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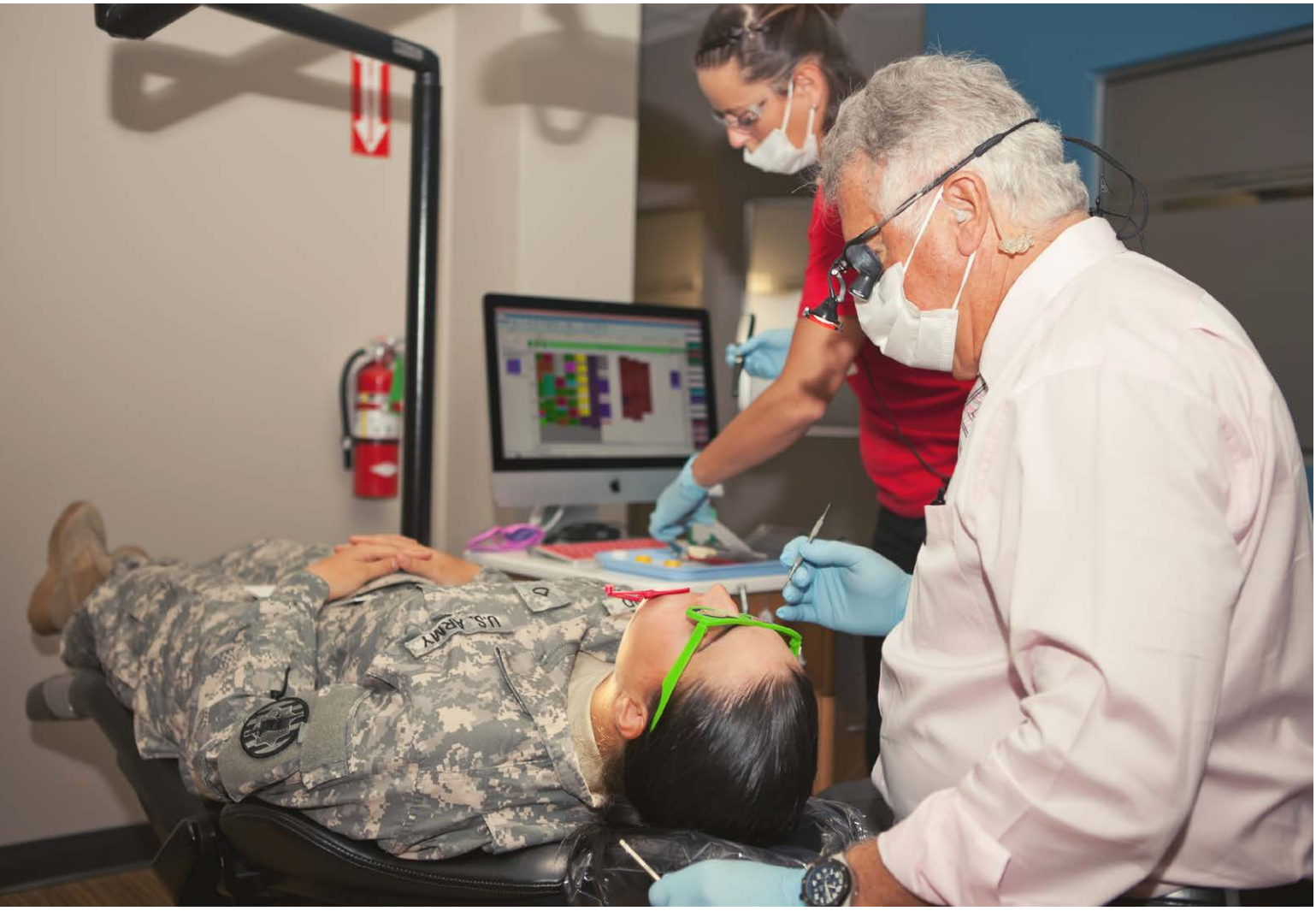
orthodontics



"The 14 Keys to Pitts Case Management"

"We are what we repeatedly do, excellence, then, is not an act but a habit" - Aristotle

Introduction:

How many times in your career have you come back from a course having seen and heard some wonderful things that you wanted to implement into your clinical procedures, only to find out when you got home that putting them into practice was very difficult. Very shortly, you reverted to old habits, and all the "value" you thought possible was lost. Inspirational speaker and self-help author, Tony Robins is correct when he says, "I know lots of people who know what to do, but fewer that do what they know".

Today's orthodontic patients consistently demand more than "just straight teeth". While "putting the plaster on the table" is now generally acknowledged as not being representative of the best orthodontics has to offer, the reality of everyday practice confirms that esthetic decline is quite common with treatment[1], and patients want treatment time to be a short as possible.

For years I have tried to simplify diagnostic processes and case management strategies allowing the Orthodontist to attain greater consistency in delivering optimal esthetic and functional occlusal results. This requires that the Orthodontist expand his/her diagnostic and mechanical understandings beyond reliance on improved "straight wire" appliances to attain superior esthetic results. David Sarver has made great contributions by painting an accurate picture of todays desired facial and smile esthetics and the impact on esthetics of orthodontic treatment mechanics. I also agree with his concept on placing the position of the upper incisor as the prime diagnostic criteria in developing superior esthetics[2].

Today I would like to develop the context for the pivotal role of case management in attaining superior esthetic and occlusal results, and suggest strategies for application of simple case management practices that provide consistent improvement in esthetic and functional outcomes during treatment.

The Pivotal Role of Case Management:

Treatment planning is one of the milestones of every Orthodontist's training. Large amounts of time and energy can be devoted to the evaluation of "static" records, like model analysis for crowding, cephalometric evaluation of potential growth direction, positions of the teeth

Pitts Case Management Principles

Figure 1

and skeletal bases, traditional "closed mouth" facial photographs for soft tissue positions, VTO's for potential tooth movements, and mounted models for CO/CR discrepancies. Once a doctor has been in practice for a while, and comes to appreciate the dynamic aspects of patient care, the value of these "initial planning exercises" change, and value of sound case management practices comes into play *(Figure 1)*.

The finest "artistic" orthodontic results are produced by the best case managers regardless of the appliances they use. This is because these clinicians clearly understand the technology they use on a daily basis, and apply clinical opportunities that are available to address specific patient clinical needs. In addition, these special orthodontists are not stymied by the "stability" ball and chain in their treatment protocols.

"Active Early" Case Management Core Principles:

For years Orthodontists have desired to gain control of axial inclination earlier in the treatment cycle. However limitations imposed by the traditional application of "straight wire theory", where torsion is created through incremental increases in wire dimension occur late (if at all) in the treatment cycle make it nearly impossible[3]. By using certain protocols, orthodontists are now able to remove that limitation.

Applying appropriate levels of technology to an "artistic" end result creates many positive opportunities. If I want to "activate" the appliance and treatment as early as possible, I can use the SAP[4] bracket position to adjust the vertical position of the incisors, invert groups of brackets to activate the appliance, select arch wire progressions that control axial inclination early in treatment, use arch forms that develop the posterior segments of the arches sooner, implement "ELSE" (Early Light Short Elastics) to control forces, and appropriate disarticulation to encourage early "wanted" tooth movements. This is known as an "Active Early" approach to case management[5].

Clinicians have been trying to explain the "stages of clinical management" for years, usually without broad success. In our case management approach[5] the treatment cycle is conceptualized as occurring in two stages based on clinical management opportunities available during the stage *(Figure 2)*.

First Stage:

Where either round or non-adjustable dimensional wires are used. The goal during the first "Active Early" stage of treatment is to achieve the majority of your occlusal and esthetic goals for the patient. Clinical management opportunities focus on adjustment in bracket position, adjustment of ELSE patterns, refinement of disarticulation, adjustment in tooth morphology with positive and negative coronoplasty, slenderizing, use of auxiliaries (TAD's for example) to control anterior and posterior tooth movements and NMI (neuromuscular intervention) as appropriate. With our protocols, we now begin early arch width development, leveling, torque control, AP and early vertical development. This stage lasts until the Pan/Repo appointment (PRACM). This is described by Dr. Jim Morrish of Bradenton Florida as Panorex Reposition, Adjust Case Management. In my experience, this commonly occurs around the 4th appointment, after some degree of torsion improvement and arch development in non-adjustable dimensional arch wires has been attained *(Figure 4)*. At PRACM, adjustments in bracket position, bracket torque (upright/flipped), ELSE, disarticulation, need for tooth re-approximation, or a modification of mechanics (decision to extract, TAD placement, etc.), based on a definitive review of the case progress are made *(Figure 5, 6)*.

Most traditional orthodontics is taught on the basis of "sequential mechanics", where one mechanical goal is addressed after the preceding goal is attained (transverse development, level/align, overbite correction, occlusal correction). One of the reasons I enjoy using a PSL appliance like H4 self-ligating bracket from OC Orthodontics, is that many of these clinical managements aspects can be approached "simultaneously", resulting in significant gains in treatment efficiency. This "simultaneous mechanics" approach to addressing esthetic and functional treatment goals is a pivotal feature of "Active Early" *(Figure 3)*. Significant occlusal gains in alignment, OB correction, and A/P correction, are combined with improvements in smile arc creation, transverse arch developments, and axial inclination improvement occurring quite early in the treatment cycle, usually by the 4th appointment.

Another hallmark of "Active Early" is the continuous assessment of progress that is occurring towards both esthetic and functional goals as treatment progresses. I encourage the broad adoption of an

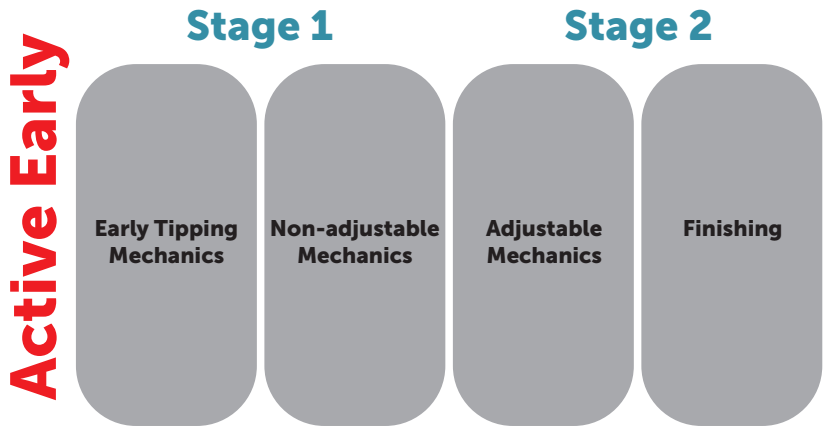


Figure 2

"every patient/every appointment imaging approach" as a discipline in improving continuous case progress assessment. The collateral marketing and patient education benefits of imaging are so great that even staff members who are initially concerned with the extra effort, are soon converted to raving fans! None of the clinicians I know that have adopted this discipline, have ever regretted the effort.

Second Stage:

After PRACM, where adjustable dimensional wires are used, the goal is the refinement of the esthetic and occlusal aspects leading to optimal results most appropriate for the patient. Clinical management opportunities focus on overcorrection, AW adjustment for occlusion and esthetic refinement, tooth size adjustments for either esthetics or anterior/cuspid guidance, optimization of the occlusion through occlusal adjustment (CO=CR), and refinement of mini-esthetics of hard and soft tissue.

The Goal: Better Results Through Simple Concepts, Trainable Skills

My goal in clinical teaching has been to simplify complex concepts into contemporary treatment protocols that can provide significant advantages in the treatment of most orthodontic cases. While some features of a patient's clinical outcome cannot be determined by orthodontics, many are able to be directly influenced by the Orthodontist. In an "Active Early" approach, I encourage clinicians to focus on the clinical opportunities they can control. In my experience I have identified several clinical approaches that positively affect the quality of the end result: "The 14 Keys to Pitts Case Management".

The next section will introduce some of these important concepts and clinical opportunities that Orthodontists can use to improve their clinical results. These will all be discussed more fully in subsequent "white papers".

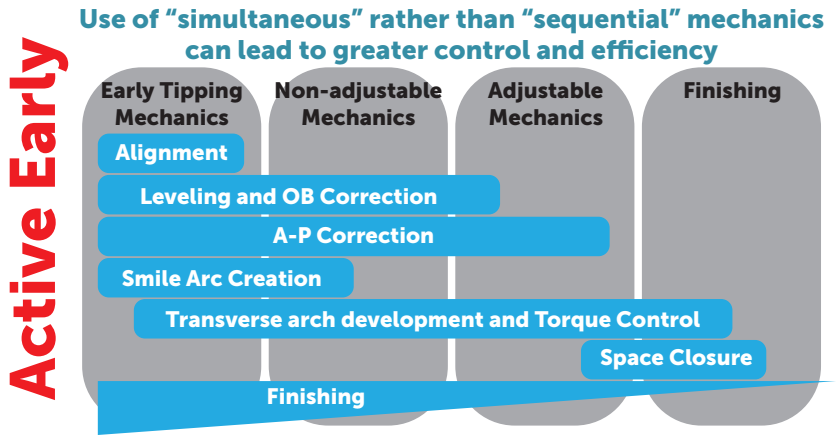


Figure 3

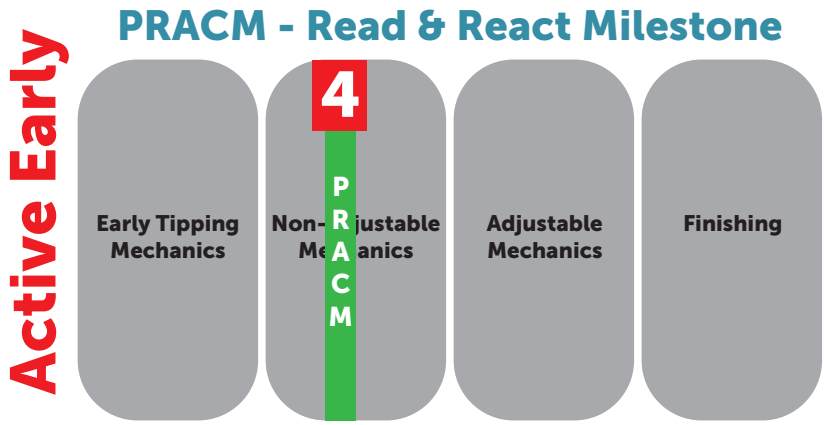


Figure 4

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Initial Smile Close Up

Progress Smile Close Up

Figure 6

Stage 1: the first of the 14 Keys to Case Management

In a conventional "straight wire" approach to treatment, all early tooth movements involve tipping, and in most approaches very limited control is afforded to the Orthodontist. In contrast, in the "Active Early" approach a good deal of control is available through a number of clinical opportunities even when using non-adjustable wires. Most obvious among them are:

1. Positive and Negative Coronoplasty: Patients today want beautiful faces, beautiful smiles, and beautiful teeth; meaning teeth need to be "optimized" for shape and contour. Prior to bonding, esthetic re-contouring improves the ability to place brackets in the appropriate location to maximize the smile arc, optimize axial inclination, and control 1st and 2nd order changes during tipping or early torsion mechanics. Softening the cusp tips of the cuspids and first bicuspids, normalizing facial irregularities, and optimizing length/width ratios of the upper anterior teeth is critical to optimum bracket placement through either positive or negative coronoplasty. All surfaces that have been adjusted are smoothed with a white stone and black rubber tip using a high speed hand piece.

2. "SAP Bracket Position[7]" as a tool in gaining optimal esthetics: Bracket position is individualized to meet patient esthetic need. In patients with "flat" occlusal planes or those that require increased enamel display, the progression of the wire plane, created by bracket position, must increase to develop the smile arch by extruding the upper incisors relative to the upper bicuspids (Figure 7, 8). In patients with normal occlusal planes a more modest progression in the wire plane is still advisable to protect the smile arc as the upper arch broadens with treatment. A modest progression in still advised in deep bite cases to avoid excessive reduction in smile arc with reduction in overbite. It is important to remember that large bracket progressions in the upper arch must be compensated for by over-leveling the lower arch to establish optimum overbite relationships. A number of articles on the SAP technique have been published in recent years[6,7,8] and SAP bracket positioning is now being employed regularly around the world.

3. "Bracket and Torque selection", Why I love the H4 Passive Self-Ligation by OC Orthodontics: With practitioners attempting to treat more cases without extractions, control of proclination of the upper anterior teeth has become a greater challenge. Frequently the technical challenge is getting enough lingual crown torque without having to resort to complex wire bending to attain esthetic results. "Low torque" Rx's endorsed by some PSL bracket producers have not met these needs for me[9]. One of the reasons I prefer the H4 appliance is that the Rx is predictable when upright, and appropriate when flipped, providing greater lingual crown torque to the central when up-righting of the anteriors is required (Figure 9). When using "flipped" anterior brackets, we encourage the patient to be seen every 6-7 weeks to assess progress and palpate and the upper anterior alveolus. Once ideal axial inclination is attained, the appliance can be "deactivated" simply by reducing the arch wire dimension or adjusting the 3rd order bending. Note that it is important to use Beta Titanium arch wires no larger than 19x25 when using "flipped" appliances.

4. "ELSE" - Early, Light, Short, Elastics: I have advocated use of early light elastics for the past 20 years, especially when using PSL mechanics. Sabrina Huang, a close friend of mine from Taiwan, suggested the acronym some years ago, and I continue to describe the technique in those terms. The use of ELSE (no more than 2.5 oz.) increases the efficiency of treatment dramatically by maximizing "wanted" tooth movements in all dimensions, and minimizing or mitigating "unwanted" tooth movements during the tipping or early torsional phases of treatment. Patient cooperation is critical, and reinforcing early progress through "every appointment" photography is very useful. John Campbell describes the use of ELSE to his patients as, "24 hour elastic wear is not part of your treatment, it is your treatment".

5. "Disarticulation" - bite turbos, or occlusal pads as a tool in increasing effectiveness of ELSE: PSL mechanics are broadly appreciated as using minimal RTS (resistance to sliding), in conjunction with low forces. By encouraging "wanted" tooth movement and removing the forces of occlusion that perpetuate the malocclusion, disarticulation contributes to the effectiveness of early mechanics. Adjustment to the disarticulation is made when required. This eases TM joint loading.

6. Arch Wire Selection and Progression - as a tool in controlling axial inclination early in treatment: Traditional straight wire application relies on incremental increases in arch wire dimension to gradually develop 1st, 2nd, and 3rd order control. The reality is that this approach is not very effective, encouraging many to reconsider the basic premises of straight wire theory[10]. One of the distinguishing features of the "Active Early" approach is the adaptation to "slop" that is present in all straight wires appliances. Through tested case management practices, appliances, and wire selection we can now negate the adverse effects of "slop". It has never made sense to me to start with arch wire forms that are narrower than the case needs to finish esthetically. Working with OC Orthodontics, we have created a full suite of arch wires that develop the arches transversely from the outset, through the whole of the buccal segments (Pitts Standard, Pitts Broad), where research has shown that a great amounts of transverse development occurs[11] (Figure 10). In order to help early torque control, i2, i3 Leashes - are used as a tool of controlling axial inclination early in treatment: The "rediscovery" by Daniela Storino and other believers of placing incisal "leashes" of elastomeric chain to minimize unwanted tipping of teeth during the relief of crowding is proving very helpful, especially in cases where the anterior brackets have not been "flipped".

7. Patient Motivation - as a tool of controlling axial inclination early in treatment: Everything depends on the patient being a full partner in attaining their best esthetic result. Whether it is 24 hour elastics wear, modification of sleep patterns, or doing "PT" exercises, it is important to educate the patient or their parents on their critical participation in the process. Larry White has correctly identified overall compliance as the "Achilles heel" of our profession[12], and the inadequacy of traditional approaches to change that dynamic. It is critical to have a collaborative relationship with patients in their treatment, to celebrate what they have accomplished, and what their new "possible self" holds for them. This goes beyond "mere cooperation" and beyond the health benefits of orthodontics into the social and psychological benefits of treatment.

8. NMI - "neuromuscular intervention" as a tool in improving results: The control of habits and behaviors that may be detrimental to treatment progress is generally appreciated as critical. By intervening in noxious breathing patterns (SDB sleep disorder breathing, sleep apnea), and noxious muscular behaviors (lip hypotonicity, swallowing patterns, digital habits, lip biting, postural concerns, sleep patterns) the quality of treatment can be improved.

