Conclusions

In-vitro testing confirmed that use of Pitts21/Pitts21 PRO appliance system, the “Engage Early” archwire progression strategy, and Pitts “Active Early” case management approaches can afford significant clinical benefit to Passive Self Ligating users in terms of control of axial inclination in anterior teeth. Future studies will investigate characteristics of the Pitts21/Pitts21 PRO system with respect to torsional control in the buccal segments, and the nature of the torsional forces developed.

PHOTO COURTESY: Dr. Duncan Brown

Dr. Tom Pitts

Dr. Duncan Brown

***Fuller** early **engagement** with **gentle** and **biologically active forces** are the gateway to a streamlined process for outstanding clinical results. The **Pitts21** unique appliance and Protocols provide a simple single-prescription system that delivers the critical elements for a simplified process with exceptional clinical outcomes.*

Pitts21 PRO

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