BEGIN WITH THE END IN MIND:
Bracket Placement and Early Elastics Protocols for Smile Arc Protection

Thomas R. Pitts, DDS, MSD
Dear Friends,

Our commitment to the orthodontic profession extends beyond tools to help you provide excellent care for your patients. Our resources are heavily invested in developing differentiated treatment technologies that motivate more consumers to seek orthodontic therapy.

To that end we are proud to announce that Ormco and Align Technology, Inc. have entered into an exclusive arrangement to jointly develop a treatment solution specifically for the orthodontic specialist. This technology involves Ormco’s Insignia® custom bracket and archwire system as well as Align’s Invisalign®* appliance. By leveraging the best-in-class technologies of Insignia and Invisalign, this dynamic new product offering will expand the scope of current aesthetic treatment options while allowing you to provide high-quality orthodontic results.

We are truly excited about this new therapeutic alternative that will provide orthodontic specialists with a dynamic new option that we expect will have appeal for more patients. In fact, third-party market research confirms that millions of adults with complex malocclusions lie outside the capabilities of aligner therapy alone. While some of these adults may choose full fixed-appliance treatment, many will reject any remedy that disallows an aligner.

Our development venture with Align will address this growing population and is expected to help orthodontists provide an integrated approach that will appeal to more patients while delivering new standards in efficiency, comfort and aesthetics.

Ormco has built its reputation on promoting improvements and innovations for the benefit of the orthodontic profession. We are proud to be true partners with the specialists we serve, working together to improve the treatments they deliver.

On behalf of all of us at Ormco and Sybron Dental Specialties, I want to thank you for your ongoing support. We will continue to provide the innovative technologies, support and services you need to deliver outstanding patient care and build even more successful practices.

Sincerely,

Don Tuttle
President, Specialty Division
Sybron Dental Specialties

*Invisalign is a registered trademark of Align Technology, Inc.
Almost 40 years ago, I had the good fortune to come under the
influence of one of the 20th century’s quintessential orthodon-
tists, Dr. Reed Holdaway of Provo, Utah. Disenamored with
the prevalent diagnostic and treatment planning regimens and
the uncertain results they produced, e.g., Tweed Triangle and
the Steiner Analysis, Reed took a different approach and
developed Visualized Treatment Objective (VTO).

VTO is based on the soft-tissue profile and position of the
maxillary incisors that support both upper and lower lips. Relying on predictions of growth and the effects of his
mechanics, Reed could accurately forecast what his patient’s
profile would look like at the completion of treatment. He
demonstrated the reliability of his calculation with cephalo-
metric tracings that superimposed almost perfectly with his
soft-tissue predictions on patient after patient.

I had never seen anything like this phenomenon, and asked
if he would instruct me in the technique. In explaining it, he
shared an article from a Salt Lake City Deseret News columnist
that had a profound effect on his thinking. The writer urged
readers to plan objectives by picturing what their venture
should look like at its termination; i.e., begin with the end in
mind. Reed thought that the idea held special relevance for
orthodontic treatment planning, and he carried out the con-
cept to its fullest and most sensible conclusion.

Today, many other orthodontists are incorporating the
concept of begin with the end in mind into the development
of their protocols that give the highest consideration to soft-
tissue limitations, growth, aging and smile arc protection.
Dr. Tom Pitts is such an orthodontist who, in his feature
article, shares how he prepares his patients’ malocclusions
from the very start to have the eventual excellence that he
demands: e.g., protect or solve for a pleasing smile arc, achieve
ideal occlusion and provide mid-facial and lip support. Tom
diligently reshapes teeth, employs variable torques and has
developed a unique bracket positioning protocol. He’ll also
share another technique he originated—early mechanotherapy
(with light elastics begun at initial bonding) for the correction
of sagittal discrepancies.

Reed Holdaway was a generous and thoughtful man to whom
we owe a great professional debt for opening our minds to
visualizing treatment outcomes. Tom Pitts, in his inimitable
way, is likewise advancing our clinical acumen with reasoned
and elegant methodologies that allow us to create treatment
outcomes that elevate the standard of orthodontic care.

Finally, this column wishes to pay tribute to one of Southern
California’s most innovative and generous orthodontists,
Dr. George Boone, who died last year at age 85. George and his
wife, MaryLou, graciously shared their good fortune with
schools and programs dedicated to the arts and education
throughout California, including the orthodontic department
at the University of Southern California, which is named for
them. Orthodontics had no greater friend and role model than
George. His genuine concern for his patients, his professional
contributions and his munificence to his community leave a
beautiful legacy and we salute him for his unselfish devotion
and commitment.

Larry W. White, DMD, MSD
Editor, Clinical Impressions
Dallas, Texas
Thomas R. Pitts, DDS, MSD
Reno, NV

Editor’s Preface: For too long, orthodontic treatment goals have been based and results assessed solely on a patient’s dentition and dental occlusion, often at the expense of facial esthetics. The Damon philosophy has long emphasized the parallel importance of facial esthetics in diagnostics, treatment planning and results evaluation and has fully endorsed the concepts of Dr. David Sarver’s individualized approach, well-recognized as the most progressive model available today. The foundation of the Sarver paradigm is to protect the positive attributes of a patient’s facial esthetics while providing solutions for areas of deficiency. Central to any such discussion is the patient’s smile arc, which the Damon philosophy incorporates in its treatment planning approach as the “smile arc protection strategy.” In his article, Dr. Pitts explains how his bracket positioning and early light elastics protocols offer two tactical means of achieving the strategic goals of smile arc protection.

The favorite occasions of my practice life are debonding appointments when we celebrate the patient’s beautiful new smile and finished occlusion. Since accurate bracket placement is the foundation for a beautifully finished case, bonding appointments then run a close second in terms of my favorite events. Developing acumen in this one aspect of treatment—precise bracket placement—is the single most important protocol to achieving efficiency and an esthetically pleasing smile and functional occlusion. So goes treatment planning and bonding, so goes treatment time and quality finishing; hence, we begin each case with the end in mind.

Facial and smile esthetics are typically the patient’s primary concern and so must be the overriding standard we use in developing a treatment plan and evaluating the merit of a finish while, at the same time, striving for excellent occlusion. Facial esthetic standards have changed in the last 20 years with patients now wanting fuller lips, more vermillion display and broader arches. Facially based treatment planning—that has at its core a smile arc protection strategy—goes hand-in-hand with occlusal goals. With an ideal smile arc as the guide for the maxillary anteriors, my objective is to idealize canine-to-canine positioning and the anterior bite (Figures 1a-b).

Leaving the maxillary anteriors forward in the face keeps the upper lip full with the nasolabial angle as close to 90° as possible for mid-facial support while maintaining or enhancing the upper vermillion curl. Having used the passive self-ligating Damon® System appliance for 13 years, I know that when used properly, its effective-force mechanics foster appreciable arch adaptation that accommodates most complete dentitions. Except for third molars, I now extract teeth only to enhance facial esthetics when a patient’s teeth are too far forward and they exhibit lip incompetence.

Although I put precise bracket placement at the top of the list of treatment protocols that I consider essential to efficiently shaping a beautiful orthodontic finish, I also feel that other protocols—
soft- and hard-tissue contouring, variable torque, early light elastics and utilizing the proper archwires with precise timing—contribute appreciably to that end. While I prefer to direct bond brackets and actually love the artistic challenge of doing so, my positioning approach also seems to work well for those clinicians who prefer indirect bonding. In this article, I will cover my Damon bracket placement protocols as well as the fundamentals of early light A/P and vertical elastics. Using early light elastics (often referred to as “shorty” elastics or “shorties”) is a relatively new protocol that I pioneered and which many Damon clinicians are finding an important adjunct to treatment. With them, the vertical dimension is now much more controllable and is yet another means of protecting the smile arc.

**Basic Principles of the Pitts Placement Protocol**

There are certain bracket placement protocols I employ:
1. Develop a detailed bonding plan prior to bonding day and carefully select torques.
2. Ensure tray setup entails all the items essential to efficient bonding.
3. Use two assistants to assist in bonding.
4. Recontour teeth for esthetics and bracket fit.
5. Follow an exacting bracket placement protocol to protect or enhance the smile arc and align buccal segment cusp tips and marginal ridges.

**1. I develop a detailed bonding plan prior to the bonding appointment and carefully select torques.**

I study the patient’s pretreatment records to develop a bonding plan prior to the bonding appointment. This planning process takes very little time because I do it every day. The patient’s photographs allow me to assess, among other things, midlines, transverse plane, smile arc and enamel display and to determine the torques for the canines. The panorex lets me check for root parallelism and positioning. The cephalogram helps me decide the torque values for the maxillary and mandibular incisors brackets. This careful analysis allows me to plan bracket positioning in order to correct inclination. The bonding plan also takes into consideration the patient’s tooth angulations, marginal ridges, contact points, cusp heights, anterior overlap, smile arc and missing teeth.

