

The Butterfly System™: brackets, prescription, and auxiliaries

Dr. S. Jay Bowman discusses the concepts behind the Butterfly System™ components



Introduction

Dr. S. Jay Bowman of Portage, Michigan, who was asked to help design and develop a low-profile, vertical slot bracket system—the Butterfly System™ from American Orthodontics—talks with *Orthodontic Practice US* about the evolution of the system. The Butterfly System™ also encompasses many other concepts that Dr. Bowman created to solve everyday clinical problems, such as the Kilroy Spring and Monkey Hook for impacted canines, the Bowman Modification and Horseshoe Jet distalizing devices for Class IIs, the Quick Fix for Pseudo Class IIIs, Aligner Chewies and Retainer Retrievers for Invisalign®, and several auxiliaries for use with miniscrews.

Can you briefly describe the foundation for your proposed improvements of the pre-adjusted appliance concept?

In 1996, the American Board of Orthodontics (ABO) described the most common mistakes found in case reports presented by candidates failing the Phase III examination: the formative basis for the development of the ABO Objective Grading System.¹ These failed cases seem likely to have exhibited some fairly common errors facing a significant number of orthodontists. Because pre-adjusted appliances are the most popular, it may appear reasonable that improvements in the straightwire concept can help to reduce the prevalence of these errors.² Making use of Andrews' original concepts³ was an important stage in our orthodontic evolution, but focusing on new modifications and enhancements to help reduce common errors, increase comfort, esthetics, and versatility had yet to be addressed.

What is the Butterfly System™?

The Butterfly System™^{4,5} is based on a very low-profile, pre-adjusted bracket (Figures 1A,1B) featuring a vertical slot (Figure 2).

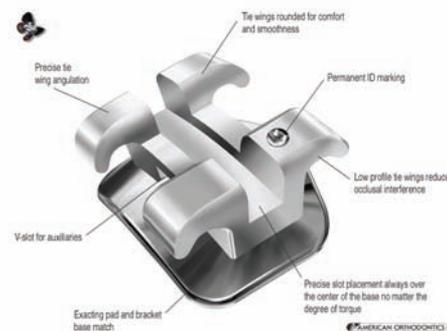


Figure 1A and 1B: Features of the Butterfly System™: Low-profile brackets for improved esthetics and comfort, plus the added versatility of a vertical slot^{4,5}

Lower-profile brackets (17% smaller in dimensions) are obviously more esthetic, comfortable, and more hygienic, especially since hooks are not necessarily incorporated into their fabrication. The added advantage of the vertical slot increases the versatility of the appliance by the simple addition of a variety of useful auxiliaries.^{4,5} For example, hook or “T-pins” for elastics are easily inserted into the vertical slot (Figure 3), whenever and wherever they are needed during treatment. Not only does this eliminate the need to have brackets manufactured with integral hooks that are unsightly, bulky, uncomfortable, and trap food and plaque, but this also helps to reduce patient confusion issues. How often has a patient been instructed to wear elastics in a Class II configuration only to return at the next office visit wearing Class III elastics, resulting in the iatrogenic worsening of the malocclusion? T-pins are inserted into the v-slot *only* where you would like elastics to be worn (Figure 4). Consequently, patients wear elastics only where there have been hooks added.

These elastic-hook T-pins or hooks are removed to facilitate hygiene and patient comfort once the need for elastics is complete.

1996
“In 1996, the American Board of Orthodontics reported on the common mistakes found in case reports failing Phase III examination. As some type of preadjusted appliance was often used, some shortcomings of existing straightwire concepts may warrant improvements.”