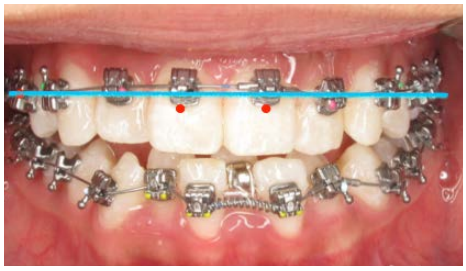
9. "PRACM" - the critical "read and react" milestone: If adjustments to bracket position or major mechanics are required to bring the case to an esthetic conclusion, non-adjustable wires are replaced and Stage 1 clinical opportunities continued. If a significant number of brackets have been repositioned or "flipped", it is usually wise to replace the same size non-adjustment wire for one treatment interval.

Stage 2 - Clinical Opportunities

If the Stage 1 response to treatment has been favorable, Stage 2 adjustments are directed towards refining the occlusion and optimizing the esthetic result. There are a number of clinical opportunities available in Stage 2:

10. Arch Wire Adjustments - As a tool of controlling axial inclination, arch form, and transverse arch development: The "10 tooth smile" has represented the gold standard for dental ethics for years. Today many excellent students of dental esthetics prefer a "12 tooth smile" esthetically[13], and I agree with them. Due to the fact that the arch form is directly related to the shape of the wire used and not the bracket system the orthodontist decides to use[14], I do not use "standard arch blanks" but shape

SAP Bracket Position



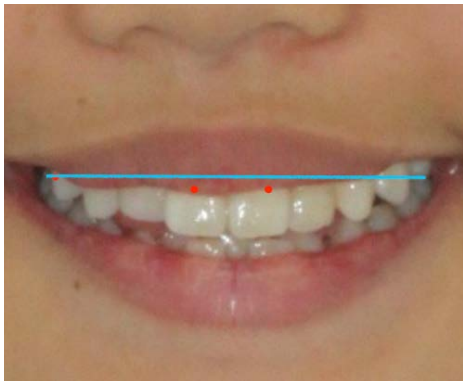


Figure 7

7 Months

4 Appointments

Figure 8

Torque	U1	U2	U3	U4	U5
Normal	+12	+8	+7	-11	-11
Flipped	-12	-8	-7		

Torque	L1	L2	L3	L4	L5
Flipped	+6	+6			
Normal	-6	-6	+7	-12	-17
Flipped			-7		

Figure 9

bendable arch wire to optimize posterior arch development for esthetics. Palpation of the buccal and lingual alveolar processes at each appointment is required to ensure that the patient's "biological availability"[5] is not compromised.

Arch forms have tended to be too flat anteriorly, too broad through the cuspid and first bicuspid, and too narrow through the second bicuspid and molars. I found that bending of adjustable arch wires was unavoidable. I have worked with OC Orthodontics to produce arch forms that mimic a shape that provides superior esthetics; OC Orthodontics's Pitts Standard and Pitts Broad arch forms. I typically use the "Broad" Arch form on all cases from the first bracketing. The only exception is when I have a narrow upper arch combined with a wide lower arch. Then I will use a "Standard" on the lower arch. Research has shown that as much posterior arch development occurs in round wires as occurs in dimensional arch wires[21], and that is why the Pitts form is available in the same arch form for round, square, and rectangular wires. This feature facilitates an "active early" approach to transverse arch development with a greater degree of torsion control whether using familiar wire progressions or when using OC Orthodontics's H4 appliance.

Where unadjusted nickel-titanium or beta-titanium arches have not optimized axial inclination, the practitioner can use shapeable beta-titanium arches for minor corrections (Figure 11). Stainless steel wires are available, however in the "Active Early" approach, I usually only use stainless steel arch wires for extraction cases. We teach necessary posterior torque control in our courses.

11. "Overcorrection": as a tool of controlling rebound: With it being generally conceded that permanent retention is a requirement of orthodontic stability, the role of "overcorrection" as a means of guiding the treatment result to a satisfactory conclusion has become more important. In our Masters training program, we spend considerable effort clarifying this complex challenge, but in essence it is advisable to overcorrect A/P, vertical, and transverse discrepancies for period of time, and then discontinue major mechanics as the occlusion adapts to the revised neuromuscular environment. With the improved tolerances of the H4 bracket system, I have found that there is less need for overcorrection of individual rotations.

12. "CO=CR": as a tool in supporting long term joint health: I treat cases to CR whenever possible. There has been much discussion of how to best attain this goal. I have gravitated towards a Peter Dawson style approach[15] for manipulating the mandible as something that is reproducible, relatively simple to do, and broadly applicable during the course of treatment. One important aspect of this technique is "bi-manual manipulation" of the mandible as a means of disclosing CO/CR discrepancies, occlusal interferences, and centric "slides" prior to or during treatment. Mandibular position is evaluated at each appointment, and adjustments to mechanics or possibly buccal segment coronoplasty is done to address interferences that develop in the course of treatment. With disarticulation buttons, it is easy to manipulate the mandible. In those cases where manipulation is difficult and CR cannot be reproducibly determined, a

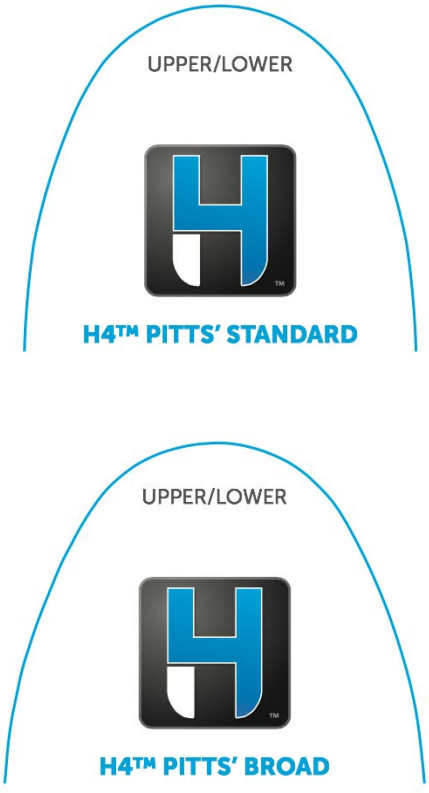


Figure 10

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Gingival Display on Smile	2	4

Figure 11

Initial Smile Close Up

Progress Smile Close Up

20 Months, 11 Appointments

"leaf gauge" is used to manipulate, or mounting of models whenever necessary. I have found diagnostic mountings to be most appropriately applied in selective adults, surgery cases where a maxillary procedure is indicated, or cases where the nature of posterior interferences is uncertain.

13. "Micro-Esthetic Detailing": as a tool in providing dental esthetics: David Sarver has championed the role of micro-esthetics in attaining a wonderful orthodontic result in both hard and soft tissues[17], and I agree completely with his approach. The refinement of "white and pink" esthetic contributions is now a routine part of esthetically superior treatments[18]. We encourage a disciplined approach to both hard and soft tissue refinement during treatment. This includes;

14. "Tooth size refinement": as a tool in perfecting guidance systems: No matter how well the brackets have been positioned, or how well the case has been managed, attaining centric stops and guidance patterns requires occlusal adjustments.

Summary of the Role of Case Management the "Active Early" Approach:

The art of Orthodontics is constantly evolving with the goal of becoming more efficient, and providing better aesthetic and functional results for our patients. Today with the combination contemporary diagnostic approaches, "Active Early" principles of case management, and purposefully designed and built precision appliances from OC Orthodontics; we are excited about the possibilities for the future. The future is so bright I have to wear shades!

Until next time.....

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Author's Comments

Dr. Tom Pitts

Dr. Duncan Brown

"Our goal in teaching continues to be to improve esthetic and functional outcomes, while simplifying treatment mechanics and improving predictability, and efficiency. Combining the "14 Keys of Pitts Case Management", an "Active early" approach to treatment, and superior OC H4 self-ligating brackets with Pitt's Broad Arch Forms has gone a long ways to achieving those ends."

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ACTIVE EARLY PRINCIPLES*

"Perfection of means and confusion of goals seems to characterize our age"
- Albert Einstein

Introduction: I have been extremely fortunate to have traveled broadly in teaching orthodontics throughout my career. One of the aspects that seems to create a great deal of confusion among orthodontists around the world is the relationship between the means of using a "straight wire" appliance to align teeth and the contemporary clinical goals of excellence in both esthetics and occlusion.

Every orthodontist is familiar with the brilliant article by Andrews[1], which introduced the basis of "straight wire" theory, which has dominated our profession for the last 40 years. Building tip, torque, and in/out into the bracket as a means of avoiding adverse "wagon wheel" effects of wire bending is the premise of every modern orthodontic appliance, and to this day, I use pre-adjusted appliances for this reason.

As with all great ideas, "Straight Wire" theory has some recognized limitations. Thomas Creekmore and Randy Kunik provided a good summary of these: inaccurate bracket placement, variation in tooth structure and tooth facial morphology, variations in the maxilla/mandible skeletal relationships, tissue rebound, mechanically deficiencies in the appliances[2], and variable threshold of biological activation, to name a few. The combination of all these factors reduces the ability of the clinician to rely strictly on the appliance to guarantee an excellent occlusal result, with an even less likelihood of reaching superior esthetic goals.

For me, there are three significant considerations of straight wire theory as it applies to using a contemporary PSL appliances in esthetics based treatment:

- The first of these is revolves around the core straight wire principle that the wire plane parallel to the occlusal plane is a requisite for excellent occlusions. It is not, and failure to adjust bracket position to meet esthetic need can result in esthetic decline[3] in many patients. The contemporary Orthodontist needs expand his/her diagnostic and mechanical understandings beyond reliance on improved "straight wire" appliances to attain superior esthetic results. David Sarver has led the charge on the impact on esthetics of orthodontic treatment mechanics[4] where the vertical position of the upper incisor is the prime diagnostic criteria in developing superior esthetics in orthodontics, and I agree with this concept.

- The second involves the misconception that incremental increases in arch wires size is an effective means of controlling axial inclination. It is not, and failure to appreciate how to control axial inclination results in frustration in many orthodontists when reliance on "the treatment built into the appliance" fails to deliver.

- The third limitation involves the lack of appreciation of the pivotal role of case management in attaining superior aesthetic and occlusal results. The best orthodontic results are attained by the best case managers, regardless of the appliances they use.

Today I would like to explore briefly the elements that are within the control of the Orthodontist; bracket position, appropriate use of pre-adjusted appliances, and arch form as they relate to esthetic outcomes.

Figure 1: Beautiful Smile Arc - The vertical position of the upper anterior teeth relative to the upper posterior teeth determines the Smile Arc. Importantly the Smile Arc extends from first molar to first molar.

Figure 2: SAP bracket placement - to protect the Smile Arc, and improve enamel display, brackets may be positioned in a more gingival position on the upper anteriors than the upper posteriors. This approach may require a wire plane that is gingival to FA, and not parallel to the upper occlusal plane.

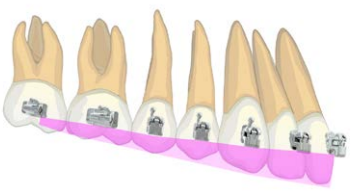
Figure 3: SAP versus Traditional bracket placement: in situations with flat upper occlusal planes, or where more enamel display is required placing brackets with the wire plane parallel to the occlusal planes adversely impacts esthetics.

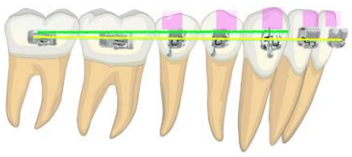
Bracket Position as it effects Contemporary Esthetic Goals:

For many years, I have been teaching the ***"Top 10 Esthetic Factors"*** that can be impacted by orthodontic mechanics. These were recently published in a SIDO article, so this article will deal more specifically with bracket position, bracket selection, and arch form as it relates to these four factors;

- **Idealized inclination of the upper incisors and canines:** Patients are more sensitive to adverse changes in axial inclination than to changes in A/P position[6]
- **Idealized smile arc**: Idealized smile arcs are more attractive especially in women[7]
- **Incisal and Gingival display:** Some gingival display, and full enamel display is appropriate in a "posed" smile[8]
- **Wide arch width, particularly in the molars:** Smiles with small buccal corridors are more aesthetic, in both men and women[9].

Placing anterior brackets in a more gingival position improves enamel and gingival display by adjusting the vertical position of the upper incisors and cuspid relative to the upper posteriors. (Figure 1, 2, 3). Lower posterior brackets are placed in a more gingival position to avoid the occlusion, and the lower anterior bracket more incisally to intrude the lower anteriors and optimize overbite (Figure 4,5).





This approach to bracket placement has come to be called the **"SAP"[10] Smile Arc Protection** approach. The specifics of this approach have been published several times[5 11 12], so rather than review those details again, I will cover the positive impact esthetics that SAP[10] produces.

- **"Positive and negative" coronoplasty** is very important. Patients today want beautiful faces, beautiful smiles, and beautiful teeth. Teeth need to be "optimized" for shape and contour. When done prior to bonding, esthetic re-contouring improves the ability to place brackets in the appropriate location to maximize the smile arc, optimize axial inclination, and control 1st and 2nd order changes in tipping mechanics. Prior to bonding, we encourage softening the cusp tips of the cuspids and first bicuspids, normalizing facial irregularities, and optimize length/width ratios of the upper anterior teeth. Other microesthetic aspects of contact point length, appropriate embrasure spaces, and slenderizing for tooth size discrepancies are accomplished after the anteriors are aligned. Centric stop adjustments are made during the finishing stages of treatment. All surfaces that have been adjusted are smoothed with a white stone, and black rubber tips in a high speed hand piece.

SAP Bracket Positioning:

- **"SAP Bracket Position[10]" as a tool in gaining optimal esthetics.** Straight wire theory is based on occlusal results but great occlusal results do not always provide great esthetic results. Bracket position must be individualized to patient esthetic need. In patients with "flat" occlusal planes or those requiring increased enamel display, the progression of the wire plane created by bracket position must increase to develop the smile arch by extrusion of the upper incisors relative to the upper bicuspids. In patients with normal occlusal planes a more modest progression in the wire plane is advisable to protect the smile

arc as the upper arch broadens with treatment. Orthodontists tend to focus on intrusion of the upper anterior teeth in deep bite cases with steep occlusal planes, and excessive enamel display which can lead to esthetic decline. A modest progression in still advised in deep bite cases to avoid excessive reduction in smile arc with reduction in overbite. It is important to remember that large bracket progressions in the upper arch must be compensated for by increased "overlevelling" of the lower arch to maintain optimal overbite through bracket position.

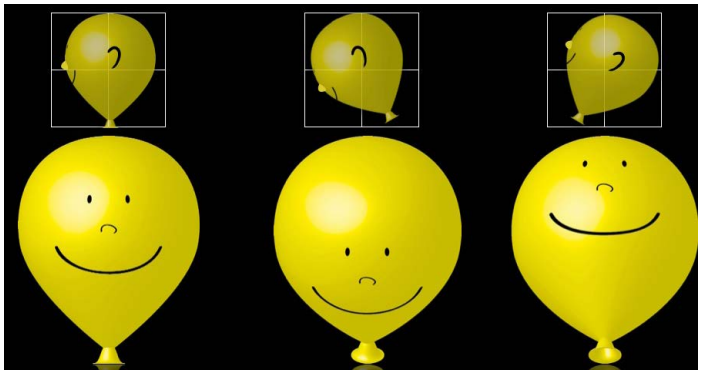


Figure 6: Impact of Head Position on Smile Arc - as the smile arc changes with head position, I use NHP (Natural Head Position) as the reference plane for aesthetic based treatment.

- **Head Position versus Frankfort Horizontal Plane in Esthetics.** The need to standardize the techniques used by orthodontists and anthropologists, to undertake diagnosis and comparative studies of head anatomy generally revolves around the Frankfort Horizontal reference plane. This plane was selected in the outcome of deliberations at 2 craniometric conferences on disarticulated skulls, held in Munich in 1877 and subsequently in Berlin in 1880, and submitted for consideration to the 13th General Congress of the German Anthropological Society held in Frankfort (or Frankfurt) in 1882. A more appropriate plane is clearly visible on a number of Leonardo da Vinci's proportional drawings[13] as a "true horizontal reference line" with the study postured in a Natural Head Position (NHP) which has become a popular reference plane for esthetically driven treatment[14]. As NHP has been shown to be reasonably reproducible, both in the short and long term[15 16 17], and smile arcs are highly dependent on the occlusal plane of the upper arch (Figure 6), I prefer using the natural head position for assessment. Patients should be assessed while standing comfortably, engaged in natural conversation, and generating unposed smiles. The Orthodontist can then make a patient specific decision regarding the bracket progression needed to generate optimal enamel display: larger progressions where more display is required, moderate progressions to protect the existing smile arc.

Bracket Torque as it effects Contemporary Esthetic Goals:

- **Realistic Expectations and Straight Wire Theory:** In straight wire theory, control of first, second, and third order tooth movement is described as being achieved by incremental increases in arch wire size and placement of the bracket slot at FA. It is required to gain optimal torque expression relative to the occlusal plane using arch wires that "fill up the slot"[18]. The recognition of the limitations of "straight wire theory" has become relatively common, with the conclusion that, **"we need to raise the need for a re-evaluation of the theories of the straight-wire appliance in orthodontics."**[19]

Few orthodontists fill the slot, so that the prescription "built into" the bracket is seldom expressed. Actual torque expression then is the result of many factors: bracket design, wire/slot play (engagement angle) mode of ligation, bracket deformation on loading, wire stiffness, magnitude of wire torsion, corner radius, initial tooth position, bracket position, and tooth anatomy[20]. The combination of these effects makes creating torsion within the appliance difficult when relying on incremental increases in wire size, without bending wire (Figure 7) using traditional bracket positions. This is especially problematic in non-extraction, crowded cases where incisor flaring created during the tipping phases of treatment is very difficult to recover later.

"Today's Orthodontist practices at the intersection of art and technology. The challenge of applying appropriate levels of technology to an artistic end result is the art of case management. The best case managers have a sound understanding of the technology they apply on a daily basis".

Fortunately in the "SAP[10]" - **Smile Arc Protection** - approach, with bracket placement guided by esthetic requirements, benefits arise in the area of third order control.

- **SAP[10] bracket positions are more effective in management of axial inclination early in treatment.** This is true during the tipping phases of treatment. Early in treatment, incisor extrusion creates a retroclining movement that helps control proclination as crowding unravels, when supported by ELSE (early light short elastics) and proper disarticulation buttons. Case Management is the key early in treatment, with needed torsion created by wire plane and disarticulation and supported by early elastics.

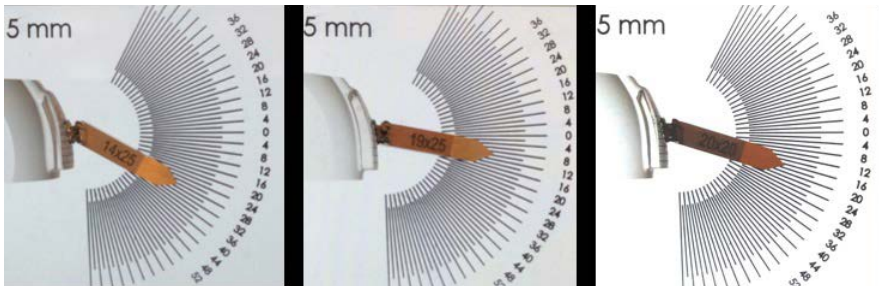


Figure 7: Incremental increases in arch wire fail to provide lingual crown torsion when the slot is not filled.

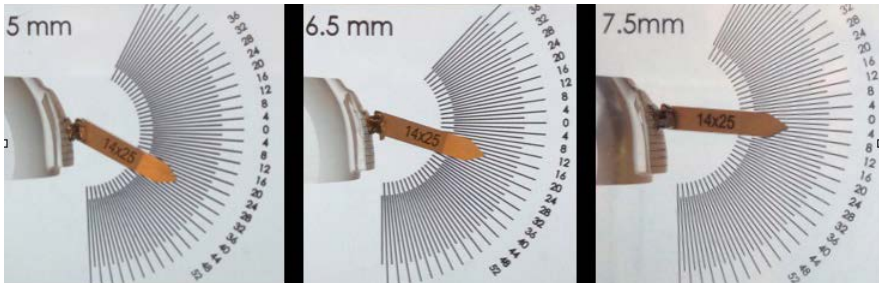


Figure 8: SAP bracket positions decrease the angle of engagement, thereby improving control of axial inclination in dimensional wires.