The study models are helpful in determining the need for disarticulation buttons and recontouring labial enamel. Like many of you, I keep the panorex, frontal facial and center intraoral photographs at chairside during bonding. Since photographs can be somewhat deceiving, however, I have the patient stand up and smile for me just prior to sitting in the chair to check the smile arc and symmetry so that I have a visual in my mind during bonding that continues to guide me in bracket placement.

In another article in this issue of *Clinical Impressions*, Dr. Bill Thomas addresses torque selection so I’ll only mention here that it is important to pay special attention to the lateral cephalogram to assess the maxillary and mandibular incisors for the selection of variable torques. In our finished cases, I expect torque to be perfect. Proclined maxillary anterior can ruin an otherwise beautiful result. Under-torqued maxillary incisors and canines lead to a less than desirable appearance and function.

**2. I ensure the tray setup entails all the items essential to efficient bonding.**

There are a number of tools I consider essential to our bonding protocol and to the bonding tray setup (Figure 2).

- All the required brackets, including special brackets and disarticulation buttons, etc., laid out properly with the molar tubes preloaded with adhesive and covered.
- Ortho Solo™ from Ormco, a universal sealant and bond enhancer that I recommend for effective bracket adhesion.
- A two-inch, large-front-surface mirror¹ that offers a clear view of the occlusal surface of each tooth.
- Long cotton rolls rather than cheek retractors for greater patient comfort and a better visual field.
- Through-the-Lens Loupes from Orascoptic provide a superior field of vision for bonding and debonding.

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¹ Flashless bonding is a simple concept – just butter brackets with the proper amount of adhesive. The less flash, the healthier the tissue will be throughout treatment. My goal is to have no flash and no cleanup after positioning the bracket. Superior bond retention requires that there be no bracket movement after positioning.
• Keat tweezers from Zona Industries for secure molar bracket delivery (Figure 3).

3. I use two assistants to assist in bonding.

I perform six-handed bonding with two assistants helping one another in prepping the patient and then both assisting me during the bonding procedure. Once the teeth have been pumiced, the assistants ensure that no saliva touches them. The assistants sit opposite one another with me in the middle. I am right-handed so when I sit down to bond—with the patient’s head directly in front of me—the assistant to my right will load the brackets with adhesive and pass them to me. The assistant to my left vacuums and light cures as necessary while holding both the large and small mirrors. This assistant (the one to my left) also keeps a small micro-brush lightly saturated with Ortho Solo at hand to wipe away any negligible amount of flash.

4. Prior to bonding, I recontour teeth for esthetics and bracket fit.

Before I pick up the first bracket, I perform macro-enamel recontouring based, in part, on study of tooth anatomy via the stone models. Having practiced this protocol over time, I now perform it in less than one minute. Softening tooth contours, buccal/labial surfaces, incisal tips and edges and plunging cusps enhances esthetics and assists in contact relationships, esthetics and bracket and occlusal fit. Bracket fit is obviously important to achieving proper torque; occlusal fit is essential to minimizing interferences. Plaster models help determine if any facial enamel contouring is necessary, particularly on maxillary centrals and laterals.

Unless they are worn off, almost all canines need reshaping for esthetics and occlusion (Figure 4a-c). The incisal edges of the central and lateral incisors usually require recontouring as well. Reshaping the incisal surfaces of canines assists with smile arc protection and improves contact relationships with adjacent teeth yet does not interfere with canine discission. Reshaping the lingual surfaces of canines also facilitates Class II, Class III and vertical correction when using elastics. I also reshape the lingual surfaces of the maxillary anteriors of some patients of Asian and American Indian descent.

5. I follow an exacting bracket placement protocol to protect the smile arc and align buccal segment cusp tips and marginal ridges.

There are certain bracket placement principles to which I adhere. I have been using the Damon 3MX (D3MX) appliance and now use the latest generation Damon appliance, Damon Q™ (DQ). I bond the mandibular arch first and then the maxillary arch: second molar to canine on half of the arch, the same sequence on the other half and then finish lateral to lateral. I bond the maxillary arch in the same sequence.

I follow this procedure because I want the right side of the arch to mirror the left side in terms of bracket heights. I use a height gauge but only on canines and anteriors (both arches) to ensure that the brackets are at the same height, right and left. While this sequence is the order for bonding, the thought process is based on the bonding plan, developed from my study of where I want to place each bracket.

I’ve learned over the years that I can save one to two appointments by bonding every tooth at the bonding appointment even if I won’t be running a wire to all of the teeth until later in treatment. Bonding all the teeth at once also allows patients to get used to the brackets on their second molars at the same time as the other bonds. Waiting to bond later in treatment lengthens treatment for me and disrupts my schedule.

I bond maxillary anteriors for esthetics and smile arc protection and the mandibular anteriors for overbite and overjet, bonding all other teeth for ideal occlusion. I treat the mandibular anteriors to the maxillary anteriors. Obviously, the canines are the transition from the anterior to the posterior segments and are integral to getting an esthetic and functional occlusion. Keying off of the maxillary canines helps me ensure that the canine-lateral and canine-first premolar contacts are esthetic and functional.
In terms of the buccal segments, it’s mandatory that the marginal ridges and contact points be perfectly aligned. Given the irregularity of buccal cusps, I feel that using them as my primary bracket placement reference for the buccal segments produces inconsistent and substandard results. For me, contact points make much more satisfactory references. If I get the brackets in the buccal segments placed correctly in relation to the contact points, the marginal ridges of the posterior teeth will take care of themselves and the buccal segments will articulate properly. Placing brackets relative to the contact points for the canines and buccal segments and then using the slot of the maxillary canine bracket as the reference for placing the incisor brackets creates a sweeping smile arc that is considered the hallmark of a pleasing dental appearance.

Symmetrical gingival margins are an esthetic must for the six maxillary anterior teeth. With the use of lasers and crown-lengthening procedures, it has become easier for me to make the gingival heights symmetrical. The remainder of the article outlines the general guidelines I follow for placing brackets, although there will be case-specific situations where I will deviate from them.

My 40-year study of bracket placement has led me to place brackets relatively more gingivally than most practitioners. Even though my placement approach often results in positioning brackets near or under tissue on premolars and molars (which is the major obstacle to my adopting indirect bonding), I rarely see labial/gingival decalcification on these teeth. Figure 5 is a case example that demonstrates my positioning approach.

A difficulty that I see many clinicians have is the height transition from the first molar to second premolar and from the first premolar to the canine. As a rule, I make very few wire bends for these transitions because of the bracket placement locations I use—referencing the contact points while keying off the canines. Dr. Mike Steffan and I developed a method to assist clinicians in perfecting this technique—drawing lines on the stone models from contact point to contact point for the canines, premolars and molars (Figure 6).

**Maxillary anteriors** (Figure 7). Since the maxillary canine is the transition from the anterior to the posterior segment and establishes the sweep for the smile arc, I plan positioning for the entire arch by first determining the position for this bracket. In terms of occluso-gingival (O-G) placement of the maxillary canine, I have learned that the incisal edge of the canine bracket wings need to be placed on a line drawn from the mesial to the distal contact at the height of contour interproximally. I refer to this line as the mesiodistal (M-D) contact line.

The O-G positioning for the maxillary central and lateral incisor brackets uses the canine bracket as the reference point, with the slot of the central incisor bracket slightly more gingival (approximately 0.5 mm) than the slot of the canine bracket (as measured from the recontoured tip) and the slot of the lateral incisor bracket slightly more incisal than the central incisor bracket (approximately 0.25 mm). Placing brackets too incisally works against the smile arc and hinders torque control.

The most common M-D placement error clinicians make in the anteriors is positioning the brackets too distally, especially on the lateral incisors and canines, both maxillary and mandibular (Figure 8). Magnification through...
The use of a two-inch, large-front-surface mirror offers a clear view of the occlusal surface of each tooth and allows me to place the brackets more accurately because the M-D reference points are best seen from this angle, particularly in the premolar, canine and anterior regions. Using the large-front-surface mirror makes it easier to keep the occlusal part of the pad touching evenly on the labial and buccal surfaces of the teeth.

Maxillary premolars (Figure 9). Using the large-front-surface mirror, I align the scribe line of the maxillary first and second premolar brackets with the crown-long axis at the height of contour. Placing the maxillary first premolar bracket too mesially is easy to do (specifically if you are making the placement from the buccal aspect) and a common mistake (Figure 10). Such placement causes rotations and throws off the buccal occlusion. Viewed from the buccal aspect after correct placement, the first premolar bracket will appear distal to the height of contour; the second premolar bracket will at times appear mesial to the height of contour. The occlusal edge of the bracket wings should fall at the M-D contact line.