Figure 2: Vertical slot permits the insertion of a variety of different auxiliaries



Figure 3: Auxiliary hook or "T-pins" for elastics can be easily added to vertical slots when and wherever needed



Figure 4: Elastic hooks and other auxiliaries can be simply inserted or removed for any bracket, thereby offering a multitude of biomechanic options. In this case, Delta or "triangle" elastics were prescribed. Hooks are inserted specifically where elastics are to be worn to avoid patient confusion



Figure 5: "Sling tie" or "v-tie" (steel ligature inserted through the vertical slot) from a blocked-out tooth, out to the arch wire, offers a "low-friction" option to enhance early dental alignment



Figure 6: Traditional Begg vertical slot auxiliaries,⁶ such as uprighting and rotating springs, can be used to facilitate the correction of severe rotations, improve root paralleling, and assist with anchorage support



Figure 7: The U-turn⁵ spring is a square wire auxiliary designed to friction fit into the square v-slot. It is individually adjusted for either clockwise or counterclockwise rotation and may be inserted either from the occlusal or gingival aspect



Figure 8: The Compliance+ Spring⁵ is a v-slot auxiliary to help elicit patient compliance with elastic wear and may be alternatively used (on a round wire) to produce individual labial root torque

In addition, it may be occasionally preferable to have intermaxillary elastics stretched from maxillary laterals, instead of cuspids (i.e., "long Class IIs"), or from lower second premolars (i.e., "short Class IIs"), or even "zig-zag" or spaghetti configurations: lacing elastics around brackets on nearly every tooth to finalize intercuspation. The advantage of adding hooks to any bracket eliminates fumbling with crimpable hooks and Kobayashi ties. Enhancement of patient comfort and esthetics are derived from the reduced profile or thickness of the bracket, its miniature Siamese twin design, and rounded tie-wings (Figure 1A). Combining these features with the elimination of hooks results in an appliance that may be more appealing to patients (Figure 1B).

As Dr. Tony Gianelly once said, "I don't understand why you wouldn't want a vertical slot in your bracket, whatever bracket you choose; it's free," and I agree completely. The v-slot is indispensable if, for nothing else, than to use that slot for the insertion of a ligature wire or elastic thread to direct the positioning of significantly blocked-out teeth (Figure 5). With "low-friction" as a pop culture term today, it is apparent that the lowest friction and largest "inter-bracket" distance for initial alignment would come from a loosely tied ligature inserted through a vertical slot and looped around the arch wire (i.e., "sling-tie" or "v-tie"; Figure 5).

What other types of auxiliaries can be used with the vertical slot of the Butterfly System™?

There are a number of other auxiliaries that can be inserted into the vertical slot, such as typical Begg springs⁶ (e.g., rotating and uprighting springs, Figure 6). These springs, constructed from round wire, can be used to enhance correction of rotations and to improve root paralleling and positioning. These auxiliaries address limitations in resolving rotations inherent to the "slop" found with some self-ligation systems, and they also preclude the need for counter-rotation "Lewis" wings on narrow brackets.⁷ Besides, modern arch wire materials have reduced the need for

single-width brackets to increase interbracket distance, so a small Siamese twin bracket provides more versatility and control.

Uprighting springs are a hallmark of the Bidimensional technique as Gianelly employed them to not only assist paralleling roots, but also for anchorage control.⁸ For example, if you intend to reduce distal migration or tipping of canines when closing posterior extraction spaces (e.g., molar protraction when second premolars or first molars are extracted or missing), then uprighting springs are inserted into the vertical slot of the canines to "tip" the crowns mesially and enhance anterior anchorage.⁸

Rather than insert a "round-wire" auxiliary into the "square" vertical slot of the Butterfly System™ bracket, we created the U-Turn Spring⁵ (American Orthodontics, Figure 7), fabricated from a segment of square wire. The U-turn is a rotating spring that can be used for either clockwise or counterclockwise rotation. The horizontal arm of the spring is "adjusted" by the clinician to whatever degree of force is desired by holding the portion of the auxiliary that will be inserted into the v-slot with a pliers and then bending the arm around that axis. These springs can be inserted into the v-slot from either the gingival or occlusal for easier access. In addition, they can be placed prior to tying-in the archwire (like a rotational wedge) or after the wire has been steel-tied into the bracket like a typical rotating spring.