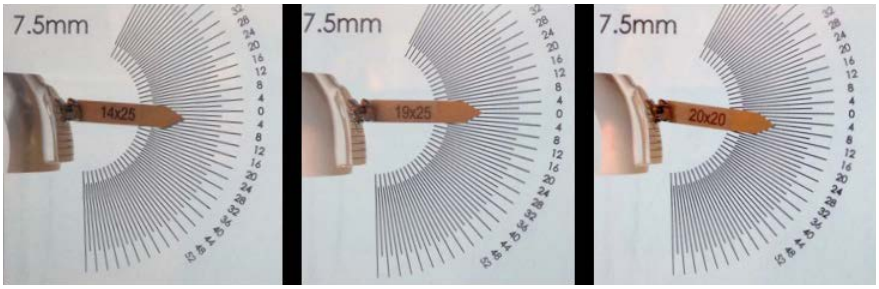


Figure 9: Even with extreme SAP positions, it is unlikely to develop excessive torsion within the slot, with common arch wire progressions.

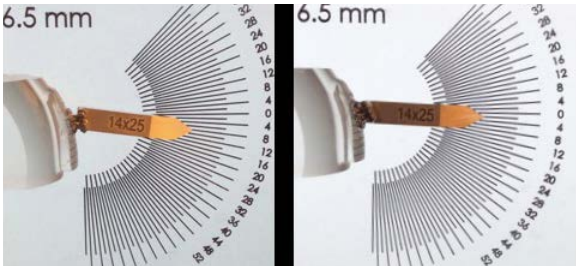


Figure 10: "Flipping" the brackets, reduces the angle of engagement further, allowing torsional couple to be developed in light dimensional wires.

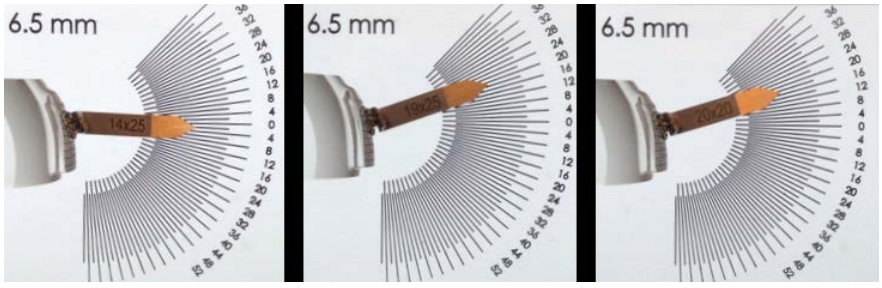


Figure 11: Increased AW sizes in "flipped" brackets produce torsional couples within the slot to effectively upright teeth.

- **Other key case management principles: ELSE, disarticulation, and AW progression are more effective.** When using SAP[9] bracket positions, improvements in esthetic and functional occlusions occur in the first few appointments. Patients notice these changes, and we encourage the use of "every patient/every appointment photography" as a means of validating the mechanical setup and the progress of treatment.

- **SAP[10] bracket positions are more effective in management of axial inclination during the torsional phase of treatment.** This attribute is a key contributor to a case management philosophy that allows changes in both transverse and axial inclination far earlier in the treatment cycle that traditional straight wire treatment would allow. There are other aspects to this "active early" approach which will be appearing in the next few months for those who are interested, but briefly:

- **SAP[10] bracket placements reduces the angle of engagement** by reducing the torque designed into the Rx, which is advantageous in cases with proclined teeth, crowded upper anteriors, or to recover proclination occurring as a result of relief of crowding (Figure 8). By applying active torsion within the appliance sooner, with lighter forces, treatment has the potential to be both more efficient and more comfortable for the patient.

The "10 tooth smile" is touted as representing an esthetic ideal. There are however many excellent students of dental esthetics that prefer a "12 tooth smile" esthetically, and I agree with them.

- **Secure Force Application:** Even with very large SAP[10] progressions, **application of excessive torsion through incremental increases in wire size is unlikely** using commonly employed AW sequences (Figure 9).

I have been an advocate of the PSL bracket system for the last 15 years of my career. I utilize OC Orthodontics's H4 bracket exclusively, and have been very pleased with the performance of the appliance. The familiar Rx *(12/8/7) in the upper anteriors, solid gate, .026 depth slot*, combined with utilization of "Pitts Standard" and Pitts Broad" arch forms has increased efficiency tremendously.

Choosing the right torque bracket or groups of brackets can minimize arch wire adjustments in finishing, but the development of "variable torque" appliances has complicated this relatively simple concept. Rather than picking a bracket torque from a constellation of variable torque Rx's on a tooth by tooth basis, torque selection has been simplified in the **"active early"** approach to reduce the arch wire adjustments in finishing.

With North American patients seeking broader smiles and fuller lips, treatment has trended towards avoiding bicuspid extractions to achieve that goal, frequently with the adverse side effect of proclined upper anteriors, which is difficult to recover, and not desirable esthetically.

Bracket inversion as a means controlling axial inclination:

Inverting brackets (***"flipped"***) as a means of creating more lingual crown torsion has been a common case management practice for years, usually as applied to controlling single teeth. Earl Johnson[21] provided a very nice summary of using this approach as it is applied to controlling axial inclination of upper lateral incisors. Some companies advocate using "low torque" prescriptions as a means of uprighting proclined teeth, but the reality is that the torque selections involved are frequently not sufficiently negative to accomplish that task. Research indicates that torsion of 20 to 25° between the bracket slot and arch wires (19X25) are required to create the requisite forces[22], and this is very close to that attained with "flipped" brackets placed at SAP positions, utilizing commonly used wire sequences (Figure 11).

One of the strategies used in an "active early" approach is to invert ("flip") groups of upper anterior brackets as a means of creating lingual crown torsion earlier in the treatment cycle. This technique dramatically reduces "slop" within the bracket wire interface by lowering the angle of engagement at the outset (Figure 10) and applies active lingual crown torsion with incremental increases in arch wire size (Figure 11). One of the critical aspects of this approach is that in the inverted or "flipped" Rx, more lingual crown torsion must be applied to the central than the lateral incisor, due to root size, allowing uprighting of the teeth with minimal adjustment to the wire in finishing. Again the H4 Rx provides appropriate torque when "flipped" **(-12/-8)** for **uprighting proclined teeth, compensating for proclination created during unravelling of crowding, or counteracting the effects of class III mechanics. (Figures 12 to 18)**

It has been suggested that when applying "single tooth" activation by "flipping" individual brackets requires that the bracket be uprighted or the wire adjusted once an ideal inclination is achieved[18], which is one of the reasons that I suggest "flipping" brackets in groups to activate the appliance. In crowded cases it is desirable to "flip" the upper cuspid bracket to avoid "paddling" of the cuspid with arch development, relief of anterior crowding, or to compensate for the adverse effects of localized torsion in the appliance. In this approach, with the four incisors and cuspids "flipped", all the anteriors have negative torque ("flocked"), allowing uprighting of the anterior segment with an unbent wire.

Figure 12: Sample Case: Extra Oral Photographs.

Figure 13: Sample Case: Intra Oral Photographs

Torque	U1	U2	U3	U4	U5
Normal	12	8	7	-11	-11
Flipped	-12	-8	-7		

Torque	L1	L2	L3	L4	L5
Flipped	+6	+6			
Normal	-6	-6	7	-12	-17
Flipped			-7		

Figure 12: Impact of Inverted Brackets - wide selection of torque values achievable with "flipping" brackets in the H4 appliance. This can be utilized in most cases to minimize wire bending while simplifying inventory considerations.

One of the reasons I have adopted the OC Orthodontics's H4 bracket system is that combination of upright and inverted H4 brackets provides a good variety of torques to choose from, that are applicable in most situations (Figure 12), with a minimal inventory cost to the practice.

Arch Form as it effects Contemporary Esthetic Goals:

The "10 tooth smile" is touted as representing an esthetic ideal. There are however many excellent students of dental esthetics that prefer a "12 tooth smile" esthetically[23], and I agree with them. Arch form is directly related to the shape of the wire used, not to the bracket system an orthodontist decides to use[24]. With this in mind, I do not use "standard arch blanks" but shape bendable arch wire to optimize posterior arch development for esthetics. Careful assessment at each appointment, with palpation of the buccal and lingual alveolar processes is required to ensure that the patient's "biological availability"[5] is not compromised.

I have always been challenged by arch forms that are too flat anteriorly, too broad through the cuspid and first bicuspid, and too narrow through the second bicuspid and molars. I have found all commonly used arch forms to be inadequate in terms of width in the posterior sections, where transverse arch development provides significant advantages from an esthetic perspective. Wider arches posteriorly also provides the opportunity to gain space and relieve crowding, which is very useful in non-extraction cases.

Fortunately two companies now produce arch forms that mimic this shape; OC Orthodontics's Pitts Standard and Pitts Broad arch forms, and G&H Wires DYB V3 arch forms both function well. Because research has shown that as much posterior arch development occurs in round wires as occurs in dimensional arch wires[21], both these suites have round, square, and rectangular wires in the same arch form. This feature facilitates an **"active early"** approach to transverse arch development with a greater degree of torsion control whether using familiar wire progressions or square wire progressions when using OC Orthodontics's H4 appliance.

Figure 14: SAP bracket placement, inverted upper anteriors, posterior bite turbos, ELSE (short class III through the bite elastics. Notice the bracket progression increases as through out the buccal segments and anteriors.

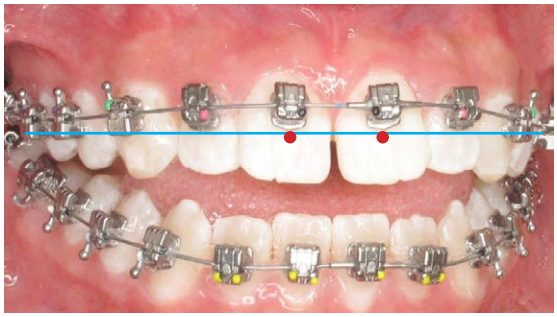


Figure 15: SAP bracket placement: bracket slot are positioned apical to FA to develop the smile arc.

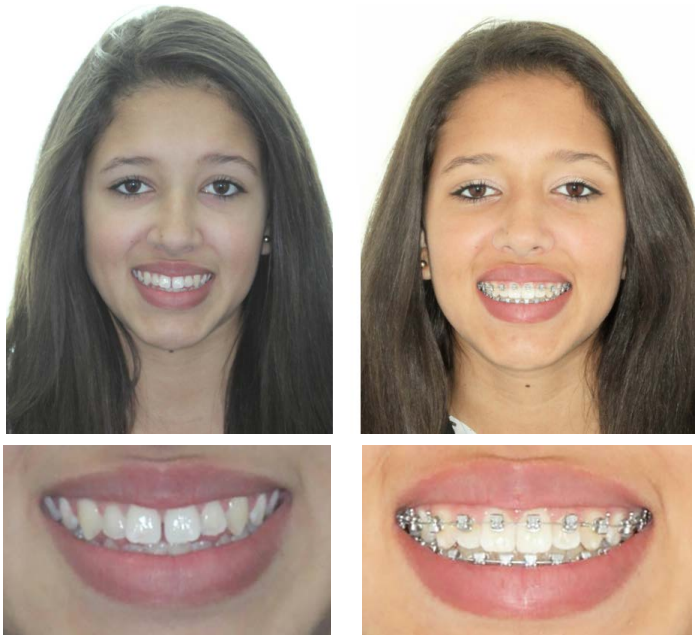


Figure 16: Improvement in smile arc, gingival display during the tipping phase of treatment

Figure 17: Improvement in axial inclination during the tipping phase of treatment due to case management.

Figure 18: Inverted brackets on the upper anteriors engage a couple early in treatment in light thermally activated dimensional wires. Notice the absence of a couple in the lower arch!

Where unadjusted nickel-titanium or beta-titanium arches do not have optimized axial inclination, **the practitioner can use shapeable beta-titanium arch wires or stiffer stainless steel to efficiently correct remaining aberrant torque situations.**

Summary and the Role of Case Management:

I have always been a teacher. During my career I have concentrated on the development of improved simplified "case management" practices, combined with a sound understanding of the impact of varying bracket position, bracket torque and use of modern arch wires forms to assist the orthodontist in creating an artistic end result. Applying these principles will make case management more efficient, and improve the quality of your end results.

Today, I choose to activate the appliance as early as possible, using the SAP[10] bracket position to adjust vertical position of the incisors, inverting groups of brackets to activate the appliance, selecting arch wire progressions that control axial inclination early in treatment, and using arch forms that develop the posterior segments of the arches sooner. We will be sharing more on the "active early" approach in the coming months, so stay tuned!

Until next time.....

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Author's Comments

Dr. Tom Pitts

Dr. Duncan Brown

"Our goal in teaching continues to be to improve esthetic and functional outcomes, while simplifying treatment mechanics and improving predictability, and efficiency. Combining the "14 Keys of Pitts Case Management", an "Active early" approach to treatment, and superior OC H4 self-ligating brackets with Pitt's Broad Arch Forms has gone a long ways to achieving those ends."

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Rev. A 01/12/17

FLIPPING AND FLOCKING

"We cannot solve our problems with the same thought processes we used when we created them"

-Albert Einstein

Introduction

We live in a challenging time. Orthodontic clinical procedures and esthetic preferences continue to evolve, so that the clinical approaches that we rely on today are different than those that earlier generations of Orthodontists used frequently[1].

Esthetic declines that were quite common with treatment[2] (including flat incisal plane and excesive retraction of incisors) are no longer acceptable to the majority of patients. Where "straight teeth" were once a primary goal, today's parents/patients frequently seek orthodontic treatment for esthetic improvement[3], in addition to health benefits. Contemporary research supports the human social benefits that accrue with improved esthetics such as: more friendly, more intelligent, more interesting, more likely gain better employment, more self confidence, more socially competent[4].

Fortunately, diagnostic appreciations have kept pace with these trends, with the increasing appreciation of predominance of the upper incisor position in 3 planes of space to esthetic outcomes[5], while planning for age related esthetic changes. I subscribe fully to this approach.

Virtually every Orthodontist that practices today uses some variant of the "straight wire appliance", a concept that has dominated our profession since Larry Andrews' breakthrough article led to its development in the 1970's. Today I use the **H4 bracket**, a precision "straight wire" appliance that incorporates a number of unique features at a great price point. Over the years, I have developed a case management strategy that is called "Active Early", which leverages the features of the H4 appliance (Figure 1), while overcoming many of the misconceptions imposed by rigid adherence to "straight wire theory" for anterior torque and anxial inclination.

Today I would like to further expound on the dual roles of case management strategy and appliance selection to address some of the limitations in traditional application of straight wire in a PSL setting in controlling anterior inclination.

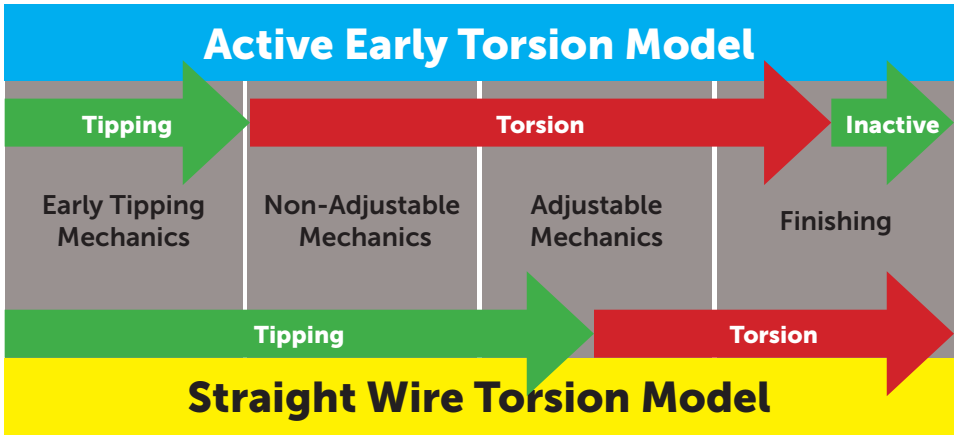


Figure 1: Pitts "Active Early" approach to case management uses lighter forces, applied for longer duration, earlier in the treatment cycle to improve control of both axial inclination and transverse arch development

.028 Slot

10 Weeks - .014

10 Weeks - .018

10 Weeks - .014 x .025

Change to H4 with .026 Slot

2 Weeks - .014 x .025

Challenges of Torque Expression in a "Straight Wire" Context:

Orthodontics lost one of our great thinkers this year with the untimely passing of Charles Burstone. Dr. Burstone clarified the distinction between axial inclination (the buccal lingual inclination of the teeth), bracket slot (labio-lingual) angulation (incorrectly termed torque), torsion (the forces resulting from a couple within the system), and torque expression (the result of torsion). Clinicians, being primarily concerned with torque expression, must be mindful of ***four things***:

1. Contemporary fixed orthodontic treatment is usually completed in wire sizes that are less than full dimension[7] for the designed bracket slot. The consequence of this incompletely filled bracket lumen is torsional play that decreases engagement of the contact between the arch wire and the bracket[8]. While decreasing friction, a potential benefit during early leveling, aligning, and sliding mechanics, torsional play reduces control of axial inclination necessary for ideal esthetics. In clinical practice then, ***incremental increases in arch wires size is NOT an effective means of controlling axial inclination when the slot isn't filled***[9].

2. Torque expression is a complex process dependent upon[10]: magnitude of torsion, wire stiffness or resilience, bracket design, engagement angle, mode of ligation, wire dimension corner radius, angulation of the bracket slot, deformation of the bracket or wire under torsion, manufacturing tolerances in the bracket and the wire, initial tooth inclination, bracket position, and the measurement technique used to evaluate torsion. Fortunately, to the clinician, ***it matters solely when/ if torsion is developed within the slot during commonly used arch wire progressions.***

3. Today's treatment targets for incisor position in 3 planes of space are based on esthetics[11,5], so that reliance on "treatment built" into the appliance through ***anterior slot "torque" angulation to the occlusal plane is not a practical way to ensure esthetically superior results.*** In the "Active Early" approach, individualized bracket positions based on esthetics[9] (SAP) is combined with other initial planning considerations, to gain control of axial inclination earlier in the treatment cycle than has been possible before.

4. The hardest torquing mechanics today for many orthodontists is lingual crown torque with occlusal plane variable. Because of this variability, we like to relate the anterior inclination to FH and not the occlusal plane, so that the labial surface of the maxillary incisor is perpendicular to corrected FH.

.014 x .025

Final

Rotational control problems resolved and improved control of axial inclination with H4 bracket and 026 depth slot - Courtesy Daniela Storino 2014

"Active Early" Case Management Protocols and the H4 Precision Bracket

In "Active Early" protocols the appliance is activated as early as possible, using the SAP[12] bracket position to adjust vertical position of the incisors, inverting groups of brackets where necessary. We have developed protocols to address torsion in the appliance, selecting arch wire progressions that control axial inclination early in treatment, arch forms that develop the posterior segments of the arches sooner, ELSE (Early Light Short Elastics) to control forces and moments, and appropriate disarticulation to encourage early "wanted" tooth movements[9], both A/PE vertical.

Working with OC Orthodontics® and their precision manufacturing, we have been able, to introduce meaningful innovations that make an impact on the Orthodontists ability to both control and predict how the PSL appliance will respond. Where commonly used PSL brackets have manufacturing inconsistencies that become clinically significant[13], OC has manufacturing tolerances that are much tighter for more predictable performance. Secondly, we have reduced the slot depth to .026, which results in two benefits: improving rotational control, and reducing the engagement angle for torsional control early in the treatment cycle, when using familiar wire progressions (Figure 2) when the bracket is upright.

My goal in clinical teaching has been to simplify complex concepts in contemporary case management strategies that can provide significant advantages in the treatment of most orthodontic cases. This distinction is very apparent in the "Active Early" approach to appropriate torque selection.

"Active Early" Approach Removes the Need for "Variable Torques"

The concept of variable torque is not new. Andrews was the first to suggest "variable torque" Rx's to customize the appliance Rx to specific clinical situations (generally extractions). The current approach of "high, normal, and low" torques[14] is not practical and overly complicated in my view.

With the worldwide tendency to treat more cases without extractions, the control of proclination of the upper anterior teeth has become a greater challenge. Correction of pre-existing crowding and proclination, proclination associated with relief of crowding during traditional round wire mechanics, or incisor proclination associated class III (in the upper arch) elastics is particularly problematic. The challenge for many non-extraction cases has been in getting enough lingual crown torsion without having to resort to complex wire bending to attain esthetic results.