Maxillary molars (Figure 11). Ormco makes M-D positioning of first molar tubes simple because it manufactures this bracket pad with a buccal tip that fits naturally into the buccal groove of the tooth. The mesial aspect of the bracket should be in the middle of the mesiobuccal cusp. For accurate cusp height transition from the first molar to the second premolar, I keep the occlusal edge of the first molar tube pad on the M-D contact line.

The M-D positioning for the maxillary second molar tube is the same as the first molar tube. In terms of O-G positioning, I place this bracket approximately 1.5 mm more occlusally than the maxillary first molar bracket. This positioning and the -27° torque keeps roots buccally inclined and lifts lingual cusps to keep them from interfering with mandibular molars. A high percentage of maxillary second molars need palatal cusp recontouring later in treatment because the mesial inclines of these cusps are major contributors to tooth interference.
Mandibular incisors (Figure 12). For the best M-D positioning of the mandibular incisors, I align the bracket scribe line with the crown-long axis at the height of contour while viewing the teeth from the incisal aspect using the large-front-surface mirror. The O-G positioning of the mandibular incisors depends on the vertical relationship of the bite. For a deep bite, I place the bracket so that the top of its slot is fairly incisally positioned, approximately 3.5 mm from the incisal edge of the tooth with the maxillary anterior bite turbos already in place. On the mandibular arch, I like to over-level deep bites to a reverse curve of Spee. Early light elastics, which I’ll discuss later in the article, accelerate bite opening and increase the vertical dimension by erupting the buccal segments. For an open bite, I place each mandibular incisor bracket so that the top of its slot is fairly gingivally positioned, approximately 5 mm from the incisal edge of the tooth. For me, open bites require some curve of Spee.

Mandibular canines (Figure 13). Like its counterpart in the maxilla, the mandibular canine is the key to my positioning approach for the mandibular buccal segments and occlusion. For the best M-D positioning, I align the scribe line of the mandibular canine bracket with the crown-long axis at the height of contour, again while viewing the tooth from the incisal aspect. From long study, I’ve determined that the best O-G position for the mandibular canine bracket is to place the incisal edge of the bracket wings on the M-D contact line.

Mandibular premolars (Figure 14). For the best M-D positioning of the mandibular first and second premolar brackets, I align the scribe line of each bracket with the crown-long axis at the height of contour (viewing the tooth from the occlusal aspect via the large mirror). I position the occlusal edge of the bracket wings 0.5 mm gingival to the M-D contact line.

Mandibular molars (Figure 15/16). I position the first and second molar tubes the same way. For the best M-D positioning, I center the buccal groove of the molar tube over the buccal groove of the tooth. Occlusogingivally, I position the occlusal edge of the bracket molar pads 0.5 mm gingivally to the
M-D contact line. In contrast to the maxillary molars, I place the mandibular first and second molar bracket at the same height occlusogingivally.

**Bracket Repositioning More Efficient than Bending Wires**

In my experience, having to place excessive wire bends is not the fault of the orthodontic appliance design; it’s inappropriate bracket positioning. Because of malposed teeth (or an off day), it isn’t always possible to position each bracket accurately at the initial bonding, but unless I reposition certain brackets, I will need to make compensating wire bends later in treatment, which introduces preventable uncertainty.

For me, failing to reposition brackets and relying excessively on wire adjustments is inefficient. Many clinicians estimate that repositioning brackets saves an average of six months of treatment time. To operate efficiently, I have 25 trays set up and kept within easy access to every chair for these rebondings. Prior to removing the original bonds, I have the patient stand up and smile so I can visualize where I want the teeth to be positioned and then I measure where the brackets had been positioned so I can reposition them appropriately. I recontour teeth as needed.

**Early Light Elastics Begin Correction Concurrent with Arch Leveling to Protect the Smile Arc**

The underlying principle of the Damon philosophy is maintaining effective forces in large passive lumens throughout all phases of treatment for optimum tooth movement. I have long been uncomfortable with the heavy forces to which I used to subject patients when beginning A-P, vertical and transverse correction with elastics after leveling the arch. Several years ago I began using light elastics beginning at the bonding appointment on deep-bite cases in order to extrude posterior teeth in the proper direction. I was so taken aback by the wonderful response to the Damon System/early elastics protocol that I now start light elastics (never more than 2 oz. to start) at the bonding appointment on most of my cases to accelerate treatment time and enhance treatment quality (Case 1). Their use allows me to progress gently in cases requiring Class II (full), Class III, deep bite, open bite and even crossbite elastics.

Because teeth are being erupted/intruded in the proper direction, early light elastics allow slight A-P correction concurrent with arch leveling. In deep bites, the general rule of thumb is to keep the elastics more posteriorly positioned in the buccal segments; in open bites, more anteriorly positioned. This protocol allows me to enhance enamel display upon smiling by changing the vertical dimension rather than by simply intruding upper anterior teeth. No adverse effects have been noted with using these early light elastics in my practice. With them, I now can control vertical and A-P correction much more efficiently and esthetically. Being able to control the vertical dimension further enhances the opportunity to produce an esthetically pleasing smile arc.

Because light elastics break easily and full-time wear is critical to success, I always recommend that patients carry a supply with them wherever they go. Patients will not be comfortable with early elastics for a few days. Those with deep bites who have disarticulation buttons placed on their anterior teeth will not be able to chew on their molars for several weeks and will need a diet of softer foods in small bite sizes until their back teeth touch. I recognize that patients are much more motivated to comply with such protocols early in treatment and this fact has certainly contributed to my success in this regard. Mentioning to patients that full-time

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**Figure 16.** The best M-D positioning for the lower molars is to center the buccal tip of the molar tube over the buccal groove of the tooth.
wear can save many months of treatment has also proven to be an effective motivational tool.

Dr. Stuart Frost of Mesa, Arizona, and I put together several charts that outline the basic protocol for elastics progression from the early stages of treatment through finishing for the classic malocclusion types (visit DamonSystem.com/elastics). While there are a myriad of ways to configure early light elastics, I find that keeping the length the same while progressing in weight is the simplest way of maintaining inventory and keeping track of their use.

CONCLUSION
I realize that my bracket placement protocols are quite different from traditional placement and will take study, but having put many years into analyzing my case results and those of my partners and students at University of the Pacific, I have come to realize that protecting or enhancing the smile arc and getting buccal cusps, marginal ridges and contact points to align called for a new positioning protocol—one based on the guidelines I’ve outlined in this article. As I mentioned previously, I truly enjoy the artistic challenge of direct bracket placement with the Damon appliance and have gotten to the point where I have to reposition very few brackets to get to excellent finishes with remarkable efficiency. I notice that my students at UOP are also getting very good finishes without an appreciable number of rebonds. If we are to walk our talk of excellence in our specialty, we must begin our cases with the end of excellence in mind.

ACKNOWLEDGMENT: I’d like to give special thanks to my associate, Dr. Mark Handelin, for taking photographs and pulling the records and other images for this article.

CASE 1 – Early Light Elastics.

Dr. Tom Pitts

1Idea from Dr. Louis Anderson, Katy, TX
2Dr. Mike Steffen, Edmond, OK
Dr. Tom Pitts

Pretreatment Diagnosis
Class I mesofacial female, age 27 years 1 month, presented with severe crowding, mucogingival issues and functionally exhibiting a minor CR/CO slide.

Facial/Soft Tissue/Macroesthetics: Flat profile, deep labial furrows and thin lips with slightly recessive upper lip. Well-proportioned chin-to-nasolabial relationship but minimal vermilion display.

Smile/Miniesthetics: Asymmetric smile with low commissure on the right, adequate incisal display and smile arc, good upper midline position but severe crowding, narrow arches and large buccal corridors.

Teeth/Microesthetics: Satisfactory tooth shade and shape. Gingival shape shows forward root position and labiogingival recession on U/L3s & LL1. Incisors bell-shaped with minimal connector areas for contacts. Lower midline shifted 5 mm to left. U2s in lingual crossbite with dilacerated LR5 root tip.

Treatment Plan (Including Anti-Aging Goals)
Treat nonextraction (except for 3rd molars) to achieve functional occlusion and enhanced facial and smile esthetics. Employ passive self-ligation (Damon3/D3MX), developing arches slowly to relieve crowding. With proper torques and bracket positioning, counteract proclination of the buccal segments and anterior teeth to protect the smile arc. (Invert STD torque on upper incisors with +12° becoming -12° for 1s; +8° becoming -8° for 2s. Use low torque on L3-3.) Minimize exacerbation of labiogingival recession. Idealize occlusion to enhance Macro-, Mini-, and Micro-esthetics; i.e., minimize buccal corridors and protect smile arc and incisal display, add lip fullness with more vermilion curl and reduce depth of labial furrows.