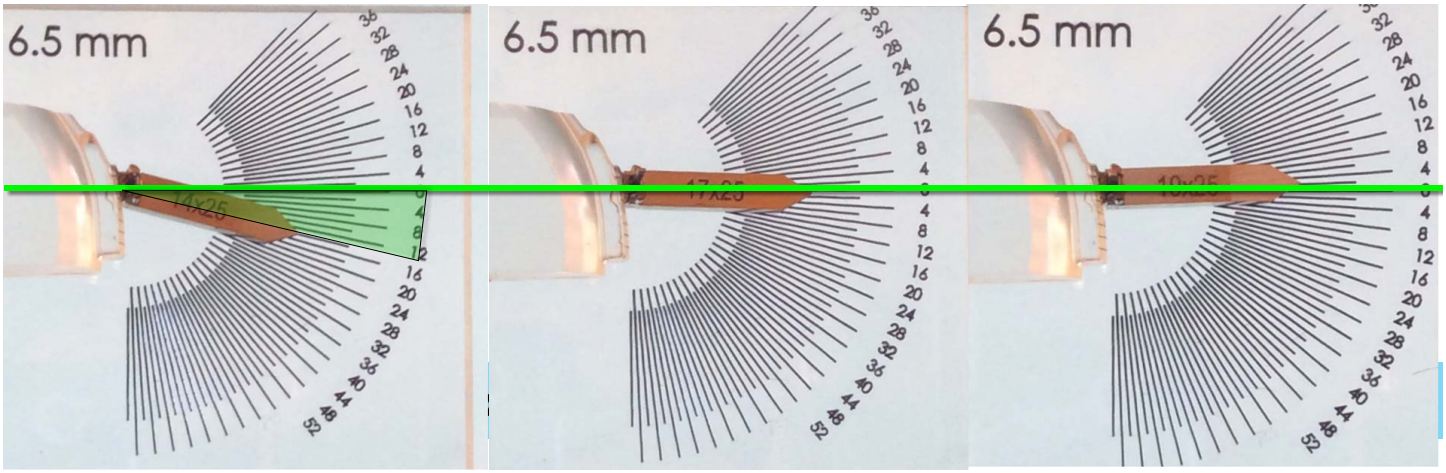


Figure 2: Combining Pitts SAP bracket position and reduced engagement angle of the H4 bracket system (.026 depth slot) enable development of torsion within the slot earlier in the treatment cycle when the bracket is upright using familiar wire progressions.

Present PSL "Low Torque" Brackets with More Lingual Crown Torque on the Lateral than Central Rx's do not Simplify Management Significantly

While variable torques has been touted to improve this situation, popular brand brackets with more lingual crown torque on the lateral than central Rx's endorsed by some PSL bracket producers increase case management complexity for me[15] in many ways:

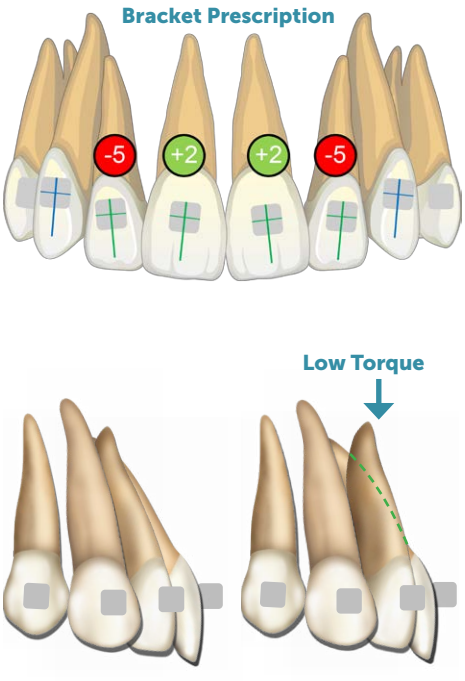


Figure 3: Complication imposed by the use of "Low Torque" brackets where the Rx has greater lingual crown torque on the lateral incisor than the central incisor when uprighting teeth with uniformly spun wires.

- Once in treatment, it is difficult to determine if an individual bracket has the potential to create clinically effective torsion because the slides all open in the same direction. This is very confusing, especially when bracket torques decisions are made on a tooth by tooth basis.
- Low torque brackets with more lingual crown torque on the lateral than central Rx's are not sufficiently low enough in the maxillary centrals to overcome both mechanical inefficiency inherent in the appliance, and biological resistance to movement associated with uprighting proclined teeth. At the clinical level, it is difficult to know what "torque expression" can be reasonably expected. Wire bending is almost immediate.
- When thse low torque variable torque brackets are employed, on individual teeth for localized concerns, the bracket must be repositioned, or the wire adjusted in order to finish well[16].
- When upper incisors with "low torque" brackets with more lingual crown torque on the lateral than central need to be activated further for esthetics, it is impossible to do so with a uniformly spun wire due excessive lingual crown angulation placed in the lateral bracket (figure 3), making either bracket replacement or complex wire bending a necessity.

Simply put, for the most part, use of "variable torques" is confusing and very inefficient.

Torque Selection to Simplify Control of Axial Inclination - "Flipping and Flocking"

To avoid these complications, I have inverted standard torque anterior brackets for years to control axial inclination. Inverting the upper anterior brackets has the effect of building negative crown torsion into the appliance while using a flat wire (Figure 5). The H4 appliance Rx is perfect is this regard, predictable when upright, and appropriate when flipped providing greater lingual crown torque to the central when uprighting of the upper anteriors is required. The single H4 Rx, then provides torque combinations suiting the majority of cases (figure 6) with a minimum of wire adjustments.

My teaching partner in crime, Duncan Brown, coined the terms "flipping and flocking" as a memorable way of describing inverting groups of brackets to control changes in axial inclination as a result of pre-existing conditions, relief of dental crowding, or responses to mechanics. To our delight, many Orthodontists around the world now are "flipping/flocking" regularly.....I can't believe that is now in print.

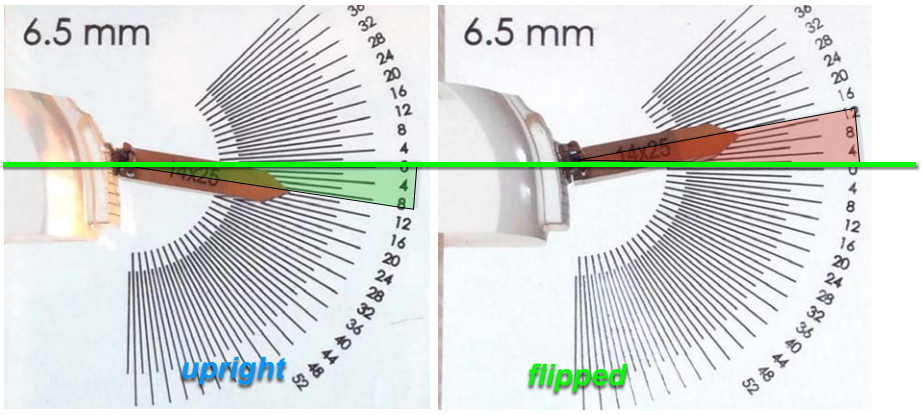


Figure 5 - Effect of "flipping" an anterior bracket is to place an effective degree of lingual crown torsion in the appliance

"Flipping" places lingual crown torsion in the appliance

Figure 6: Wide range of torques available in the H4 bracket system attaining simply by inverting ("flipping") brackets with an appropriate Rx

Torque	U1	U2	U3	U4	U5
Normal	+12	+8	+7	-11	-11
Low	-12	-8	-7		

Torque	L1	L2	L3	L4	L5
High	+6	+6			
Normal	-6	-6	+7	-12	-17
Low			-7		

Here are some highlights and benefits of using the technique:

- Choose bracket torques in groups, rather than on individual teeth. This greatly simplifies bracket selection and case management when using adjustable wires, and avoids having to replace brackets later in the treatment cycle, and simplifies wire bending.
- Choosing to "flip" upper incisor brackets in cases with mild crowding and proclination, "flock" upper cuspid brackets where significant crowding is present in the upper arch, and "flip" lower incisor brackets when class III mechanics are anticipated. It is immediately apparent, which upper anteriors brackets will have active lingual crown torsion, as those brackets with slides opening to the gingival are "active" when "flipped". The Orthodontist knows immediately if active torsion is present within the slot or not (Figure 7).
- Standard wire progressions with "flipped/flocked" brackets will produce effective levels of lingual crown torsion with commonly used wire sequences. As you would expect, uprighting of the upper anteriors requires space, gained through arch development, slenderizing, or use of skeletal anchorage (TAD's). The use of Pitts' Broad arch forms are particularly helpful, in supporting arch development early in treatment (Figure 8).
- When using "flipped/flocked" appliances, incremental increases in arch wire size actually produces incremental increases in effective torsion. This is the way "straight wire" appliances were designed to function.
- The inclusion of .020X.020 Thermal Activate Nickel Titanium and Beta Titanium arch wires in the Pitts' Broad arch forms allows active and effective lingual crown torsion to be placed very early in the treatment cycle in either the second or third arch wire (Figure 8). I am finding that many cases finish very nicely in .020X.020 wire dimensions, with .025 wire progressions being best suited for cases where large degree of rotational control is required.
- When using "flipped" anterior brackets, we encourage the patient to be seen every 6-7 weeks when Beta Titanium arch wires are in place, to assess progress and palpate the upper anterior alveolus.
- Once ideal axial inclination is attained, the appliance can be "deactivated" simply by reducing the AW dimension or adjusting 3rd order wire bending in Beta T arch wires. Of course it's important to use alloy/wire profiles no larger than Beta Titanium .019x.025 when using "flipped" appliances.
- We very rarely resort to stainless steel wires in the "Active Early" technique, although it is available for those who wish it.

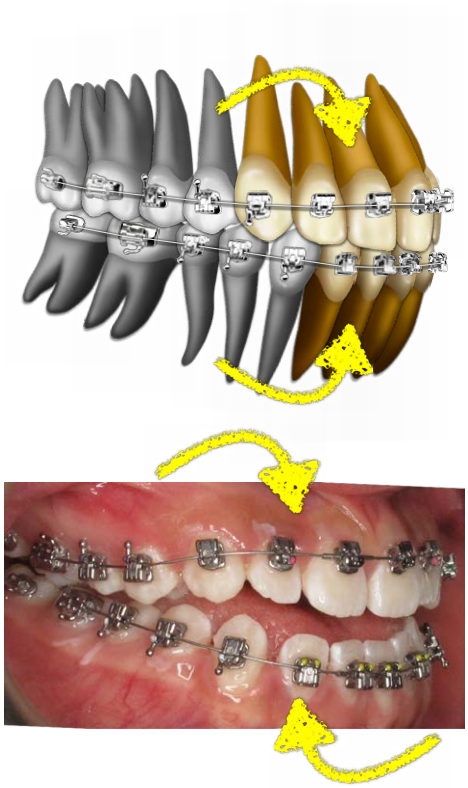


Figure 7: "flipped and flocked" upper appliance, "flipped" lower anteriors in a class III AOB patient

Using these principles Orthodontists can achieve surprising benefits for our patients with great efficiency (Figures 9 to 21).

Summary and Case Management Considerations

In an earlier Pitts Protocol, we introduced the "Active Early" Case Management strategy[12]. By combining the SAP bracket position to adjust vertical position of the incisors, selecting arch wire progressions that control axial inclination early in treatment, using arch forms that develop the posterior segments of the arches sooner, and relying on ELSE and disarticulation to encourage "wanted" tooth movements, great things are possible. The decision to "flip/flock" anterior brackets as a part of the "Active Early" approach, in combination with the precision and dependable Rx of the H4 appliance makes a quantum leap for our non-extraction and class 3 treatments in the areas that Orthodontists have traditionally struggled with other PSL appliances.

In the "Active Early" approach, lighter forces, applied earlier, for longer duration are accomplishing many things more efficiently for the Orthodontist, and more gently for the patient than has ever been possible before. Our work in improving the lives of our patients, and the ease with which Orthodontist can deliver esthetically superior results efficiently is just beginning. With OC Orthodontics, we are continuing to refine the appliance, as the "Active Early" protocols continue to evolve.

Look for us to introduce more meaningful innovations in the coming months, and thanks for joining us on the journey. It's going to be a fun ride! Until next time.....

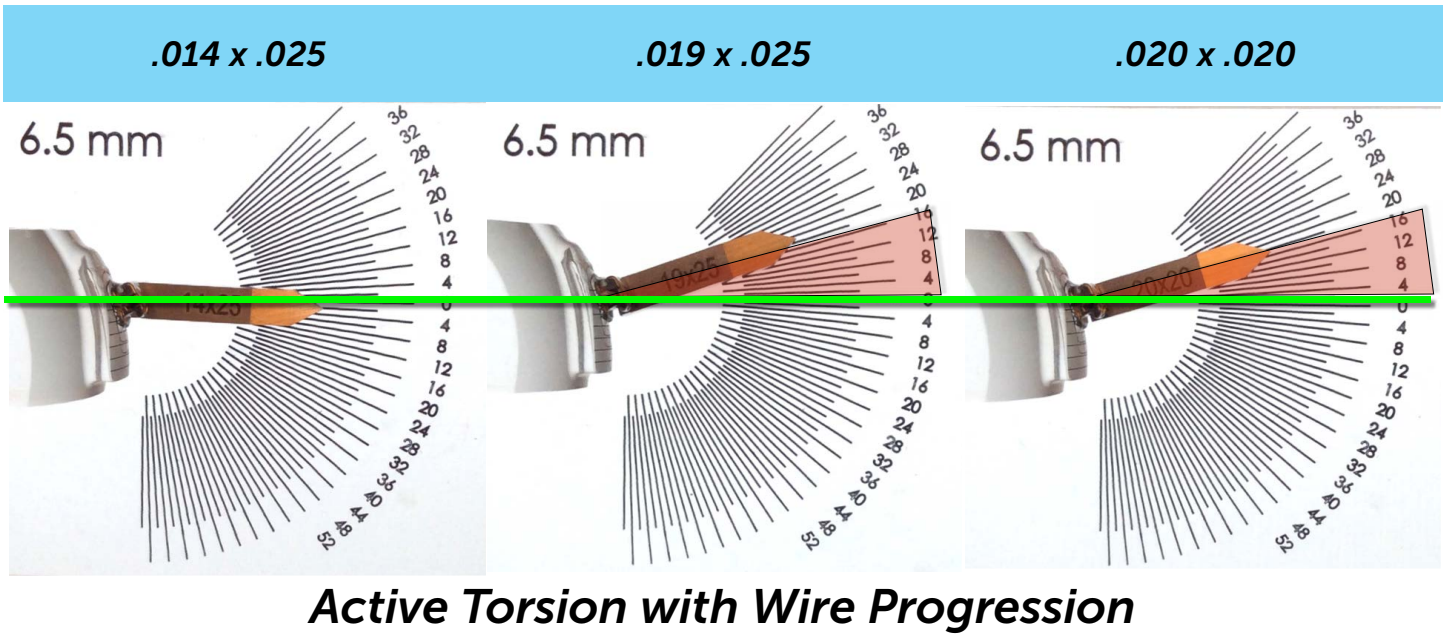


Figure 8: "flipped" upper appliance demonstrating effective levels of torsion, increases with incremental AW progressions. Note that 020x020 AW provides almost the same degree of torsion as 019x025

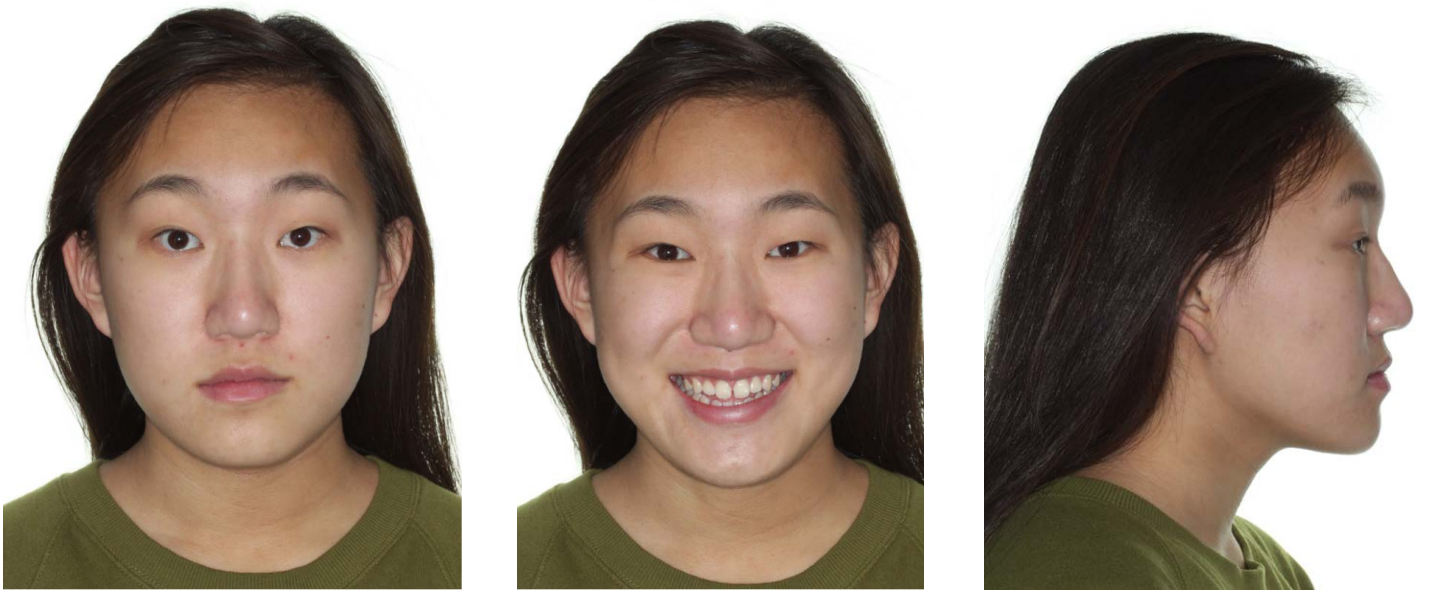


Figure 9: Pre-Treatment Extra-Oral Photographs

Figure 10: Pre-Treatment Intra-Oral Photographs demonstrating class III, AOB, with proclined upper incisors

Figure 11: "Active Early" Stage I Mechanics: SAP bracket position, "flipped and flocked" upper H4 appliance, posterior disarticulation, ELSE (TTB short class III elastics FT, anterior reverse rainbow PM)

PRACM - 7 Months, 4 Appointments

Very Nice Control Early in Treatment

Figure 12: PRACM appointment (7 months, 4 appointments): Smile Arc is developing and excellent control of axial inclination with tipping and early torsion mechanics

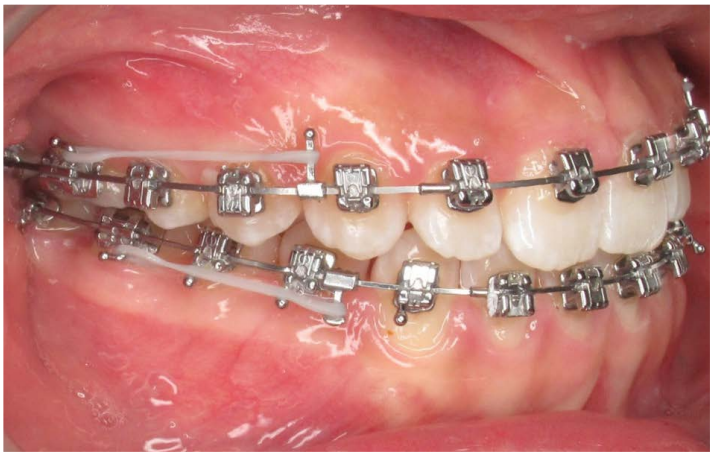


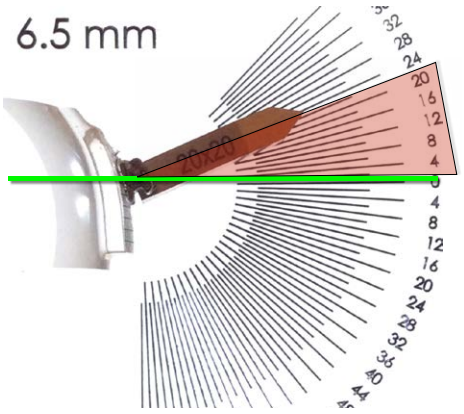
Figure 13: PRACM appointment: good control of axial inclination, and improvement in occlusion with very simple mechanics

Flipped and Flocked Appliance

.020 x .020 TA

Figure 14: PRACM appointment: "Flipped and Flocked" upper appliance delivers effective lingual crown torsion to prevent increased proclination of the upper incisor with class III mechanics in the upper arch. Flipping the lower anterior brackets prevents retroclination of the lower anteriors with class III mechanics.

Flipped Appliance



Debond - 16 months, 10 Appointments

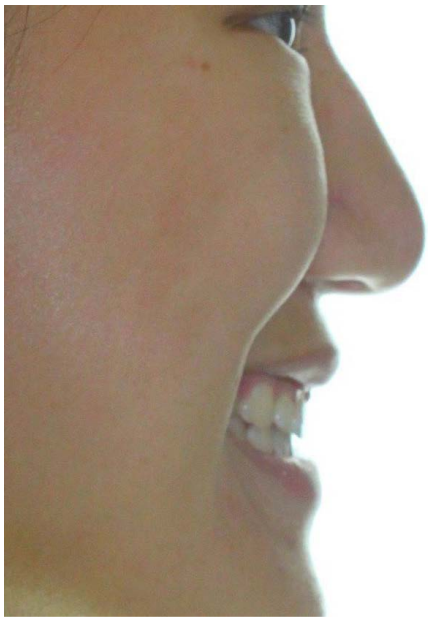


Figure 15: Debond Records: very nice esthetic changes, improved smile arc, uprighting of upper incisors, improved incisor display

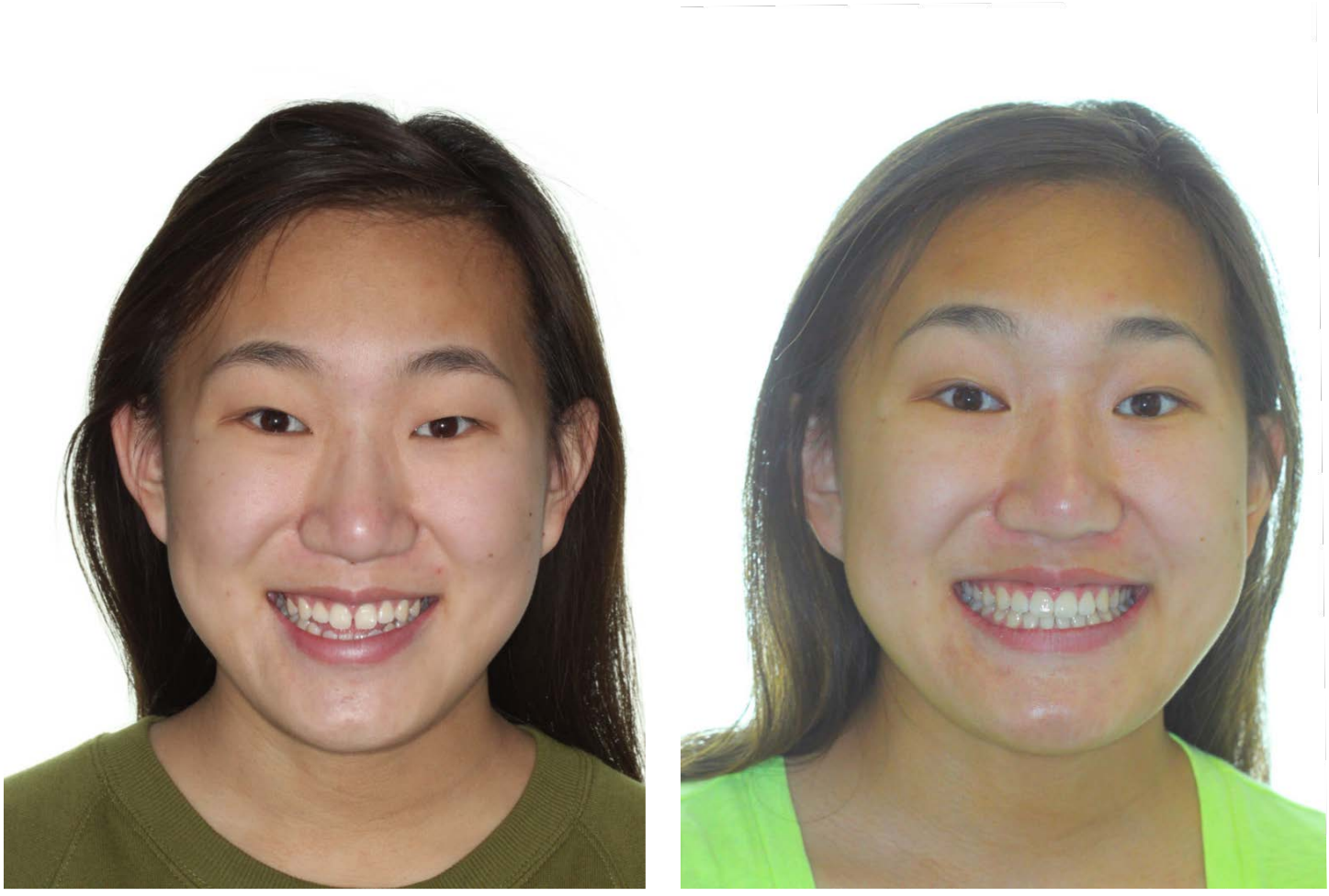


Figure 16: Debond Records: very nice esthetic change

Debond - 16 months, 10 Appointments

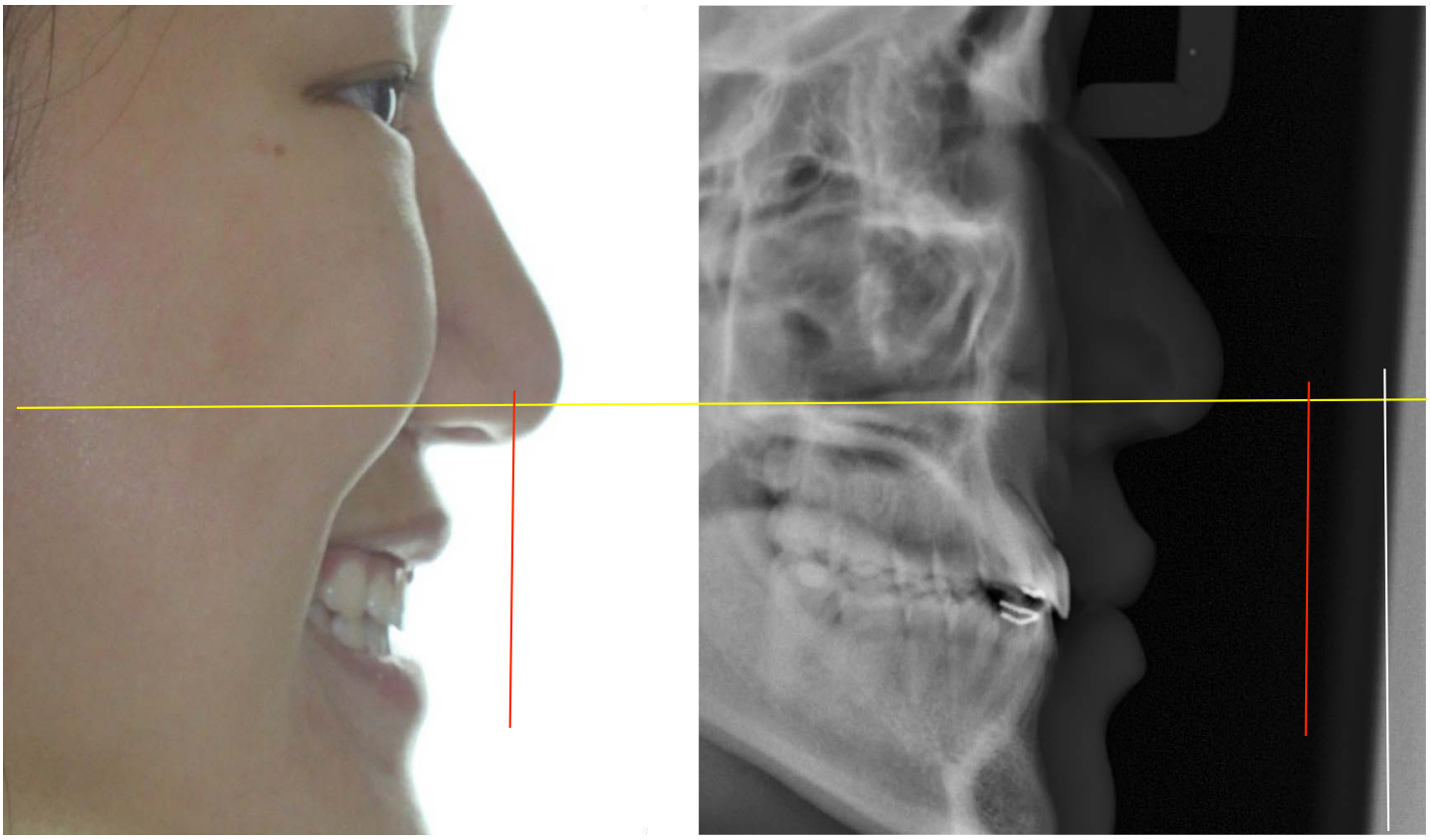


Figure 17: Debond Records: uprighted upper incisor, lower incisor has not retroclined excessively with light class III mechanics

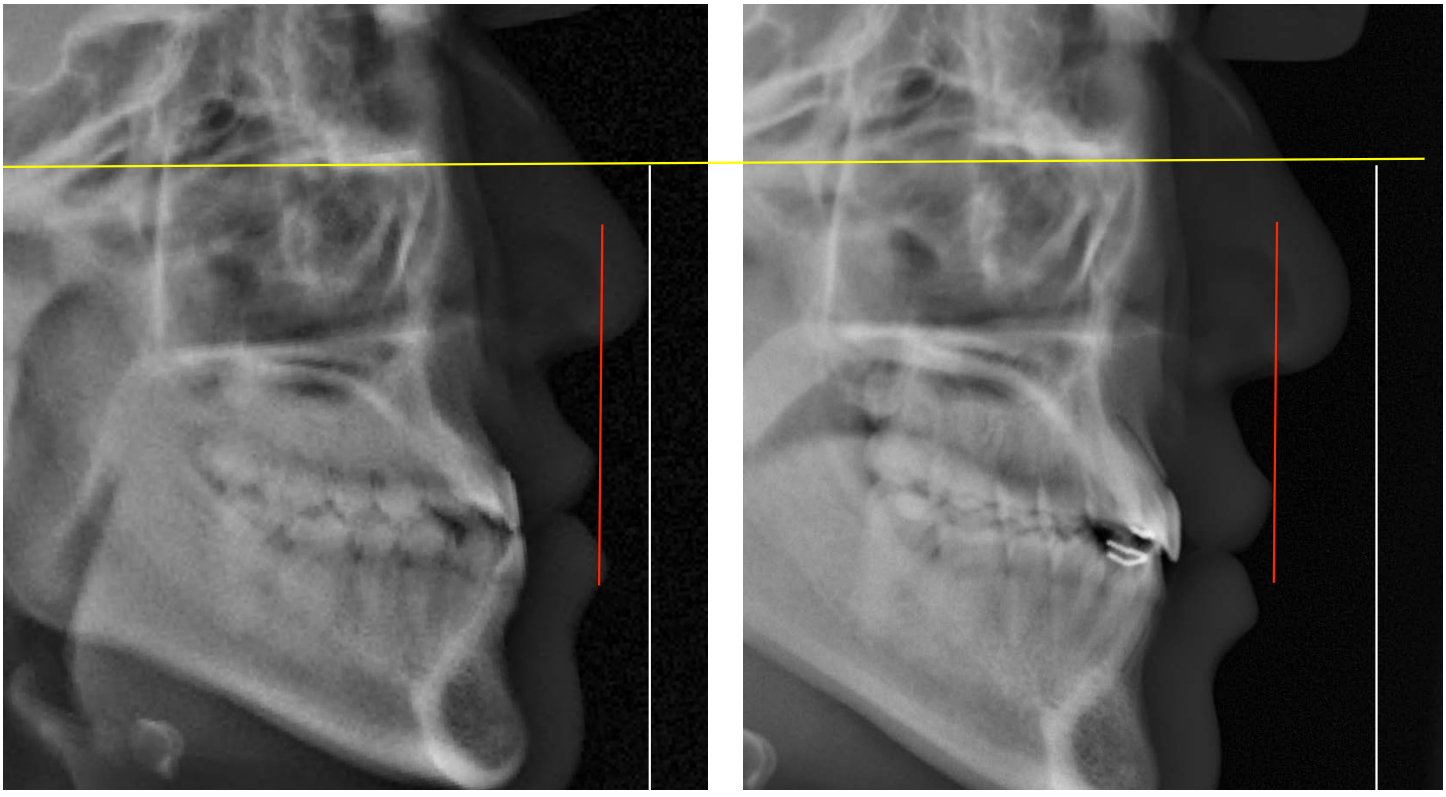


Figure 17: Debond Records: upper incisor inclination has improved, lower incisor inclination has not deteriorated

Debond - 16 months, 10 Appointments

Figure 18: Debond Records: very nice occlusal change with very simple mechanics, great control of axial inclination

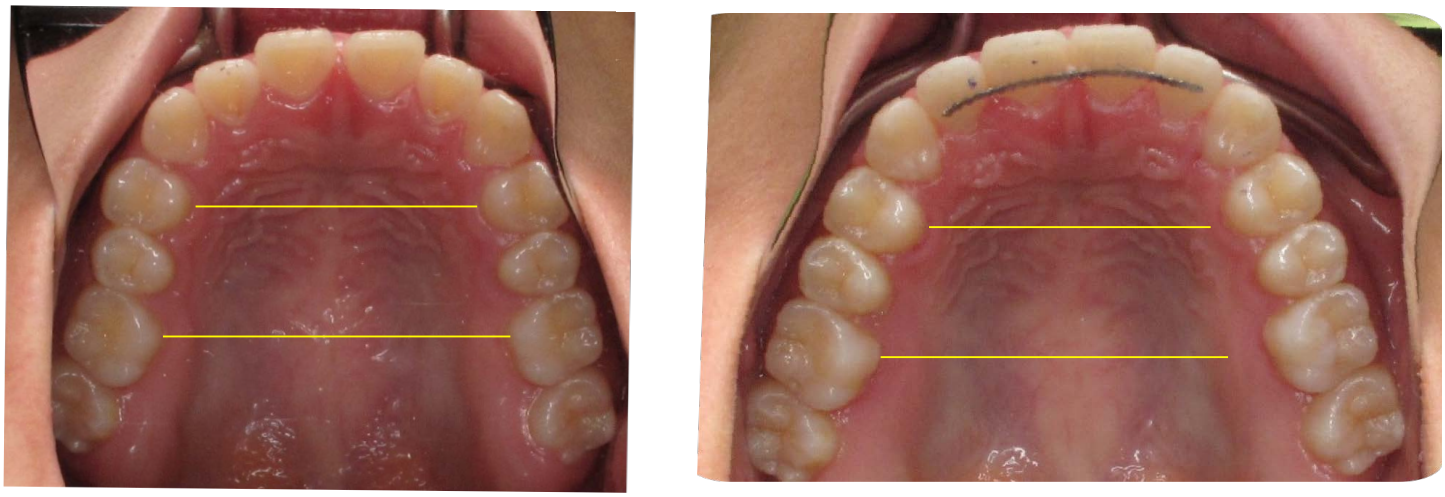


Figure 19: Debond Records: very nice arch development with Pitts Broad arch form

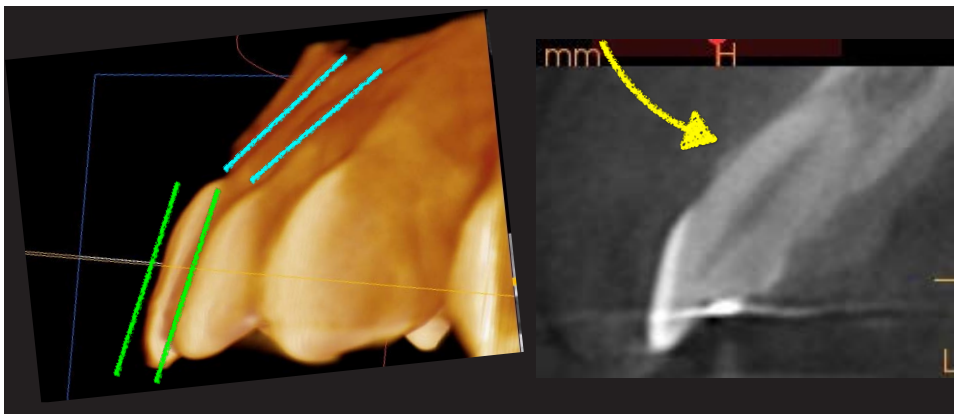


Figure 20: Debond Records: very nice control of axial inclination, the CBCT demonstrates the presence buccal plate

Author's Comments

Dr. Tom Pitts

Dr. Duncan Brown

"Our goal in teaching continues to be to improve esthetic and functional outcomes, while simplifying treatment mechanics and improving predictability, and efficiency. In Active Early case management strategies, "flipping and flocking" the anterior brackets provides activation of torsion within the appliance without bending wires. The H4 precision appliance is perfect in this regards."

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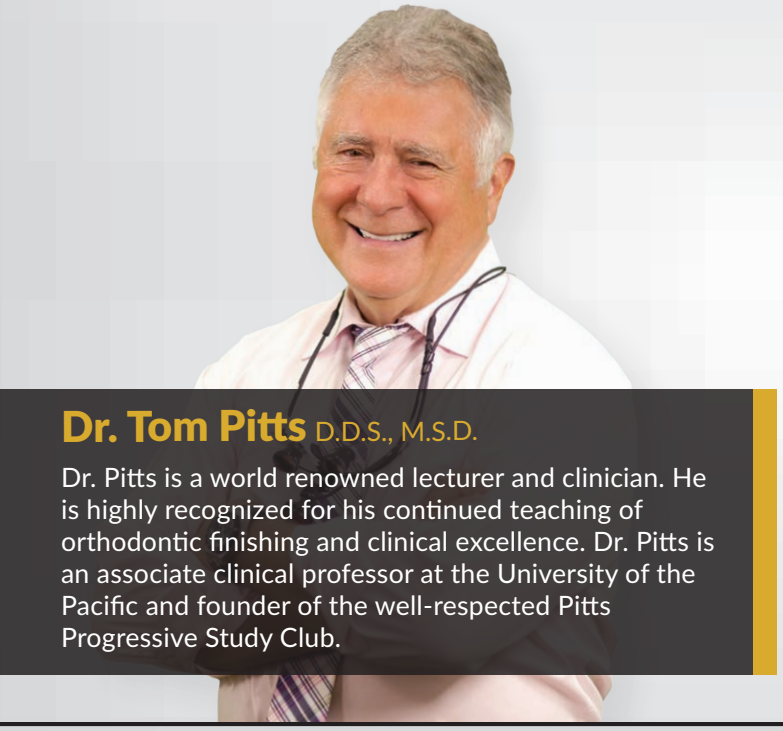

Dr. Tom Pitts D.D.S., M.S.D.

Dr. Pitts is a world renowned lecturer and clinician. He is highly recognized for his continued teaching of orthodontic finishing and clinical excellence. Dr. Pitts is an associate clinical professor at the University of the Pacific and founder of the well-respected Pitts Progressive Study Club.