17 Months: Differential Torque Continues to Work
Of particular note is that at 17 months, incisors are still proclined, but allowing the differential torques and prescribed Damon wire sequence time to work out will foster proper lingual incisor inclination as the arch continues to develop.

28 Months: Treatment Complete (records taken 1 week before debonding)
Note the change in incisor inclination.

Posttreatment
Achieved all goals for functional occlusion (manipulated to coincident CR/CO) and enhanced anti-aging facial and smile esthetics. Accomplished proper tooth inclinations and enhanced smile arc and enamel display, diminished labial furrows and improved vermilion curl, incisal display and lip fullness. Vertical, transverse and A-P changes were all positive. Microesthetic analysis reveals mucogingival enhancement, greater contact connectors and an esthetically pleasing emergence profile. Delivered fixed retainers U/L and removable retainers (.040 slipcovers) for nighttime wear. Looking back, I would have liked more lingual crown torque and distal root tip on UR2.

Case Discussion
This patient’s result not only demonstrates my years of bracket placement analysis, it also exemplifies a paradigm shift in orthodontic treatment that mandates enhanced facial esthetics as well as a beautiful smile and functional occlusion. Specifically, esthetic facial standards now favor greater lip projection, lip curl and vermilion display. Such contemporary esthetic orthodontic finishing is made possible by the proper placement of passive self-ligation that offers low-friction sliding mechanics, which when combined with proper bracket placement and variable torques, deliver what patients want. This patient says she feels that she looks years younger and I have not been able to achieve such esthetic goals with any other methodology.

Pretreatment

17 Months: Differential Torque Continues to Work

28 Months: Treatment Complete (records taken 1 week before debonding)

Posttreatment
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Even for the inexperienced lingual user, the advanced technology of the STb Light Lingual System makes lingual treatment remarkably easy-to-use and more effective than ever. The STb System combines maximum 3D control and complete invisibility, making it the ideal aesthetic solution for you AND your patients. Exceptional quality, efficiency, simplicity and patient comfort – you can have it all with the STb System.

- Confidently predict treatment times and eliminate compliance issues
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- Maximum patient comfort with minimal impact on speech
- Standard indirect setup in your own practice or through AOA Lab, making bracket placement fast, simple and accurate
- Most cases do not require a TARG or CLASS setup

NEW! Convenient single patient kits, hook options and single tie-wing design on anterior brackets.

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<th>COMPLETE STb SYSTEM (7 to 7)</th>
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<td>Treats a wide range of cases with optimal results.</td>
<td>Treats minor-to-moderate anterior crowding and spacing within a few months and with 1-2 wires.</td>
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<td>Treatment time: 6 months</td>
<td>Treatment time: 8 weeks – 1 wire used</td>
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The reduced profile and rounded contours of the STb bracket minimize tongue discomfort and pronunciation challenges.
Molar Protraction
Using Temporary Skeletal Anchorage

After third molars, the most common congenitally missing teeth are mandibular second premolars; the most frequently lost permanent teeth are mandibular first molars. While orthodontic molar protraction may be a favorable alternative to dental implants or prostheses for treating patients with these types of missing teeth, it can be challenging. Molar protraction relies on anterior tooth-borne anchorage, which is often inadequate and results in undesired reciprocal retraction of incisors in either the same or the opposing arch. Temporary anchorage devices (TADs) can provide stable/reliable anchorage that avoids these problems. TADs can be used to protract posterior segments bilaterally or even unilaterally, close space from a missing or extracted tooth and/or correct anteroposterior discrepancies that would otherwise be difficult, if not impossible, to correct.

Since the advent of temporary skeletal anchorage, clinicians have reported the results of various molar protraction techniques using TADs. Although the benefits of using TADs to minimize the difficulties of protracting posterior teeth are significant, orthodontists must understand the biomechanics involved in order to prevent potential side effects of pulling teeth in one direction. Protracting molars directly with a TAD placed gingivally to the archwire will create a posterior open bite unless a power arm such as a VectorTAS Crimpable Post is used to protract the posterior teeth through the center of resistance of the posterior segment. Since the mandible is often too shallow for comfortable use of a power arm, indirect anchorage via a TAD is an effective alternative. In addition, transverse problems can occur if the force pulls only from the facial aspect of the posterior segment without a counter-rotational force from the lingual surface. See Case 1.

TAD Placement that Increases Stability

Research indicates that the stability of TADs is enhanced when they are placed away from the proximity of adjacent roots. Orthodontists are naturally more comfortable placing TADs themselves when there is more than adequate space available to do so. Progressing to a rectangular archwire before placing TADs and initiating protraction—as illustrated in both Cases 1 and 2—allows the practitioner to bond brackets to achieve appropriate root divergence. In Case 2, the mesialization of the anteriors alone provided ample space for miniscrew placement.

Conclusion

Having used various skeletal anchorage devices, I find it advantageous to use low-profile miniscrews with smooth heads, such as VectorTAS, especially in anterior regions because of the tightness and continual movement of the orbicularis oris muscle and the high potential for tissue ulcerations.
CASE 1 – Unilateral Molar Protraction with Indirect Anchorage Setup via VectorTAS

Dr. Nicole Scheffler

Pretreatment Diagnosis: Discussion limited to protraction
Male patient, age 12 years 6 months, presented with moderate crowding of the lower arch, the LL3 in crossbite and a congenitally missing LL5 with the roots of the LLE partially resorbed.

Treatment Plan
Extract the LLE, align the teeth and upright the molars. Close extraction site via unilateral molar protraction using a TAD for anchorage.

Treatment Progress/TAD Placement at 10 Months
Extracted the LLE. Bonded both arches with Damon 3/Damon 3MX brackets positioned on the LL3 and LL4 to diverge roots for TAD placement ease. Progressed to a .019 x .025 stainless steel wire in the lower arch, then lace-tied the LL molars together. To ease sliding mechanics and minimize the potential of the entire arch protracting, thinned the posterior wire segment with a gray stone.

Placed an 8 mm VectorTAS miniscrew between the LL3 and LL4 and ligature-tied the TAD to the LL4 to anchor it and preclude it from moving distally during protraction. To initiate protraction, engaged a 9 mm ni-ti coil spring (Masel, Bristol, PA) from the LL6 to a crimpable hook on the archwire just distal to the LL3. Bonded lingual buttons on the LL4 and LL6 and attached an anti-rotational chain between these teeth during protraction to keep the molar from flaring buccally. Ligated the lower anteriors together from the LL3 to the LR4 to prevent anterior space from opening during buccal segment space consolidation.

14 Months: Continuing Space Consolidation
To continue space consolidation, replaced the ni-ti coil spring with an elastic chain from the hook on the LL6 to the LL3. To help erupt the UL3, placed a Kobayashi hook on the “anchored” LL4 for nighttime short-elastic wear. At 16 months, replaced elastic chain with Damon elastic module to continue space closure.

17.5 Months (7.5 Months of TAD Protraction): Protraction Complete & Extraction Site Closed
The LL5 space had closed completely. Repositioned the LL4 bracket to remove some of the root diversion and dropped back to a .014 x .025 Copper Ni-Ti® archwire. With protraction complete, removed the ligature tie to the anchor and replaced the Kobayashi hook with a drop-in vertical hook to continue nighttime short-elastic wear to the UL3 to help close the bite between the UL3 and LL4.

Discussion: Improving Occlusion after Protraction
Without maxillary extractions, the final CL III molar relationship may not be ideal. Reducing protracted L6s mesially and distally and allowing L8s to erupt and occlude with U7s can create a better occlusion.
CASE 2 – Single-Arch En Masse Protraction with Direct Anchorage Setup via VectorTAS

Dr. Nicole Scheffler

Pretreatment Diagnosis
Male patient, age 18, had finished orthodontic treatment at age 15 with successful correction of a dental Class III malocclusion but had experienced considerable mandibular growth in the intervening years, which resulted in an anterior crossbite that was causing incisor wear and eating difficulty. He requested retreatment to alleviate his edge-to-edge bite with the hope of finishing treatment before he went to college.

Treatment Plan
Mesialize U3-3 with open coils distal to U3s to approximate a Class I canine relationship followed by posterior protraction using direct TAD anchorage.

Treatment Progress/TAD Placement at 9 Months
Bonded the upper arch with Damon 3MX (low torque U2-2; high torque U3s). Progressed to a .019 x .025 stainless steel archwire, then placed Ni-Ti® open coil springs bilaterally distal to U3s to mesialize the anteriors. After 9 months of mesialization, placed one 8 mm VectorTAS miniscrew in each buccal segment distal to the 3s, then attached a Ni-Ti coil spring from each TAD to a power arm placed distal to each U6. This setup exerts a translational force close to the center of resistance of the molars. The power arm offers 3 points of attachment for a controlled vertical force. Since this patient had an open-bite tendency, placed the coil springs so that they exhibited a slight intrusive force on the molars during protraction. The patient also had a posterior crossbite tendency and would benefit from slight posterior buccal flaring so there was no need to offset the unidirectional pull from the facial surface of the teeth. Protracted the arch U7-7 while maintaining the closed coils distal to the U3s to assist with the continued protraction of the anteriors. Later, removed the closed coils and protracted the posteriors up against the U3s.

16 Months (7 Months of TAD Protraction): Treatment Complete
Given the difficulty of unilateral protraction and the limited timeframe, the result was acceptable and the patient was well-satisfied with the outcome. The upper arch protracted about 4 mm and the patient had better positive overjet and improved incisor angulation with greater midfacial support and upper lip fullness.

Discussion: Minimal Anchorage Loss During Mesialization
The case did not lose much anchorage in the posterior during anterior mesialization despite its having served as the only anchorage. Using two additional miniscrews could have ensured that no posterior anchorage loss occurred, but pitting the 8 posterior teeth against the 6 anteriors was effective and resulted in minimal round-tripping. I would like to have achieved more anterior mesialization for ideal miniscrew placement, but leaving the springs distal to the U3s for 2 months after beginning posterior protraction continued the needed anterior mesialization and ensured that the U3s did not relapse into the TADs.
Pretreatment

9 Months: TAD Placement

16 Months (7 Months of TAD Protraction): Treatment Complete
Breaking Through

Introducing Damon® Q.
More than evolutionary.


Whether you are new to self-ligation or a full-time user, Damon Q opens new doors to practice efficiency, clinical flexibility, patient comfort and aesthetics. Combined with the Damon System’s force-calibrated archwires and minimally invasive treatment protocols, Damon Q is the natural selection for your patients.

See why Damon Q is more than evolutionary.

Contact your Ormco sales representative or visit DamonSystem.com/DamonQ.
The amount of torque a bracket expresses is the difference between the degree of torque built into its slot and the degree of play between the slot and the rectangular wire engaged in the slot. If we could completely fill all dimensions of a bracket lumen, we could achieve full torque expression but since a wire can never be the same size as the lumen into which it fits, we never achieve the torque value that a manufacturer designed into its bracket. This phenomenon is known as "wire play." 

Factoring wire play into planning ideal tooth inclinations is essential to achieving proper tooth-by-tooth inclination for an esthetically pleasing, functional result but it can sometimes get overlooked when considering all the variables we must take into consideration when planning treatment. As opposed to conventional brackets and active self-ligating brackets, wire play in the Damon System—which I have used exclusively in my practice for the past six years—is more than a mere mathematical calculation. It performs a fundamental role.

Before I discuss that role, let’s review how wire play affects the torque that a bracket expresses, a phenomenon that applies to all fixed appliances regardless of whether they are conventional twin brackets or active or passive self-ligating appliances.

Manufacturing tolerances aside, the degree of wire play between a .019 x .025 stainless steel wire and a .022 x.028 slot is +/−10.5°. With this type/size wire, a standard torque Damon Q central incisor bracket with +15° of torque will typically lose 10.5° of torque to wire play, delivering expressed torque of +4.5°. (Moreover, the smaller the cross section of wire in the lumen, the greater the wire play.) If additional torque is required, the clinician must add torque to the working wire or use pretorqued Ni-Ti® wires.

Achieving Proper Tooth Inclination with Damon System Mechanics

There has been a lack of understanding about how to achieve torque in the Damon appliance, which requires that only two edges of a rectangular wire engage on opposing walls of a bracket lumen—a core advantage of the Damon System (Fig. 1). In conventional appliances and active self-ligating brackets, the goal is to seat a rectangular archwire against the bracket base in some or all phases of treatment to achieve the required torque. One might suggest engaging the largest cross section of wire (.021 x .025) that fits into a .022 slot to express as much of the built-in bracket torque as possible, but in the Damon System there are valid reasons not to do so. The friction and binding that result from almost completely filling a slot make leveling and alignment, space closing, and even finishing and settling of the occlusion more difficult to accomplish. More importantly, to achieve biologically compatible tooth movement, it is advantageous not to seat an archwire against the base of the slot because it is the play in the system during all phases of treatment.
that greatly assists in keeping forces effective, blood vessels from totally occluding and tooth movement consistent. In Damon mechanics, wire play is not just a calculation; it is fundamental to its many benefits.

The Advantages of Variable Torque
With regard to rectangular wires, there are three primary means of creating the torque required to achieve an esthetically pleasing functional result: employing pretorqued brackets, adding torque to archwires or both. Dr. Dwight Damon is a strong proponent of employing variable-torque brackets (rather than primarily relying on placing torque in wires) for a number of reasons. One is that doing so introduces torque correction gradually, beginning with the first light rectangular wires, which keeps forces effective throughout all stages of treatment while sustaining the blood supply around teeth for consistent tooth movement. I’ve learned that employing variable torque:

- Allows roots to begin uprighting early during the rectangular wire-leveling phase.
- Maintains anterior torque during major mechanics, avoiding the trauma and time of round-tripping teeth.
- Permits selective torque for individual teeth.
- Maintains posterior torque during maxillary width increases and bone adaptation.
- Minimizes the guesswork of adding, then duplicating torquing bends to different sizes and alloys of finishing wires.
- Enhances the quality of case results while minimizing time and appointments.
- Can improve final root position, which supports greater stability.

Expanding Torque Options without Further Expanding Bracket Inventory
Note: I wrote this article from my experience with Damon 3 and Damon 3MX (D3/D3MX), both of which offer variable torque and have dramatically reduced the need for adding wire torque.Ormco has recently launched Damon Q™ (DQ) with new torque values that are intended to further lessen the need for adding wire torque as well as minimizing or even eliminating some of the techniques described in this article. Throughout the article, I specify when I am referring to D3/D3MX or DQ, and how the new DQ torque values address specific torque challenges.

Even with the number of variable torque options that D3, D3MX and DQ prescriptions provide (Fig. 2), some cases may require additional means of torque. Three options include: (1) employing a bracket on a tooth different from its intended placement on the same side of the arch; (2) switching a bracket from its intended placement in one arch to the same or a different tooth in the opposing arch; and (3) inverting a bracket 180° on the same tooth for which it is intended.

Moving a bracket from one arch to the opposing arch requires switching placement to the other side of the arch and taking the differences in angulation into account. Some clinicians have the mistaken idea that inverting brackets also requires switching placement to the other side of the arch but that is not so. Maintaining inverted brackets on the same side of the arch keeps the root tip the same mesiodistal.2

Switching brackets from one arch to the other or inverting brackets on the same tooth changes positive torque to negative and vice versa, thus increasing the number of torque options available. For example, in a case such as is depicted in Fig. 3, root movement of a palatally inclined maxillary lateral incisor will lag sufficiently behind crown movement, a situation which warrants a torque value lower than the available +3° of the lowest torque D3/D3MX lateral incisor bracket. Inverting a low- (+3°) or standard-torque (+8°) D3/D3MX bracket on this tooth offers two additional low-torque options (-3° and -8°). DQ offers a -5° low-torque option designed to address most of these situations without inverting brackets. I admonish clinicians that inverting brackets comes with inherent risks. It is imperative that inverted brackets be carefully
monitored and when the intended torque is achieved, the brackets be reflipped and rebonded or the tooth rebonded with another appropriate torque bracket. Regardless of appliance, it is necessary to palpate roots at each appointment to monitor movement.

Using Torque to Counter Major Mechanics
Correcting Class II and Class III malocclusions requires selecting proper variable-torque appliances to help offset torque loss during correction, maintaining inclination (both anterior and posterior) and avoiding the trauma and time of round-tripping teeth. I’ll address the counterbalancing protocols of variable torque for major mechanics in cases being treated nonextraction (Fig. 4) before discussing torque selection for individual tooth positions.

In mildly crowded Class I cases where no significant incisor inclination discrepancies exist, standard-torque D3/D3MX or DQ brackets on the incisors are sufficient to maintain existing tooth inclinations.

For Class I cases with moderate to severe crowding, low-torque incisor brackets on both arches help resist proclination as teeth start to unravel (Fig. 5). Beginning in the round-wire phase, lip pressure helps drive transverse arch development to the posterior. When moving into rectangular wires, low-torque incisor brackets help resist proclination. In these situations I often finish in .016 x .025 stainless steel archwires.

Depending on the severity of the crowding, the narrowness of the arch and the degree of lip pressure, inverting maxillary low-torque D3/D3 MX brackets (which changes +7° and +3° for the central and lateral incisors to -7° and -3°, respectively) offers even greater resistance to labial crown proclination. Once crowding is resolved and incisor inclination has been established, either I leave the brackets in this position, reflip and rebond them, or rebond brackets with different torques. In such situations, wire play may work to our advantage by decreasing the need to reflip brackets or rebond teeth with other torque values. DQ offers low-torque incisor values (+2° and -5° for the maxillary central and lateral incisors, respectively) that are intended to address such situations without inverting brackets, although there may certainly be exceptions.