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- Keys to Proper Arch Development
- "Active Early" Concepts Including Torsion
- Open-Bite, Cl III, Cl II Non-Surgical Corrections
- Retaining Open-Bites, and Cl III's
- Mastering Esthetics with OC H4
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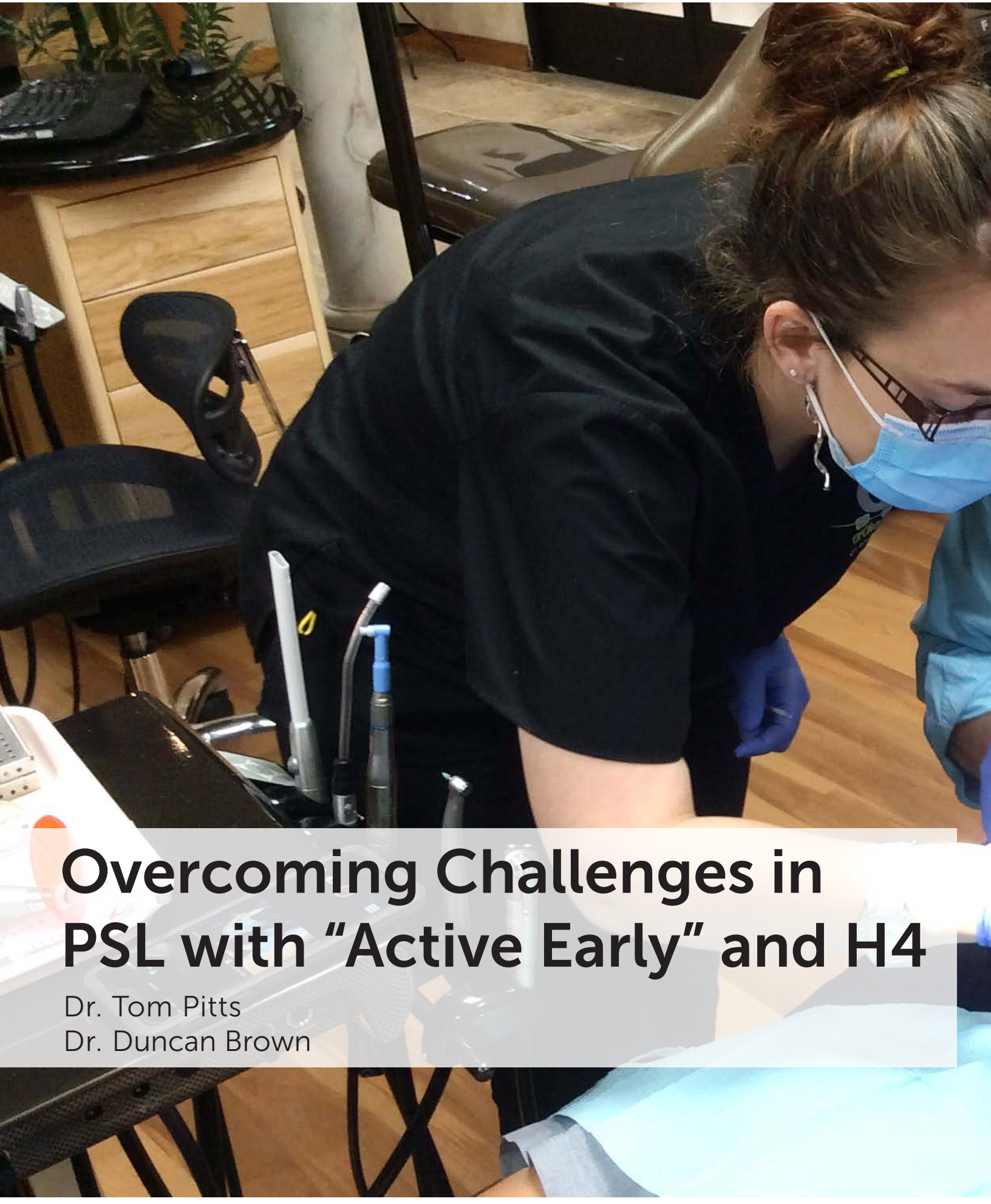


Overcoming Challenges in PSL with "Active Early" and H4

Dr. Tom Pitts
Dr. Duncan Brown

“Everything should be made as simple as possible but no simpler”

- Albert Einstein

Introduction

As orthodontic clinical procedures and esthetic preferences continue to evolve, the clinical approaches that we rely on today are quite different than those frequently used by earlier generations of orthodontists[1]. Frequency of four bicuspid extraction has diminished with greater acceptance of non-extraction and has been gaining in popularity as fuller lips, broader smiles, and greater enamel display becomes esthetically more desirable (Figure 1,2,3). Most of the fixed appliances today have their torque values based on extraction cases and class II correction with maximum anchorage.

Virtually every orthodontist that practices today uses some variant of the "straight wire appliance", a concept that has dominated our profession since Larry Andrews' breakthrough article[2] led to its development in the 1970's. Mechanical limitations are inherent in the theory in terms of the potential for torque expression[4]. Inaccurate bracket placement, variation in tooth structure and tooth facial morphology, variations in the maxilla/mandible skeletal relationships, tissue rebound, mechanical deficiencies in the appliances[3], and variable threshold of biological activation are all factors that can affect torque expression. Refinements to the straight wire appliance in the last twenty years have largely focused on minor 3rd order adjustments with the goal of attaining greater predictability of desired 3rd order movements during treatment. The pivotal point is that appliance and treatment techniques must combine to provide forces in a wanted direction to create a positive effect on tooth movement[4].

Each orthodontist chooses an appliance system believing that it will help to attain good results. Unfortunately, limitations in the manufacturing processes combined with strongly held misconceptions derived from "straight wire theory" make case management more difficult. Too often, good clinical results are attained "in spite of the technology used, not because of it".

Today I would like to briefly examine the role of the appliance, some widely held case management approaches, and suggest a few simple strategies that can make treatment more efficient, more consistent, and improve the quality of the end result. **Far too many treatment outcomes today have excessive upper incisor proclination.**

Figure 1: Contemporary macro-esthetic standards include full lips, broad smiles, good enamel display - Courtesy Duncan Brown 2014

Figure 2: Contemporary mini-esthetic standards include broad smiles, consonant smile arcs, optimal axial inclination - Courtesy Duncan Brown 2014

Figure 3: Contemporary micro-esthetic standards include "white and pink" tissues optimized for esthetics and functional health - Courtesy Duncan Brown 2014

How Ligation Method Fits into this Context

While there has been much debate on the relative merits of ASL (Active Self-Ligating), PSL (Passive Self-Ligating), and Traditional Ligation, these principles that we talk about today apply to all fixed orthodontic appliances regardless of ligation type. The fact is that the "best orthodontic results are produced by the best case managers regardless of the appliances they use".

I have used self-ligating appliances almost exclusively for the last 15 years. I prefer this ligation method for a number of reasons:

I also prefer "passive" ligation, but realized long ago that manufacturing accurate manufacturing tolerances are paramount.

- **Initial Bracket Engagement:** With self-ligating brackets, consistent ligation is assured. Once the slide is closed, engagement of the wire/bracket interface is as good as it is going to get. This increases efficiency.
- **Improved Hygiene:** Elimination of either steel ligature "pigtails" or elastomeric ties is an asset in terms of improving hygienic outcomes[5]. A disciplined hygiene control program will help ensure beautiful results.
- **Faster Wire Changes:** It is very easy to engage wires in a PSL mechanism, so that wire changes can be done very quickly and efficiently.
- **Quick Out of the Gate:** Orthodontists around the world have found PSL to be very quick out of the gate in terms of unravelling and crowding but difficult down the stretch, where rotations and torsional control are difficult, often taking longer to achieve excellent finishing. We have changed the slot geometry in the H4 appliance in order to address the typical PSL difficulties and reduce treatment time by several months[7].
- **Easier Arch Development and Open Bite Closure:** We find that arch development and early mechanics in cases with proclination, crowding, or class III are most easily managed with appliances that have minimal resistance to sliding (RTS). We like the H4 PSL for this.

"The combination of H4 brackets and Pitts Broad AW's in **"Active Early"** case management protocols provides **"3D control"** earlier in treatment than has been possible with any other system!" ***-Tom Pitts***

Studies demonstrate that PSL mechanisms display less RTS than either ASL or traditional ligated systems in round wires. This has led to marketing claims made by some companies that the PSL mechanism would translate to: improved treatment outcomes, shorter treatment times, and fewer treatment appointments. None of these companies have the necessary rigorous clinical research to support these potential benefits.

I use the H4 bracket, a more precise "straight wire" PSL appliance that incorporates a number of unique features in a high quality appliance, at a great price point. Over the years, I have developed a case management strategy that is being called "Active Early", which leverages the unique features of the H4 appliance, overcomes many misconceptions imposed by rigid adherence to "straight wire theory", and addresses the shortcomings common in other PSL brackets.

In PSL, engagement of the wire and slot is entirely dependent on the mechanism rather than on elastomeric ties or steel ligature ties, so it is of paramount importance that the manufacturing tolerances are precise to ensure predictable performance of the appliance. **Too much "slop" in the bracket slot leads to difficulty in rotations and torque expression in the anterior region.**

Manufacturing Tolerances Matter

Early literature on the potential for torsion created in the appliance was based on theoretical mathematical models. When conclusions derived from this process are applied clinically, the results are frequently disappointing and there are a number of reasons for this.

As clinicians are primarily concerned with torque expression, the ability of the appliance to generate appropriate forces and moments is of primary importance, even after patient specific factors are taken into account. Basic scientific research into manufacturing tolerances of both the brackets and wires have discovered several important facts that have direct clinical application:

- **There is No True Straight Wire Appliance, Even When Using Digital Setup:** Very rarely can a case be finished with excellence without wire adjustments (Figure 5).
- **Many Orthodontic Slots Are Very Inconsistent:** Many have rounded corners, slot walls that are not parallel, rounded internal line angles, variable slot taper, slot dimensions that are oversized up to 27%[9]. This variation effects generation of torsion developed within the slot as well as rotational control.
- **Orthodontic Brackets Are Not Rigid:** Deformation occurs in an elastic (returns to original shape after torsion is removed) or plastic (permanent deformation) manner when torsion is applied. These deformations can and do occur within torsion ranges commonly applied in clinical practice[10], effecting torsional expression.
- **Orthodontic Wires Are Variable:** Actual cross sectional geometry and varying material properties effect torsional stiffness and therefore torque expression[11]. The clinical relevance of this research is that even at 25 degrees of twist (a clinically significant twist), insufficient torsion may be created effectively to change the axial inclination of teeth.
- **Corner Radius of Wires Are Remarkably Variable:** The angle of engagement is dependent on the corners of the wires engaging the super and inferior walls of the slot. The edge bevel contribution to engagement angle can range from .2 to 13 degrees depending on the bracket/wire combinations[12]. The worst performer in this regard is found in certain beta titanium wires, which is generally favored for increasing torsion through wire bending.

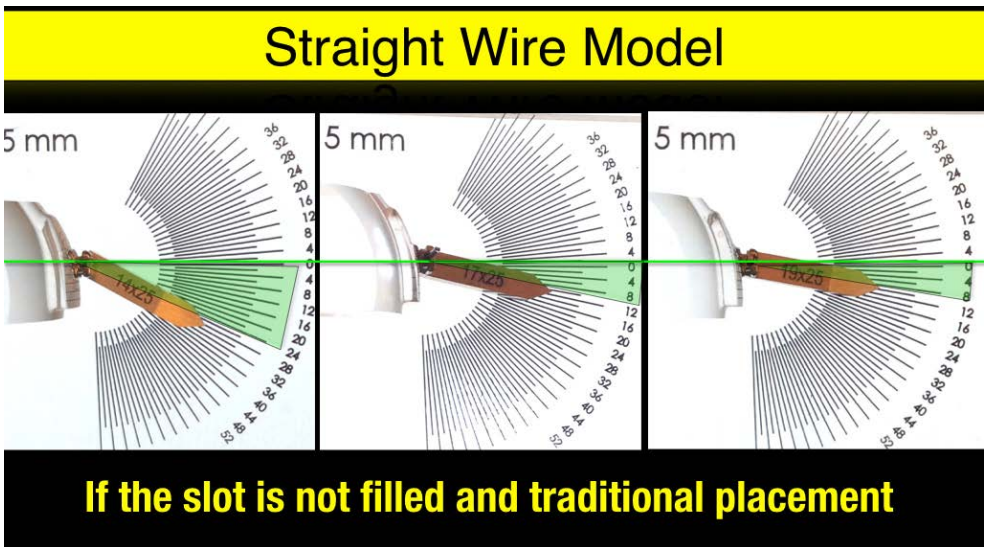


Figure 5: Too proclined incisors with familiar wire progressions and bracket slot positioned as suggested in "Straight Wire" theory, torsion is unlikely to be developed within the slot

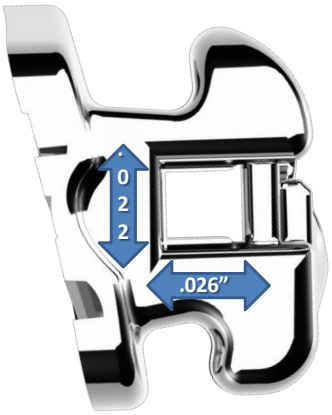


Figure 4

H4 Slot Dimension
.022" x .0260" +/- .001"
Slot Depth Tolerance

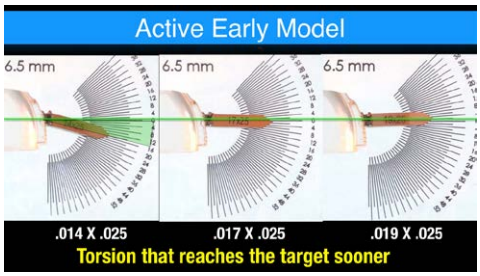


Figure 6: With familiar wire progressions and bracket slot positioned as suggested in "Active Early" approach, torsion within the slot is developed earlier in the treatment cycle.

Popular "low" torque brackets are not low enough to do the job.

Reducing Challenges of Appliance Manufacturing & Common Clinical Practices

We favor the H4 appliance from OC Orthodontics for a number of reasons. OC has a MIM manufacturing process with tolerances that are much tighter for more predictable performance, dense metallurgy minimizing deformation, a rigid slide, and reduced slot depth. These factors improve rotational control while reducing the engagement angle for torsional control early in the treatment cycle, when using familiar wire progressions when the bracket is upright (Figure 6).

Today, I want to initiate wanted forces and moments within the appliance as early in treatment as possible. We use SAP[18] bracket position to adjust the vertical position of the incisors for smile arc an enamel display, and invert groups of brackets ("flipped and flocked") as needed to activate torsion in the appliance sooner. We adopt arch wire progressions and profiles that control axial inclination earlier in treatment. We adopt arch forms that develop the posterior segments of the arches sooner, "ELSE" (Early Light Short Elastics) to control forces and moments, and appropriate disarticulation to encourage specific tooth movements. This has become known as an "Active Early" approach to case management.

An "Active Early" Approach

One of the distinguishing features of the "Active Early" approach is adapting to "slop" that is present in all straight wires appliance slots. In this approach a good deal of control is available through a number of clinical opportunities when using non-adjustable wires. Most notable among them are:

Figure 7: Positive effects of "White and Pink" tissue optimization prior to bonding. Courtesy Nimet Guiga and Duncan Brown.

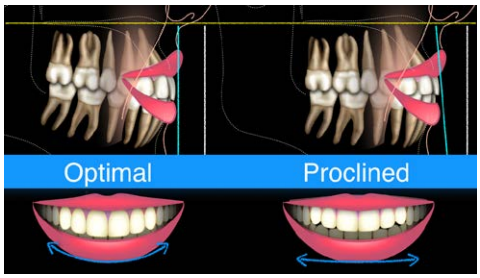


Figure 8: Although the upper incisor inclination to occlusal plane is the same, esthetic presentation is effected by cant of the occlusal plane - adapted from Rungsi Tavarungkul 2012

- **Optimize "White and Pink" tissue contour prior to bonding:** Patients today want beautiful faces, beautiful smiles, and beautiful teeth; meaning teeth and tissues need to be "optimized" for shape and contour. Prior to bonding, hard tissue recontouring improves the ability to place brackets in the appropriate location to maximize the smile arc, optimize axial inclination, and control 1st and 2nd order changes during tipping or early torsion mechanics. All surfaces that have been adjusted are smoothed with a white stone and black rubber tip using a high speed hand piece. Soft tissue revision using diode lasers are very useful in optimizing bracket position for smile arc enhancement (Figure 7).

- **Patient Specific SAP Bracket positioning:** We reject the theory that the bracket slot has to be positioned in the middle of the crown. Bracket position is individualized to meet each patient's **esthetic** need. **Many patients need more enamel display upon smiling**. I like to enhance or preserve the **"smile arc"** on all patients. This requires the divergence of the upper wire plane, created by bracket position, and must increase anteriorly to develop the smile arc by extruding the upper incisors relative to the upper bicuspids. A divergence is still advised in deep bite cases to avoid excessive reduction in smile arc with reduction in overbite. It is important to remember that large bracket progressions in the upper arch must be compensated for by over-leveling the lower arch to establish optimum overbite relationships. A number of articles on the SAP technique have been published in recent years and SAP bracket positioning is now being employed regularly around the world[19,20] (Figure 8,9,10).

Don't believe the mythology that SAP hurts the bracket slot torque. Torques changes in SAP positions are actually an advantage in a high percentage of non-extraction cases. Being closer to the center of resistance of the root provides more control. Most of my non-extraction cases required lowered torque, so we "flip" many upper anteriors in cases of crowding, class III, and proclination as needed (Figure 11).

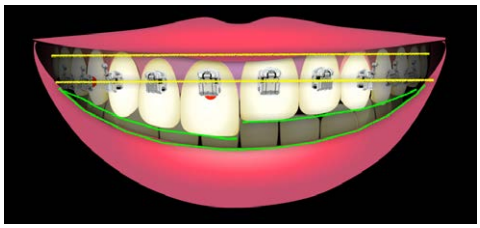


Figure 9: SAP versus Traditional bracket position - failure to adjust the bracket position to meet esthetic needs can result in flattening of the smile arc and esthetic decline

- **Torque Selection:** With the worldwide tendency to treat more cases without extractions, the control of proclination of the upper anterior teeth has become a greater challenge. Correction of pre-existing crowding and proclination, associated with relief of crowding during traditional round wire mechanics, or incisor proclination associated class III (in the upper arch) elastics is particularly problematic. The challenge for many non-extraction cases has been in getting enough lingual crown torsion without having to resort to complex wire bending and torquing springs to attain esthetic results.

- **Inverting or Flipping Brackets For Flared Upper Incisors:** Rather than resorting to a constellation of "variable torque" prescriptions, **inverting standard torque anterior brackets** builds sufficient lingual crown torsion into the appliance using a flat wire (Figure 11). The H4 appliance Rx is much better in this regard, predictable when upright, and appropriate when flipped providing greater lingual crown torque to the central when uprighting of the upper anteriors is required. The single H4 Rx then provides torque combinations suiting the majority of cases with a minimum of wire adjustments. For the clinician primarily concerned with torque expression, it matters solely when/if torsion is developed within the slot during commonly used arch wire progressions, and "flipping" brackets for proclined upper incisors, ensures that torsion is present in the slot from the outset of dimensional wires. We are teaching orthodontists how and when to "flip" brackets (Figure 11).

Figure 10: Wire plane and upper occlusal plane are not necessarily parallel in patients with good esthetics and sound functional occlusions - Courtesy Duncan Brown 2015

- **ELSE (Elastics, Light, Short and Early):** I have advocated use of light elastics from the first appointment for the past 20 years, especially when using PSL mechanics. Sabrina Huang, from Taiwan, suggested the ELSE acronym some years ago, and I continue to describe the technique in those terms. The use of ELSE (no more than 2.5 oz.) increases the efficiency of treatment dramatically by maximizing "wanted" tooth movements in all dimensions, and minimizing or mitigating "unwanted" tooth movements early during the tipping or early torsional phases of treatment (Figure 12,13). Patient cooperation is critical, and reinforcing early progress through "every appointment" photography is very useful. ELSE can minimize "round tripping" on non-extraction cases, and facilitates moving disarticulated teeth with very light forces.

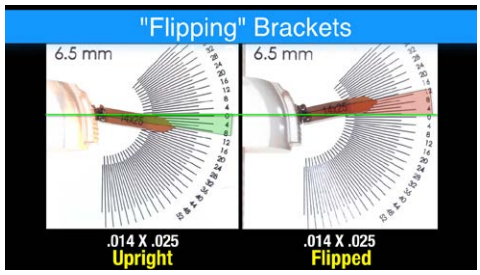


Figure 11 - Effect of "flipping" an anterior bracket is to place an effective degree of lingual crown torsion in the appliance

- **Appropriate Disarticulation:** The use of OG's (occlusal guides) to adjust the occlusal plane and maximize wanted and minimize unwanted tooth movements is a important "Active Early" contributor. Teeth move readily with lighter forces when disarticulated. It is very important that OG's are positioned strategically to erupt or intrude the appropriate teeth to improve esthetics and function. We'll be talking about OG's in a later issue of the Protocol.