To counter the negative effects of Class II mechanics, which cause maxillary incisors to incline lingually and mandibular incisors to procline, I place high-torque brackets on maxillary incisors and low-torque on mandibular incisors but the latter only if using a MARA or a Herbst® (Fig. 6). The same torque values apply whether the Class II case is mildly or severely crowded as long as the treatment plan is nonextraction, although I don’t recommend low torque on the mandibular incisors if the patient has periodontal issues.

In regard to DQ, the low-torque incisor bracket (-11°) is particularly recommended for cases involving Herbst and Mara appliances but not for those with extensive crowding and/or thin attached labial tissue. As with all cases, evaluation of attached tissue plays an important role in torque selection.

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In regard to DQ, the low-torque incisor bracket (-11°) is particularly recommended for cases involving Herbst and Mara appliances but not for those with extensive crowding and/or thin attached labial tissue. As with all cases, evaluation of attached tissue plays an important role in torque selection.
Because of wire play, even when finishing in .019 x .025 stainless steel archwires, high-torque D3/D3MX maxillary incisor brackets (+17º and +10º for the central and lateral incisors, respectively) may not provide enough inclination control so I routinely add 10º of lingual root torque to the working archwire. DQ offers high-torque maxillary values of +22º and +13º for the central and lateral incisors, respectively, which are intended to address such situations without adding wire torque.

To counter the negative effects of Class III mechanics, which often cause maxillary incisors to procline and mandibular incisors to tip lingually, I typically use low-torque brackets on the maxillary incisors and standard torque on mandibular incisors (Fig. 8). DQ offers low-torque maxillary incisor values (+2º and -5º for the central and lateral incisors, respectively) that are even more effective than D3/D3MX values in such situations.

Selecting Torque Values for Individual Teeth
The orthodontic profession has long accepted Dr. Larry Andrews’ research that determined standards for optimal tooth positioning relative to the occlusal plane: e.g., +7º for the upper central incisor (Fig. 9). Andrews’ conclusions were derived from 120 natural occlusions that he deemed most favorable based on hard-tissue considerations only. The range for the maxillary central incisor inclination in his optimal occlusion sample spanned from -7º to +15º with a standard deviation of +/-4º. With such a wide range and relatively large standard deviation as was the case with all tooth positions deemed optimal in the study, Andrews’ benchmarks offer considerable opportunity for clinician discretion in determining tooth inclinations.

The Damon philosophy emphasizes the paramount importance of smile arc and soft tissue to treatment planning, recognizing the importance of lip and midfacial support for esthetics, especially as we age. Keeping this in mind, ideal central incisor position (AP, SI and inclination) is not an arbitrary number but should be based on each patient’s unique needs. I have found, however, that with the patient’s head in a natural position, the maxillary central incisor is usually in optimal position when it is balanced under Glabella, which is best determined at the initial examination with the patient in profile, smiling.

Andrews’ research on maxillary canine inclination found that the optimal torque value to be -7º with a range from -17º to +10º and...
a standard deviation of +/-4.2º. Dr. Damon has always recommended finishing canines relatively upright for improved function and esthetics with the canine positioned from 0º to -2º relative to the occlusal plane, depending on its labial surface contours.

Pretreatment and Ideal Tooth Positions

Determine Incisor and Canine Torque

Except where countering major mechanics, I always base maxillary incisor and canine bracket torque selections on the pretreatment tooth positions and prescribed final tooth positions, factoring wire play into the determinations. As with any technique, experience and training are critical to making these judgments.

To maintain maxillary incisor and canine positions when there is no need to counter the negative effects of major mechanics, standard-torque brackets are usually adequate. On the other hand, uprighting lingually inclined maxillary incisors and canines often requires high-torque brackets, which, even when factoring in wire play, are usually satisfactory although I occasionally engage Ni-Ti archwires with 20º of built-in anterior torque or add torque to the stainless steel archwire. The increased DQ maxillary incisor and canine torque values are designed to upright lingually inclined anteriors without the need to use wires with built-in torque or add torque to the stainless steel wire.

To correct maxillary lateral incisors that are blocked out lingually, not only must the crown be moved labially but also extra labial root torque is almost always required. In such situations, the lowest D3/D3MX torque option (+3º) is usually not enough. Given that we generally need to factor in overcorrection, flipping a low- or standard-torque D3/D3MX lateral incisor bracket (which offers two additional options of -3º and -8º) is often necessary to provide the additional labial root torque (as shown in Figure 3). DQ offers a low-torque value of -5º that is designed to provide the additional labial root torque required in most situations. At the discretion of the clinician, additional wire torque may be added as needed.

If I have inverted brackets, as soon as the crown and root are in an overcorrected position, I either downsize the wire (increasing wire play and stopping active torque) or reflip the bracket and rebond it or rebond with a standard-torque bracket. Note that overcorrection applies to root positions as well as crown positions in all three planes of space. Determining when root position has been adequately overcorrected is difficult to quantify and requires experience.

When maxillary lateral incisors are minimally blocked out to the palate, it’s a judgment call whether to use a low-torque (+3º) or flip a low-torque D3/D3MX bracket for a torque value of -3º (Fig.10). The DQ maxillary lateral incisor torque value of -5º is designed to manage most laterals that are minimally blocked out to the palate without the need to invert brackets.

In situations where teeth are blocked out either labially or lingually, the strategy almost always includes tying in the blocked-out tooth at the initial bonding. You can employ Kaplan hooks, embed a ligature wire in light-cured composite or consider cutting a bracket in half. Including blocked-out teeth creates the best opportunity to optimize forces and moments. Two situations that preclude tying in blocked-out teeth at initial bonding are: (1) when incisors are in an anterior crossbite and cannot be engaged because of the deep bite; and (2) when space must be opened prior to bringing blocked-out canines into the arch.

Lingually blocked-out mandibular incisors (Fig. 11) often need considerable labial root torque, even more than the lowest torque (-6º) that the D3/D3MX prescription provides. Shifting a standard- or high-torque D3/D3MX maxillary lateral incisor bracket to a mandibular incisor changes the positive torque to negative for much lower effective torque values (-8º and -10º). DQ offers a -11º low-torque option that is intended to foster appropriate labial root torque in such situations without the need to invert brackets. If more torque is required, make adjustments to the appropriate wires.

Figure 10. With a minimally blocked-out upper lateral, use a low-torque or invert a low-torque D3/D3MX bracket.

Figure 11. Bonding a high-torque D3/D3MX maxillary lateral incisor bracket to a lingually blocked-out mandibular incisor (which changes the +10º to -10º) generates greater labial root torque than the lowest torque D3/D3MX mandibular lateral incisor.
If I have shifted a bracket between arches, as soon as the root apex is in an overcorrected position, I rebond it with the optimal mandibular incisor bracket. When making such a shift, it is best to place the bracket on the opposite side of the arch (e.g., moving the maxillary left lateral incisor bracket to the mandibular right lateral incisor), which assists with proper tip; however, you still need to bond the bracket on the tooth with the slot correctly positioned for proper root tip instead of basing the bracket position on how the sides of the bracket parallel the edges of the tooth.

It is important to understand that uprighting mandibular canines is not expanding them. One of the basic tenants of the Damon philosophy adheres to the widely accepted standard that maintaining or closely approximating pretreatment with posttreatment canine width provides the greatest means of long-term case stability. Many orthodontists confuse the two movements—uprighting versus expanding—but the distinction is vital to one’s treatment plan and canine inclination goals. Measurements to determine canine inclination should be related to the center of rotation (i.e., CEJ) and would be more relevant than measurements at the cusp tip. Perhaps future CT scans will allow us to predict final canine inclination more accurately by taking the center of resistance into account.

Patients with narrow arches requiring transverse arch development often have lingually inclined canines that respond well to high-torque brackets, either D3MX or DQ. Uprighting canines with high-torque brackets does not widen them bodily within the alveolar process; it uprights the crowns thereby centering the teeth in the boney trough. To prevent canines from inclining lingually when closing extraction spaces, I also use high-torque brackets, either D3/D3MX or DQ.

**Proper Torque in the Buccal Segments**

For the buccal segments, I think it’s appropriate to refer back to Dr. Andrews’s research related to his preferred tooth inclinations (Fig. 9).

**Maxillary Premolars.** In his study, Andrews reported optimal inclinations for maxillary 1st and 2nd premolars to be -7º. The D3/D3MX prescription offers one torque of -7º for maxillary premolars. Since there is a tendency for maxillary premolar crowns to tip buccally during transverse arch adaptation, it is often necessary to add buccal root torque to the wire for proper maxillary premolar positioning when using this prescription.