- **Arch Width and Arch form:** Using Pitts Broad arch forms allows early development of arch width in the areas where the esthetic benefit is the greatest. It has never made sense to me to start with arch wire forms that are narrower than the case needs to finish esthetically. Working with OC Orthodontics, we have created a full suite of arch wires

Figure 12: Excellent control of tooth position, and esthetic improvement using "Active Early" principles of recontouring, SAP bracket placement, disarticulation and ELSE- Courtesy of Nimet Guiga 2015

Figure 13: Excellent control of tooth position, and esthetic improvement using "Active Early" principles of recontouring, SAP bracket placement, disarticulation and ELSE- Courtesy of Duncan Brown 2014

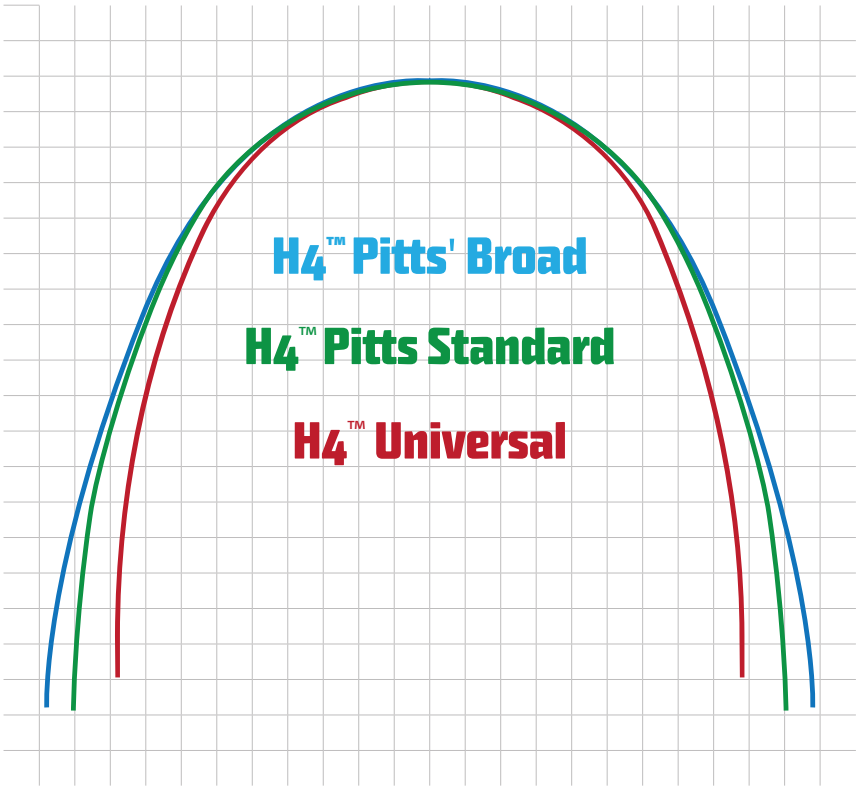
Figure 14: i2 torquing powerchain for torsional control early in treatment - Courtesy of Nimet Guiga 2015

- develop the arches transversely from the outset to an esthetically pleasing arch form (Pitts Standard, Pitts Broad) (Figure 13), where research has shown that a great amounts of transverse development occurs[21]. It is very important and optimal inclination of the buccal segments is attained for ideal esthetics and occlusal function, and this is assessed at each appointment. Lifelong retention is a part of this strategy.

- **Torquing Power Chains:**
  In order to help early torque control, i2, i3 torquing powerchains are used as a tool of controlling axial inclination early in treatment. Incisal torquing elastomeric chain to minimize unwanted tipping of teeth during the relief of crowding is proving very helpful, especially in cases where the anterior brackets have not been "flipped" (Figure 14). Dr. Guiga introduced us to this concept, which has helped significantly in torque control early in cases after the 20X20 TA Niti is placed (Figure 14).

- **Square Wire Early:** We have developed a wire progression approach that allows the orthodontist to initiate control of axial inclination through torsion developed within the slot much earlier in treatment than was previously possible. Using 020X020 TA Niti wires allows torsion within the slot to be initiated early, frequently by the 2nd or 3rd appointment. "Square Wire" finishing on many cases provides a simple, effective and efficient means of attaining esthetic results.

  Look for more innovations in the near future to further improve this approach.



Pitts Broad (blue), H4 Standard (green), H4 Universal (red) arch forms - broader arch forms produce broader arches and broader smiles - Courtesy Tom Pitts 2013

Summary and Case Management Considerations

We see efficient esthetic treatment by these active early protocols:

- Combining the SAP bracket position to adjust vertical position of the incisors.
- Selecting arch wire progressions that control axial inclination early in treatment through using Pitts Wide arch forms that develop the posterior segments of the arches sooner
- Shortening the depth of the bracket slot.
- Using ELSE and appropriate disarticulation to encourage "wanted" tooth movements.

The H4 appliance makes a quantum leap for treatment. The ability to "flip" anterior brackets as a part of the "Active Early" approach, in combination with the precision and dependable prescription (Figures 15 - 21) solves issues orthodontists have traditionaly struggled with in most PSL appliances. With OC Orthodontics, we are continuing to refine the H4 appliance, as the "Active Early" protocols continue to evolve.

In the upcoming issues of The Protocol, we will explore other parameters of "Active Early". Stay tuned, it will be exciting.

Until next time.....

Figure 15: Initial Records - Courtesy Duncan Brown 2015

Figure 16: Excellent control early in treatment using "Active Early" case management protocols; SAP bracket placement, "flipped" slots 2x2.- Courtesy Duncan Brown 2015

Figure 17: Excellent control early in treatment using "Active Early" case management protocols; SAP bracket placement, "flipped and flocked" upper anteriors, "flipped" lower anteriors, ELSE and disarticulation - Courtesy Duncan Brown 2015

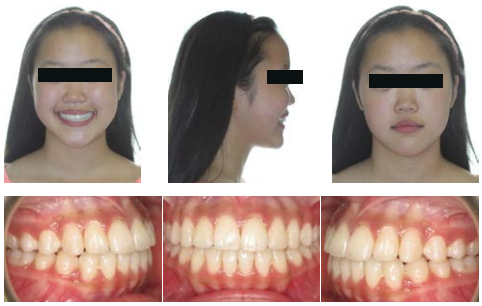


Figure 18: Very nice esthetic change efficiently attained- Courtesy Duncan Brown 2015

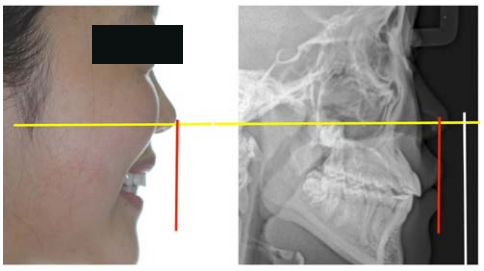


Figure 19: Optimized upper incisor position- Courtesy Duncan Brown 2015

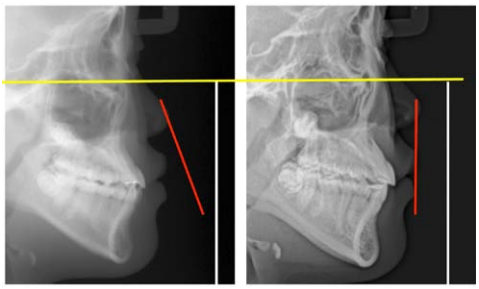


Figure 20: Uprighted upper incisor with "Active Early" protocols- Courtesy Duncan Brown 2015

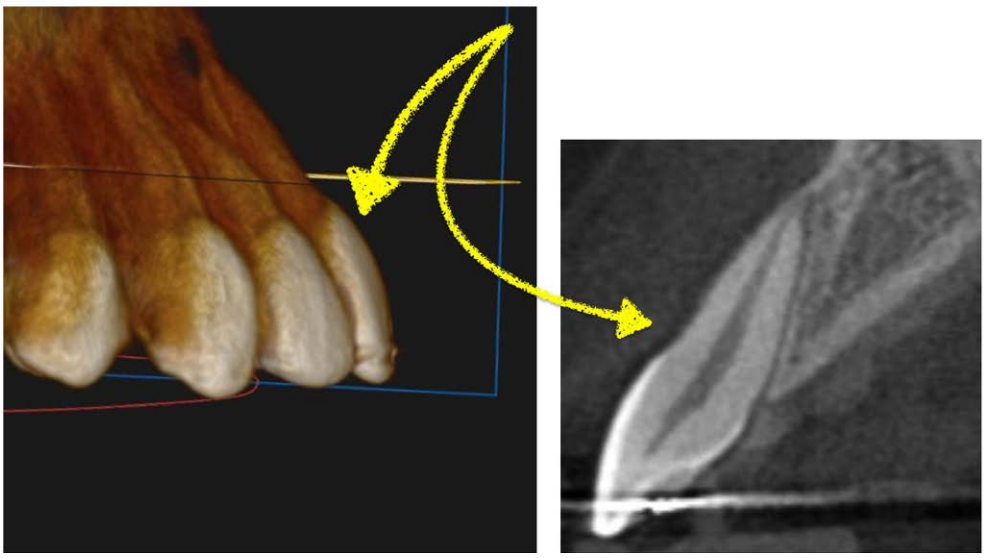


Figure 21: Post treatment CBCT confirming presence of buccal plate - Courtesy Duncan Brown 2015

Author's Comments

Dr. Tom Pitts

Dr. Duncan Brown

"Our goal in teaching is to improve esthetic and functional outcomes, while simplifying treatment mechanics and improving predictability, and efficiency. Working alongside OC Orthodontics we will be introducing more innovative technology and approaches to simplify your mechanics, while providing effective solutions to clinical problems that are also efficient."

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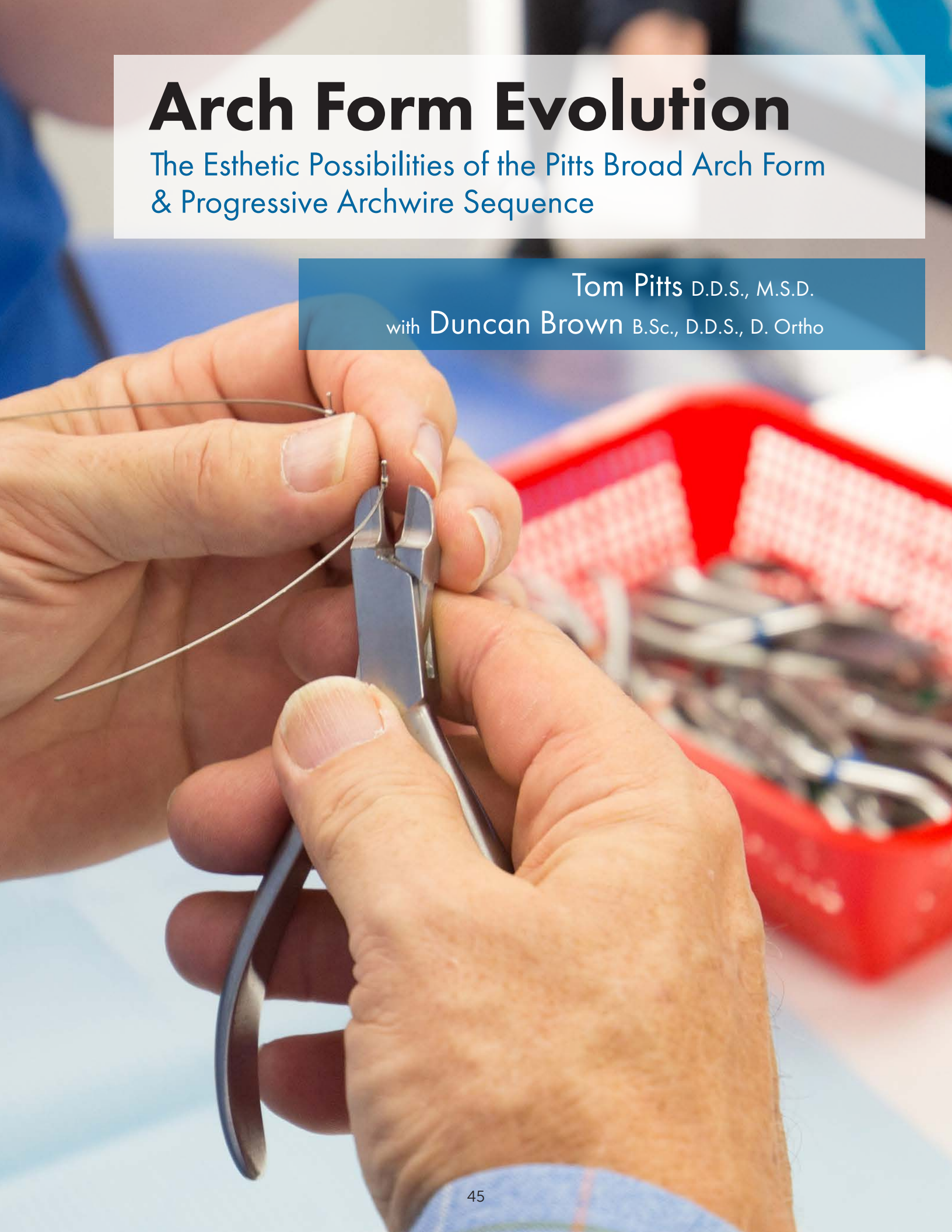
Arch Form Evolution

The Esthetic Possibilities of the Pitts Broad Arch Form & Progressive Archwire Sequence

Tom Pitts D.D.S., M.S.D.
with Duncan Brown B.Sc., D.D.S., D. Ortho



"Logic will get you from A to B, imagination will take you everywhere!" – Einstein

The most frequent questions that we get asked from orthodontists around the world are related to arch form, and archwire progression. This article will explain why we believe the Pitts Broad Arch Form - a relatively new arch form - produces the most esthetic orthodontics on the market today, and why the Pitts Progressive Archwire Sequence is efficient, effective, and simple.

I have been evolving an arch form and approach to archwire progression since my residency. This journey has provided a number of insights. When I was studying at the University of Washington from 1968 to 1970 under Drs. Richard Riedel and Alton Moore, I was taught that - in an attempt to enhance stability - arch form and arch width should reflect the original malocclusion prior to treatment. Over 35 years of data collection from the faculty at the Department of Orthodontics at the University of Washington has clearly demonstrated that long term stability is highly unpredictable. "Orthodontic treatment is inherently unstable and without retention relapse is inevitable."

Because of these findings, my own clinical experience and that of the thousands of orthodontists I've coached and spoken with over the course of my career, **I believe in lifetime nighttime retention of orthodontic finishes.**

Shortly after graduation in 1970 I enrolled in the first FACE continuum, studying with Dr. Ron Roth. Dr. Roth had adopted an arch form that was horseshoe-shaped and very wide in the anterior. After using this arch form for some time, it became clear to me that cases treated with arch forms too broad and flat in the anterior and too narrow in the molars do not create esthetically appealing finishes.

Later, a group of innovative orthodontists with which I was affiliated (the A Company Innovation Group), developed an arch form sometimes called the "Universal" or "Damon" arch form. This arch form was subsequently adopted by many orthodontists around the world and seemed at first to be able to achieve results more esthetic than previous arch forms. After using the Universal and Damon arch form for many years, however, I found the shape lacking.

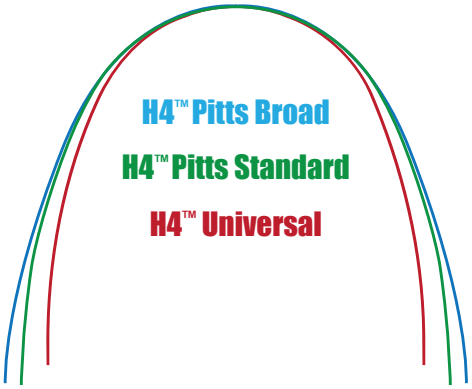
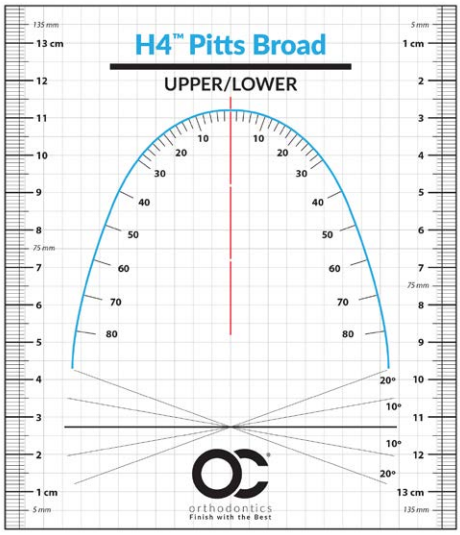


Figure 1: Evolution of esthetic arch forms: "Pitts Broad" arch forms are preferred - courtesy Tom Pitts 2013



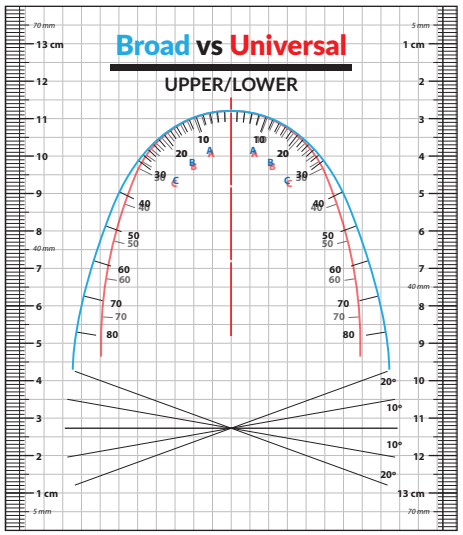


Figure 2: Comparison of Pitts Broad and Universal Arch form developed by Tom Pitts - courtesy Tom Pitts 2013

Figure 3: Esthetic changes associated with change in arch form created through arch shaping in adjustable archwires - courtesy Tom Pitts 2013

Cases were not broad enough posteriorly for great esthetics and required further arch shaping in adjustable wires. Using wires with this arch form in conjunction with traditional archwire progressions through the nickel titanium archwire stage, it would take eight months to a year to progress to an adjustable archwire (TMA or Stainless Steel) where further posterior arch development would need to be initiated through wire shaping. This was effective but not efficient.

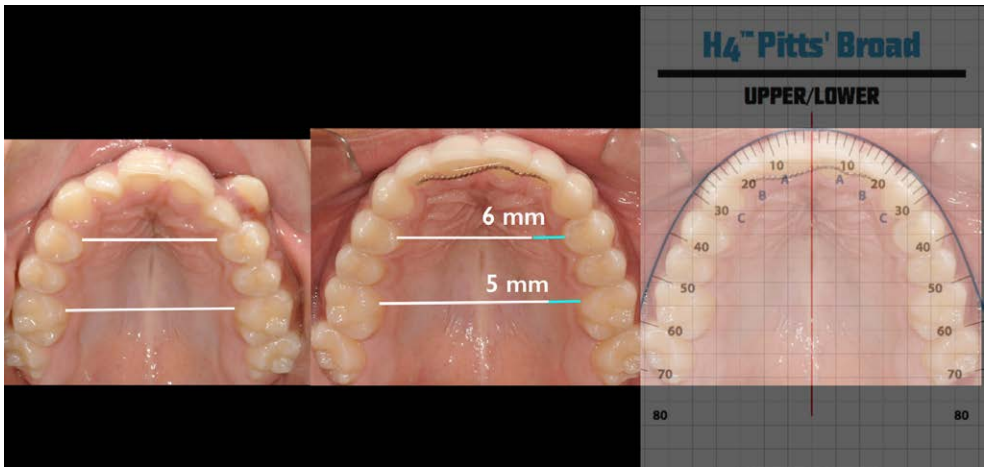


Figure 4: Esthetically derived arch forms created through wire bending were the basis of Pitts Broad Arch Form (no molar distalization) - courtesy Tom Pitts 2013

Figure 5: Esthetic gain of a broader smile, not too wide in the canines, great smile arc, full enamel display on smiling, and optimal incisor inclination - courtesy Duncan Brown 2016

Figure 6: Arch Width and Arch Form changes associated with esthetic gain - courtesy Duncan Brown 2016

When I attended Dr. Robert Rickett's continuum in 1975, I began to appreciate the treatment outcomes obtainable from a more esthetic arch shape that offered less expansion in the canine region and greater broadening at the molars. This arch form resulted in very esthetic smiles with less negative space in the buccal corridors. I began to mimic this shape when using adjustable wires and to gradually develop width in the molar region to maximize tooth display in the buccal segments (Figures 1-3). The result mirrors current concepts of dentistry where 12-tooth smiles are considered the most esthetic.

Obviously, some "out of the box" thinking is required to develop a system (bracket geometries, arch form, and archwire progression) that is efficient, effective, simple to use (and to train), that allows the orthodontist to consistently produce exceptional esthetic results. Fortunately, OC Orthodontics has a corporate culture that is committed to meaningful innovation.

Arch Form and Today's Esthetic and Functional Expectations:

Today, as I interview and show photographs of excellent smile esthetics to potential patients, they readily appreciate the esthetic value of fuller lips, broader smiles, great smile arcs, full upper teeth display upon smiling and optimal inclination of incisor teeth for esthetic presentation. Inevitably they will all say "I want that". For their smile to "age well", anticipation of facial aging changes must be incorporated into treatment designs as a primary focus rather than an afterthought,[1] (Figure 4 - 9)

Throughout the world, there is an increase in preference for non-extraction mechanics[2] to fill esthetic needs. Unfortunately for many, non-extraction biomechanics is frequently accompanied by the challenge of controlling upper anterior proclination associated with the relief of crowding. As we addressed in a previous version of the *Protocol*, control of axial inclination is achievable through the use of Active Early protocols with flipping the H4 brackets 180°[3]. For more information about the Active Early protocols, see an overview of it later in this article and also in issue 2 of *The Protocol*.

I have flipped upper anterior brackets for many years along with widening the buccal segments to control anterior axial inclination in non-extraction cases that had the potential to procline. Another challenge of broadening bicuspids and molars with fixed appliances is that axial inclination of the buccal segments must be controlled. Even though we use -27 degree torque brackets on upper molars and -22 on lower molars, we sometimes spin a little lingual crown torsion in the wires as we develop posterior arch width.

Research has confirmed that final arch width is a function of archwire form, not of the bracket[4] used during treatment. In response to the need for an improved arch form, broad in the molars (filling out buccal corridors), tapered in the anteriors (improving incisor flow and presentation), and slightly narrower than conventional arch forms in the cuspids and first bicuspids (enabling 12-tooth smiles during animation), I

developed the Pitts Broad arch form. In most patients, this arch shape fosters the 12-tooth smile. I have worked with the engineers at OC to develop all the wires I use - both the Pitts Broad and Universal arch forms. Beginning treatment with the Pitts Broad Thermal Activated Nickel-Titanium (TA NiTi) archwires gives the arches a chance to widen very early - part of the Active Early protocols.

Esthetic concepts of "Golden Proportion"[2] have largely been eclipsed by the concept of "Crown Virtual Widths"[5] in dental esthetic circles as a means of describing the visual "flow" desired in esthetically aligned teeth, and we subscribe to this concept. We view transverse development of esthetic arch forms as being independent of tooth size or extraction preference so that a single arch form, adjusted to meet esthetic need and compensated for biological availability is preferred. We reject the concept that patients with reduced tooth mass (either through extractions or smaller mesial distal widths of anterior teeth) should be treated with narrower arch forms[6]. To me, the arch shape is more important to smile esthetics than the proportions of the anterior teeth sizes to each other. (Figure 10 - 15)

Caution should be exercised in widening bicuspids and molars in patients with a thin periodontal biotype. We ascribe to the concept suggested by Dr. Michael Major (Edmonton, Alberta) of continuous assessment of the patient's biological availability to desired tooth movements as being especially valuable. In patients with thin biotypes, patients with thin labial and lingual thickness of labial/buccal/lingual bone plates at the level of root apex, or patients with pre-existing bony fenestrations[7], I modify the arch form to do very little widening, and assess progress through palpating of the labial and lingual plates at each appointment. This is a direct compromise where imposed biological limitations "trumps" esthetic desires.

It has been reported that achieving transverse arch development in the cuspids, bicuspids, and molars is highly effective with round thermally activated wires[8]. OC provides a full suite of archwire sizes and profiles so that arch form can be developed from the onset, producing arch forms that mimic esthetic arch shapes formerly created by wire bending. OC provides the following arch forms (Figure 1): Pitts Broad (which we use almost exclusively), Pitts Standard (which we use rarely) and Universal (for patients with limited biological availability or for wide lower arches and low torque).

Subtle adjustments in **final archwire shape in response to esthetic needs or biological limitations and minor torque corrections are possible in Beta Titanium and Stainless Steel archwires.** When using an Active Early approach - where torsional control and transverse arch development is achieved early in treatment - use of stainless steel archwires is seldom required, but these archwires are available for user who like them.

Figure 7: Esthetic changes associated with change in arch form created through arch shaping in adjustable archwires - courtesy Tom Pitts 2013

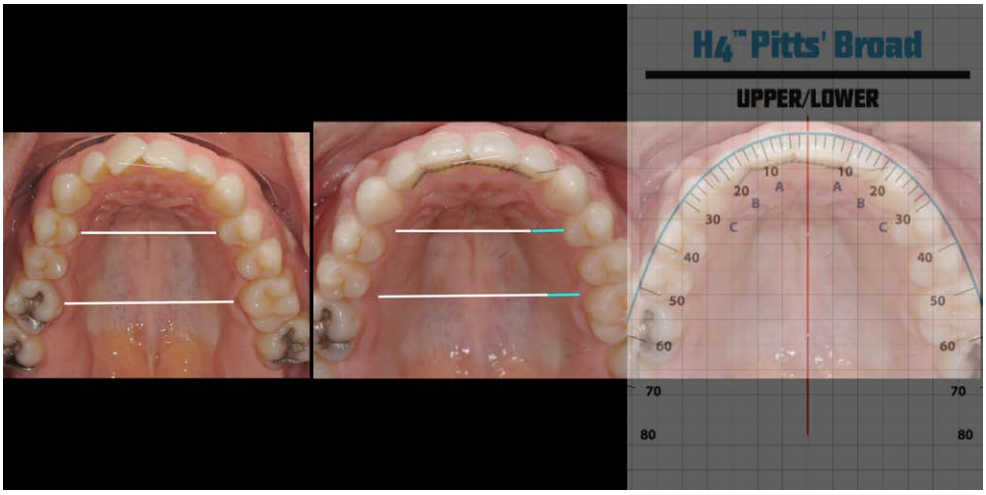


Figure 8: Esthetically derived arch forms created through wire bending were the basis of Pitts Broad arch form - courtesy Tom Pitts 2013

Management of Arch Form and Archwire Progressions:

In Active Early protocols,[9] the appliance is activated as early as possible using the Smile Arc Protection (SAP)[10] Bracket Positioning to adjust vertical position of the incisors, inverting groups of brackets **when appropriate** to activate torsion in the appliance, selecting arch wire progressions that control axial inclination early in treatment, arch forms that develop the posterior segments of the arches sooner, Early Light Short Elastics (ELSE) to control forces and moments, and appropriate disarticulation to encourage early "wanted" tooth movements as well as extrusion or intrusion. In contrast to conventional "straight wire thinking" where forces for torsional correction or transverse arch development are applied in short duration later in treatment and at higher force levels, the Active Early

Figure 9: Esthetics delivered by Pitts Broad arch form create "WOW" smiles - courtesy Nimet Guiga 2016 [12]

Figure 10: A broad smile, great smile arc, and full enamel display is critical in patients with smaller teeth - courtesy Duncan Brown 2016

Figure 11: Esthetic gain of optimal incisor inclination -courtesy Duncan Brown 2016

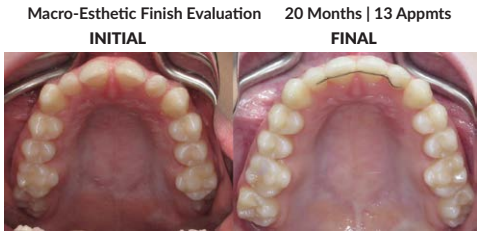


Figure 12: Arch Width and Arch Form changes associated with esthetics gain - courtesy Duncan Brown 2016

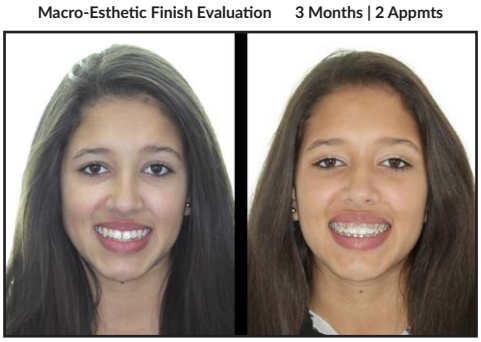


Figure 13

Figure 14

Figure 15: Esthetic gain using Pitts' "Active Early" in control of axial inclination early in treatment in a compliant patient- courtesy Duncan Brown 2014

approach applies lighter forces, earlier in treatment, and for longer durations.

The Pitts Archwire progresssion leverages the tighter tolerances and reduced buccal-lingual slot dimensions of the OC H4 appliance and this sequence is specifically designed for use with the esthetically optimized Pitts Broad arch form and the Pitts Active Early protocols of case management.

Stage 1 - Arch Development and Torsion in Non-Adjustable Wires

In the past, wire progressions recommended for PSL brackets were intended for the use of light forces over long appointment intervals with the goal of initiating transverse arch development, controlling axial inclination using non-adjustable wires in the early stages of treatment. While this approach is still applicable for very crowded cases, the H4 appliance - with its shortened slot depth and more accurate slot tolerances - provides more treatment opportunities.

The goal of the Active Early protocols using the Pitts Archwire progressions is to move into .020″ x .020″ thermally activated archwires as early as possible to enable both transverse development (with Pitts Broad arch form) and anterior axial inclination control (through torsion developed in the slot). Dr. Ricketts held that a square wire is gentle and as effective in achieving torsion as using a rectangular wire and the science supports this claim[11]. Control of arch development and anterior axial inclination is maintained during the early stages of treatment by using light, short elastics (ELSE) from the first appointment, bite turbos, and other Active Early approaches. We suggest seeing patients every 6 weeks for the first 3 appointments by which time .020″ x .020″ thermally active archwires are usually in place.

Most cases are started with .014″ TA NiTi or .018″ x .018″ TA UltraSoft NiTi (in cases without significant crowding or rotations). Both of these archwires come in the Pitts Broad arch form. For cases started in .014″ TA NiTi archwires, patients are seen 6 weeks after bonding, then transitioned to .018″ x .018″ TA UltraSoft NiTi for 6 weeks. The goal is to get to .020″ x .020″ TA NiTi in 6 to 12 weeks, which initiates torsion developed within the slot via archwires while continuing arch form development. Square wires are great for torquing in lieu of rectangular wires. The .018″ x .018″ UltraSoft NiTi is a new archwire we developed at OC.

In patients where difficulty in resolving rotations occurs, we suggest progressing into .018″ x .025″ TA NiTi after the .020″ x .020″ TA NiTi. With the .025 dimension in the H4 .026″ depth slot, rotational correction should be easily acquired if the brackets are correctly positioned.

Stage 2 - Torsion and Arch Shaping in Adjustable Wires

In the adjustable wire phase of treatment there are several alternatives:

Without Rotations: In cases with few or minimal rotations, it is usually possible to move to completion in .020″ x .020″ Beta Titanium archwires. This wire is easy to adjust for individualized esthetic arch form and single-tooth adjustments of axial inclination. Clinicians should expect 2nd order adjustments, but axial inclination should be close. (Figure 16 to 19)

With Rotations: In cases where further rotational control is desired, progression into the .025″ wire is desirable. As torsion has been occurring within the slot for some time, axial inclination should be well controlled at this point:

- We suggest transition from .020″ x .020″ TA NiTi to .018″ x .025″ TA NiTi in these patients. In adjustable archwires, .017″ x .025″ Beta Titanium or .019″ x .025″ Beta Titanium represents familiar finishing wires for most experienced PSL user.
    - With flipped upper anterior brackets (either lateral-to-lateral or canine-to-canine), .017″ x .025″ Beta Titanium hits the "sweet spot" or optimal torsional and rotational forces. We have not found wire dimensions larger than this to be necessary.
    - In cases where greater torsional correction is desired, .021″ x .025″ TA NiTi is a good alternative, progressing to .019″ x .025″ or .017″ x.025″ Beta Titanium for finishing.

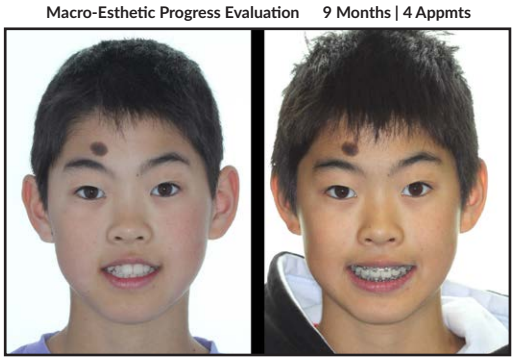


Figure 16

Figure 17

Figure 18: In Stage 2 the clinician should expect some 2nd order corrections will be required in the .020˝ x .020˝ archwire progression - courtesy Duncan Brown 2016

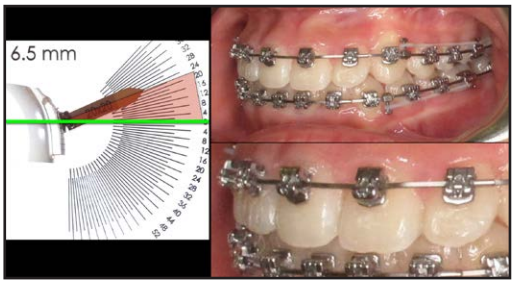


Figure 19: Good torsional control is present with flipped upper anteriors and canines with .020 x .020 Beta Titanium archwire — courtesy Duncan Brown 2016

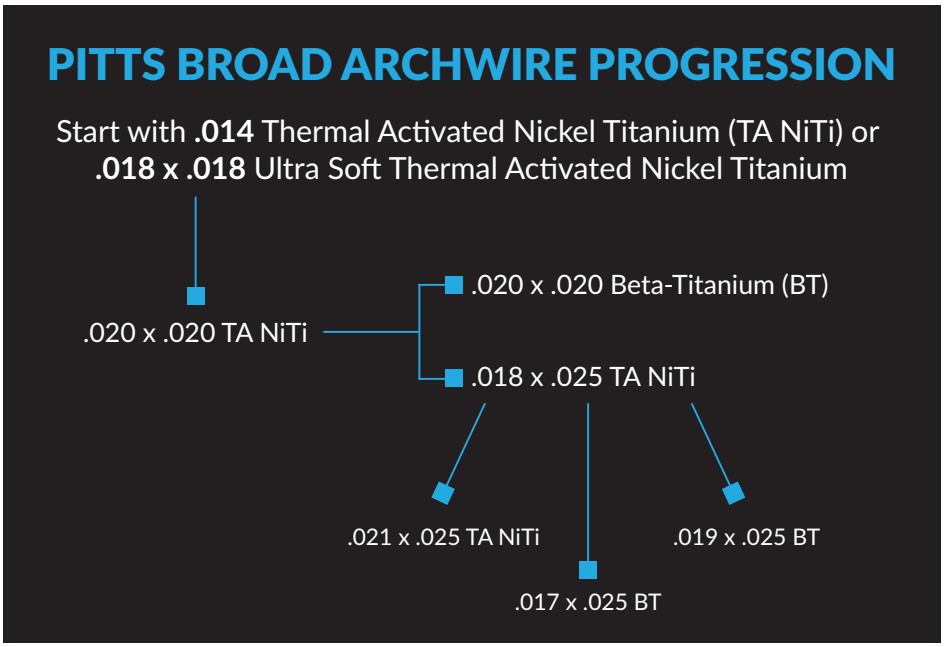


Figure 20: Simplified arch wire progression strategy using 022x026 H4 appliance — courtesy Tom Pitts 2016

The .018˝ x .018˝ Ultra-Soft Thermal Activated NiTi wire is breakthrough technology. We start many cases with this wire, including the second molars in the strap up on the first appointment. Progression to .020˝ x .020˝ TA NiTi in 6 weeks is very common. In cases where more rotational control is required, progression to .018˝ x .025˝ TA NiTi prior to .017˝ x .025˝ Beta Titanium is usually possible.

Because of the tighter tolerances of H4, many clinicians using it have been able to save several months of finishing time than with previous PSL brackets using the wire progression strategies just discussed.(Figure 20). We use Thermal Activated NiTi not Super-elastic NiTi - for all these wire progressions.

Don't clinicians want more effective, efficient and simpler treatment mechanics?
Working with OC, we will be continuing to introduce innovations to positively impact orthodontics, particularly from an efficiency standpoint. Look for these innovations to be forthcoming!

Cases and Stainless Steel Archwires:

We have found that stainless steel archwires are rarely needed in non-extraction cases, but are available for those who prefer them. I use them for extra widening when needed and for extraction cases where we typically use .016˝ x .025˝ stainless steel archwires for final space closure.

To Summarize:

Our goals in orthodontics are driven by "wow" esthetics and designed to compensate for - or counteract - the effects of aging. For many orthodontists, such goals constitute a new context for their treatment planning and clinical protocols. The scope of treatment is continually expanding. To remain competitive in an esthetically driven professional environment is a challenge. The Pitts Broad arch form - in combination with the H4 bracket and the associated Active Early protocols - offer new tools that are designed to simplify your lives while improving patient results.

We welcome you to join us for the Pitts Global Masters Continuum starting March 23, 2017. This is a four session comprehensive continuum over a two year period. For more information visit www.orthoevolve.com or contact Joni Abel at 775.720.7222 or email jonibeedle@yahoo.com.

We are planning more innovations so stay tuned! Great to have you along!

Until next time...

Drs. Tom Pitts and Duncan Brown

Author's Comments

Dr. Tom Pitts

Dr. Duncan Brown

"Most orthodontists think achieving the esthetic results they want comes down to the bracket they use. The truth is that the wire used is just as important as the bracket when attaining efficient and superior results. Working with OC Orthodontics, we have developed a bracket and wire combination that is effective, efficient, and simple. Outstanding and predictable results, with a reduction in inventory, are now obtainable when using the Pitts Broad Arch Form in combination with the H4 bracket and Active Early Protocols. Try it, you'll love it!" - Dr. Tom Pitts

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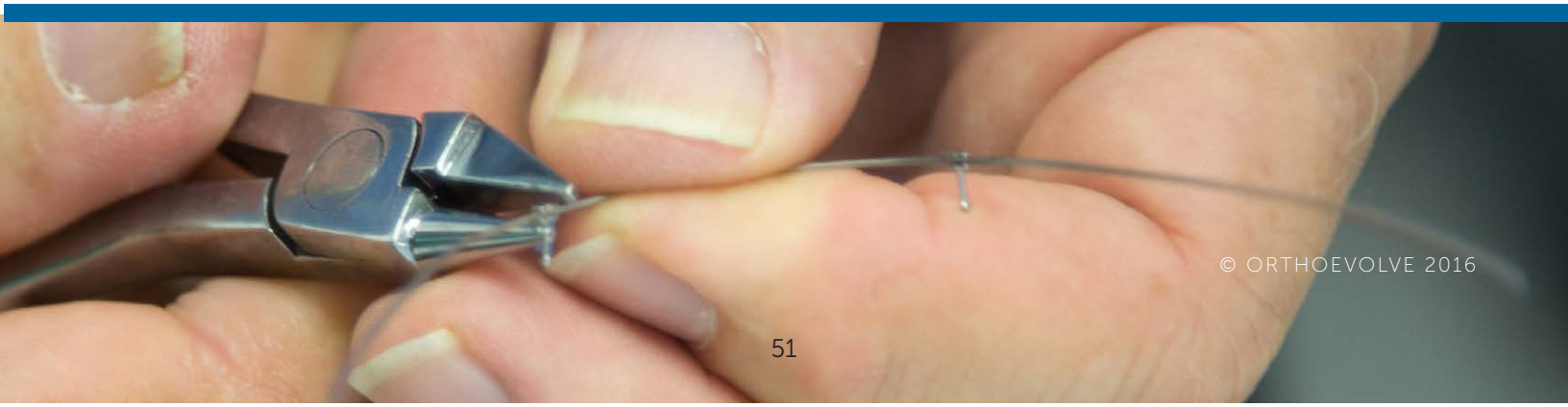

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