DQ offers a torque value of -11º for maxillary premolars that is intended to minimize the need to add wire torque in such situations.

**Maxillary Molars.** In his study, Andrews reported optimal inclinations for maxillary 1st and 2nd molars to be -9º. Crowns of maxillary 1st and 2nd molars tend to tip buccally during transverse arch adaptation. Sufficient buccal root torque keeps these teeth uprighted and the lingual cusps lifted to preclude interference with the mandibular molars. Most prescriptions offer -10º torque for the maxillary 1st molar; the Damon prescription is -18º (Fig. 12). The Titanium Orthos™ buccal tube recommended for the maxillary 2nd molar has a torque value of -27º. This increased molar torque takes into account wire play and maintains upright buccal segments during lateral arch development. If additional torque is required, you must add buccal root torque to the working wire.

**Mandibular Premolars.** In his study, Andrews reported optimal inclinations for mandibular 1st and 2nd premolars to be -17º and -22º, respectively. Damon torque values in the D3/D3MX and DQ prescriptions for the mandibular 1st and 2nd premolars are -12º and -17º, respectively. Occasionally you will find a mandibular 2nd premolar with an excessive lingual inclination. In these instances, using a mandibular 1st premolar bracket (-12º) on a mandibular 2nd premolar aids in uprighting this tooth.

**Mandibular Molars.** In his study, Andrews reported optimal inclinations for the mandibular 1st and 2nd molars to be -30º and -35º, respectively. The goal for mandibular molars is to have sufficient lingual crown torque to ensure optimal occlusion with the maxillary molars. Mandibular molars tend to upright around their center of resistance as arches widen. The Damon SL and SnapLink™ molar tubes for mandibular 1st molars each has a torque value of -28º, which is usually sufficient to ensure optimal
Mandibular 2nd molars often erupt quite lingually inclined. The molar tube recommended for mandibular 2nd molars is Titanium Orthos with -10° of torque, which greatly assists in appropriately uprighting this tooth. One must also keep in mind that mandibular molar inclination is also affected by arch form. The Damon arch form is an effective starting point for optimizing mandibular buccal segment torque.

**CONCLUSION**
A variable-torque fixed appliance introduces torque into a patient’s case on a selective and gradual basis and is yet another means of keeping forces effective by using just enough force to keep blood vessels from totally occluding and teeth consistently moving throughout treatment. Beginning torque movement with the first light rectangular wires allows roots to begin uprighting early and minimizes the guesswork of adding torque to wires later in treatment. It also maintains anterior inclination during major mechanics, which helps avoid unnecessary tooth movement.

In my practice, variable torque has enhanced the overall quality of treatment, decreasing chair time and the number of treatment appointments and reducing stress, while improving root position. I feel that learning to incorporate variable torque is one of the key opportunities we have to experience the many advantages of Damon System mechanics.

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1 For more discussion about wire play between different wire sizes and bracket lumens, see Dr. John R. “Bob” Smith’s article in *Clinical Impressions*, Vol. 12, No. 1, 2003, pp. 8 – 13 by going to www.ormco.com. Click on *Clinical Impressions* under Publications.

2 For more discussion, see Dr. Jeff Kozlowski’s article in *Clinical Impressions*, Vol. 16, No. 1, 2008, pp. 23 – 28 by going to www.ormco.com. Click on *Clinical Impressions* under Publications.

3 Herbst is a registered trademark of Dentaurum, Inc.


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CASE
Dr. Bill Thomas

Pretreatment Diagnosis
Female Patient: K.B. Age: 11 years 8 months

Diagnosis: Mesofacial patient presented with a Class II (R 2 mm, L 5 mm) deep bite, deep curve of Spee, moderate upper arch crowding, mild lower arch crowding, narrow arch forms, a lower midline shift (L 3 mm), rotated upper 1st molars and an over-retained UR deciduous canine. The maxillary incisors were nicely positioned relative to the patient’s smile arc and she has a good chin button.

Treatment Plan: Treat nonextraction with Damon 3MX. Correct Class II with a Herbst* appliance, using fixed appliances in the upper arch to counter the negative effects of the mechanics: high-torque brackets on the incisors and standard-torque on the canines. Bond the lower arch after Herbst treatment, employing low-torque brackets on the lower incisors and standard-torque on the canines. Correct all other issues with fixed appliances while maintaining the smile arc. Develop arch widths via Damon mechanics utilizing Copper Ni-Ti® archwires followed by stainless steel wires. Employ Damon SL molar buccal tubes with -18º torque on upper 1st molars and Titanium Orthos™ buccal tubes with -27º torque on upper 2nd molars to control molar inclination during transverse development.

8 Months: Buccal Segments in Class I Position
The buccal segments are in Class I, the upper arch has aligned 4-4 and the upper 1st molars have derotated. Left Herbst in place until buccal segments were super Class I for 10 weeks. Removed Herbst at 13 months and bonded lower arch.

15 Months: Arch Leveling is Complete
Arches have leveled and alignment is almost complete. Placed .014 x .025 Copper Ni-Ti wires, followed at the next appointment by a Panorex, applicable bracket repositioning and placement of .018 x .025 CuNi-Ti wires in both arches, which was subsequently followed by a .019 x .025 stainless steel wire in the upper arch and a .016 x .025 stainless steel wire in the lower arch. Finished the case with .017 x .025 TMA® archwires in both arches in one appointment.

Posttreatment: 22 Months, 14 Appointments
Case finished in Class I canine and molar relationships with midlines centered, arch forms coordinated and widened through the premolar region. Placed bonded retainers in the upper arch 2-2 and lower arch 3-3 with a removable suck-down retainer for the upper arch worn nights. In hindsight, flipping a high-torque D3/D3MX bracket on the upper right canine would have helped tuck this tooth in lingually even better.

Case Discussion
Treatment options for this patient included use of headgear, a Twin Block, Bionator, Herbst appliance or other Class II corrector. The result would have been far less attractive and her facial symmetry compromised had extractions been the treatment of choice. Altering the transverse dimension was critical to achieving the beautiful overall result. In my hands, all Class II correction options except the Herbst would have required tremendous patient cooperation with a likely 24- to 30-month treatment time and 24 to 30 total appointments. The combination of the Damon System appliance with the Herbst appliance allowed anterior crowding to be converted into transverse development. In this case, we used energy from anterior crowding coupled with the Herbst appliance to correct both transverse and A/P discrepancies.

* Herbst is a registered trademark of Dentaurum, Inc.
15 Months: Arch Leveling Complete

Posttreatment: 22 Months, 14 Appointments
Hygienists:
A Powerful Source for Practice Growth

Kristy Menage Bernie, RDH, BS, RYT
San Ramon, California

Editor’s Note: In this interview, Ms. Bernie suggests that orthodontists target a heretofore neglected part of the dental health team for their marketing efforts—dental hygienists. She offers cogent observations about why hygienists make powerful referral sources, what they expect from orthodontists in order to make referrals, and how doctors can fulfill those expectations to grow their practices.

Dr. White: Orthodontists are continuing to report a decline in referrals from dentists. I understand that you consider hygienists a powerful, yet neglected patient referral source. Why is that?

Ms. Bernie: Many orthodontists focus exclusively on dentists in their marketing efforts, but that limits their referral base. While dentists often have only one practice to enlist, hygienists work in as many as two or three practices and can potentially convert the staff in each one to become referral sources. By marketing to hygienists, you’re covering more ground. Plus, hygienists see patients more frequently and have more opportunity to propose orthodontics to patients and answer questions about it. They spend more time with patients than any other dental professional and subsequently have the opportunity to build better rapport and instill considerable confidence in their recommendations. Hygienists themselves have children who may need orthodontic services and you can hardly have a better reference than from a hygienist whose children you have treated.

Dr. White: How do hygienists want to be engaged by orthodontists?

Ms Bernie: Hygienists are highly educated dental professionals and are always eager to learn about the latest development in all aspects of dentistry. Orthodontics is no exception. Because of their knowledge, they are quite open about sharing their points of view and they want orthodontists to listen to them respectfully and take their concerns seriously. They especially want to be considered integral to the dental health team with a collegiate involvement in the process of care for mutual patients—not dictated to nor considered an afterthought to care. Collaborating with them during your mutual patients’ treatments will go a long way in earning their continued loyalty and increasing case success.

Ms. Bernie earned her B.S. degree in dental hygiene in 1984, graduating with honors from the University of Maryland. With 20 years of experience in the field of dental hygiene, she has served as clinician, association leader, national speaker, author, and business owner. Her company, Educational Designs, specializes in marketing through education as well as providing workshops for speakers and educators focused on experiential and adult learning principles. Ms. Bernie can be reached through her Web site www.EducationalDesigns.com and is available to provide continuing education sessions to groups throughout the country.
Dr. White: How can orthodontists use continuing education (CE) to attract hygienists?

Ms. Bernie: There are a number of national and local organizations, such as the American Dental Hygienists’ Association (ADHA), which generally holds continuing education events from September through May. These organizations are continually looking for new topics and speakers. Unfortunately, these groups do not have the funds of their dental organization counterparts, so they often seek speakers who are willing to waive honorariums. Orthodontic professionals who volunteer to deliver useful and relevant information will find an appreciative and attentive audience—anywhere from 25 to 400+ dental hygienists in any given area whom they can potentially turn into referral sources. For a listing of ADHA associations, visit www.ADHA.org and click on “Related Links.”

Dr. White: How else can clinicians familiarize hygienists about orthodontic practices that align with their philosophies?

Ms. Bernie: Dr. Bob Waugh (Athens, Georgia) hosts an annual symposium that attracts more than 100 dental hygienists. This endeavor gives him a great opportunity to inform these influential staff members about the latest innovations in orthodontics and how their mutual patients benefit from his staying on the leading edge of proven technologies. Dr. Waugh says hygienists anticipate this event for not only the information they receive but also the CE credits they earn. Continuing education is as important for dental hygienists as it is for dentists, and they appreciate efforts to fulfill this requirement. By the way, I always recommend using terms such as “dental professionals” in course descriptions for such workshops so that other members of the dental staff interested in attending will feel included.

Dr. White: What are other opportunities for educating dentists and their staffs?

Ms. Bernie: Some orthodontists have discovered that bringing entire staffs into their offices and presenting programs during lunch has offered important opportunities for getting dental assistants and hygienists excited about state-of-the-art orthodontics. Dr. Tom Barron (Towson, Maryland) has had exceptional success with this approach. He employs the Damon System and uses these events for presenting the advantages of the bioadaptive treatment that characterizes Damon mechanics, explaining the science behind the appliance. Dr. Barron’s practice has flourished over the past few years, and he attributes it to the referrals he generates from these lunch-and-learn sessions. Other orthodontists also offer programs such as discounted treatment specifically to hygienists so they can realize the benefits themselves. They, in turn, are able to share their experiences firsthand with patients who may be candidates for orthodontic treatment.

Dr. White: How do orthodontists get CE program approval?

Ms. Bernie: State dental boards, the Academy of General Dentistry and the American Dental Association help clinicians develop credentials for providing approved courses. Orthodontists who present courses on their own or through informal study clubs, etc. need certification to offer CE credits. State and local hygiene societies typically have accreditation and therefore speakers are not required to have CE approval status if their courses meet the group’s provider status requirements.

Dr. White: What specific marketing tools are available to clinicians to reach out to hygienists?

Ms. Bernie: Ormco has developed a program that specifically educates dental hygienists about the benefits of orthodontic treatment with information about how best to identify a candidate for treatment. This resource includes a PowerPoint presentation, script and applicable research that substantiates the information provided. I enjoyed presenting these materials at the 2009 Damon Forum. Doctors who are interested in this referring dental hygienist presentation should talk with their sales representative.

Dr. White: Each year you give programs to dental hygienist groups about orthodontic treatment. What have been their reactions?

Ms. Bernie: My lectures give a detailed overview of typical orthodontic treatment modalities ranging from invisible aligners to self-ligation, such as Damon System. By and large, hygienists are impressed by the results and the research associated with the Damon System. They appreciate any approach that reduces extractions and patient discomfort and any appliance that is easier to keep clean and speeds treatment. They have also appreciated increasing their knowledge about the science of tooth movement and their role in orthodontic treatment success.

Dr. White: One final question. What do you recommend for the patient who exhibits chronically poor oral hygiene?

Ms. Bernie: By all means, get them using an electric toothbrush. Some patients simply do not have the dexterity to do a thorough job brushing manually and they need the help that only a mechanical brush can give. Sonicare and Braun make reliable products.

Dr. White: Ms. Bernie, thank you so much for sharing your unique knowledge and expertise with our readers.
Functional NONEXTRACTION Treatment

Larry W. White, DMD, MSD
Dallas, Texas

James E. Eckhart, DDS
Manhattan Beach, California

Functional orthodontics received its main endorsement from European dentists in the early 1900s through such clinicians as Robin1, Swartz2, Andresen34 , Haupl5, Herbst6-8 and Frankel9 10, among others. With the exception of Herbst*, most of these approaches relied on removable appliances with multiple designs. Other than brief flirtations with removable appliances, American orthodontists had never really adopted them for sustained periods and continued to rely on fixed appliances for the correction of malocclusions. The use of fixed appliances has, nevertheless, inherent weaknesses in the correction of sagittal discrepancies such as Class II and Class III malocclusions. Clinicians have to rely on patients to wear corrective elastics or headgears of some sort to achieve the desired improvements.

Pancherz11 rediscovered the work and fixed appliance of Herbst and popularized its use anew in the correction of Class II malocclusions. This appliance has animated orthodontists ever since. Orthodontic journals have published dozens of articles about its use and continue to do so as more and more adaptations and designs surface. Orthodontists have discovered, however, that although patients could not remove the appliance as they could with previous functional devices, they still did not appreciate having their mandibles and maxillae joined together, and they often resorted to destructive behavior with the appliances in order to avoid using them.

Eckhart12 13, undertook the task of solving this undesirable feature with the development of the Mandibular Anterior Repositioning Appliance (MARA). This relatively new functional apparatus retains the needed mandibular advancement of Class II correctors but does it without connecting the maxilla and mandible. This has contributed much toward greater patient comfort with less-restricted function. Dr. Eckhart presents two patients treated with the MARA, illustrating its clinical capabilities.

* Herbst is a registered trademark of Dentaurum, Inc.
CASE 1
Dr. James Eckhart

Pretreatment/Treatment Plan
Female, 12 years 11 months, presented with a Class II division 1 malocclusion characterized by a deep bite, large overjet, an absence of crowding in both arches and an acceptable soft-tissue profile.

Treatment plan included first placing the MARA, which is ideal for correcting this type of malocclusion, followed by fixed appliances (.022 Damon® 2) to close the remaining spaces, and posterior up and down elastics to correct any remaining posterior open bite that resulted from MARA placement. Placing a MARA always causes an immediate posterior open bite.

Treatment Initiation
Placed the MARA using crowns on the molars.

10 Months: Class I Occlusion Obtained
The posterior open bite substantially resolved without mechanotherapy but with the usual increase in maxillary dental spacing. The premolars had moved distally with the molars, settling into a firm Class I occlusion. There were minimal side effects on the lower teeth.

Note: It is not unusual to see maxillary teeth drift distally during MARA therapy, particularly in girls who do not experience as much mandibular growth as boys during ages 11 to 14. The distalization is also more noticeable in patients who are not bonded with fixed appliances during the MARA phase of therapy because as the maxillary molars distalize, the gum fibers pull the premolars distally as well.

13 Months: MARA Removed; Fixed Appliance Treatment Begins
Removed the MARA, bonded fixed appliances to close the remaining spaces and applied elastics to close the remaining posterior open bite that persisted after MARA removal (not pictured).

40 Months: Treatment Complete
Removed fixed appliances and delivered removable retainers to hold the correction.

Case Discussion
Combining the MARA-only phase with bonded brackets would have reduced the total treatment time and number of visits.
CASE 2
Dr. James Eckhart

Pretreatment/Treatment Plan
Male, 12 years 3 months, presented with a Class II malocclusion characterized by maxillary and mandibular arch length discrepancies, an anterior open bite, large overjet, a protrusive profile and a congenitally missing right mandibular second premolar. The patient’s family refused extraction therapy.

Treatment plan included the concurrent use of the MARA, a tongue crib and fixed appliances (.022 Orthos) in both arches and after MARA treatment, posterior bite-closing elastics and a cervical collar (similar to that worn by automobile whiplash victims) to push upward on the mandible and retain the corrected anterior open bite. Note: I treated this patient before I began using the Damon appliance.

Treatment Initiation
Placed the MARA with crowns on the molars, a tongue crib and fixed appliances in both arches.

14 Months: MARA Treatment Complete
Removed the MARA and tongue crib. Bonded the remaining teeth, applied bite-closing elastics and delivered the orthopedic cervical collar (not pictured).

38 Months: Treatment Complete
Removed fixed appliances and delivered removable retainers to hold the correction.

Case Discussion
This patient was not an ideal one for MARA correction because of the myriad of problems. The preferred treatment might have been justifiably to extract the premolars in order to retract the protruded dentition, reduce the protrusive profile and aid in the closure of the anterior open bite. Since the family rejected this approach and preferred correction on a nonextraction basis, the final result justified this therapeutic decision.
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