The Compliance+ Spring⁵ (American Orthodontics, Figure 8) is a vertical slot auxiliary designed for two different uses. The force from the spring is derived from intermaxillary elastics (e.g., Class I, II, III or delta [triangle] elastics). When the Compliance+ is used on a round, base arch wire then the force of the spring can produce single-tooth labial root torque. This is often useful after a palatally impacted canine has been directed out to the arch form, but the root still requires substantial labial movement. The C+ spring can also provide labial root torque for upper or lower lingually positioned lateral incisor roots.

In addition, the C+ spring can assist with compliance issues

Figure 9A-9D: The Monkey Hook^{9,11} auxiliary is designed to assist with impacted, rotated, and displaced teeth. It may also be used to attach elastic chain or coil springs to mini-screws. B: The Kilroy Spring^{10,11} is an adjustable auxiliary for directing the eruption of impacted teeth. C: The Ulysses Spring^{12,13} is an extrusive mini-screw auxiliary to close open bites. D: The TAD Bite Opener^{12,13} is an intrusive mini-screw auxiliary to open overbites



Figure 10: The Bowman Modification^{12,13,15} is an evidence-based enhancement of the Distal Jet for molar distalization



Figure 11: The Horseshoe Jet^{12,13,15} is a miniscrew-supported molar distalizer that produces no anterior anchorage loss



Figure 12: The Wyred™ Lip Supports¹⁶ are spring steel, adjustable cheek retractors to enhance stability and visibility for direct bonding procedures

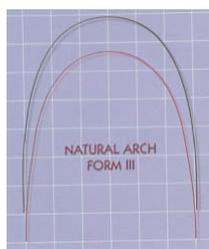
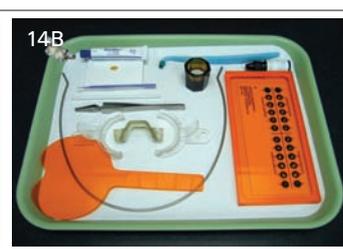


Figure 13: The Natural Arch III was selected to produce a more natural smile and anatomical arch form



Figures 14A and 14B: The Orange Box System¹⁶ is a selection of “light-safe” devices to permit the convenient, efficient, and organized management of pre-loading light-cured adhesives onto orthodontic brackets

in wearing elastics. The arm (elastic hook) of the spring can be adjusted to protrude slightly into the buccal tissues to cause some minor patient lip or cheek irritation that is alleviated by simply wearing elastics. In this scenario, the C+ springs must be used with a rectangular base arch wire, or unintended labial torque force will be applied to the tooth where the elastics are worn. The Compliance+ auxiliary slides onto the main arch wire, prior to inserting the leg of the spring into the v-slot, and then the arch wire must be steel-tied into the bracket to prevent it from becoming dislodged due to force from the C+ spring.

Does the Butterfly System™ concept imply more than “just another bracket?”

Certainly. In fact, we’ve developed a variety of simple solutions to everyday clinical problems. This is the key behind the development of the unique features of not only the brackets, but other associated aspects of patient care within an overall treatment “system.” For instance, we have designed a series of auxiliary springs, the Monkey Hook⁹ (Figure 9A) and Kilroy Spring^{10,11} (Figure 9B), to simplify the handling of impacted teeth as well as the Ulysses Spring (Figure 9C), TAD Bite Opening Spring (Figure 9D), and Propeller Arm for use with mini-screws (American Orthodontics).^{12,13}

Within this system framework, we have also continued making improvements to the Distal Jet Family of appliances (i.e., Distal Jet, Spring Jet, Uprighter Jet, etc.).^{14,15} There have been a significant number of Distal Jet research studies at several universities, and the results have helped refine our clinical techniques.¹⁴ This

includes Class II Combination Therapy¹⁵ where fixed functionals (e.g., Jasper Jumpers) are occasionally used after the completion of molar distalization to help maintain the distalized molar position. As a direct result of the evidence from these studies,¹⁴ we created the Bowman Modification Distal Jet¹⁵ (Figure 10) as well as the Horseshoe Jet (AOA Laboratories, Figure 11),^{12,13,15} using pure skeletal anchorage (mini-screw support) to eliminate untoward anchorage loss during distalization.

We also introduced a simple, adjustable, and autoclavable Wyred™ Lip Retractor (Dentsply Glenroe Technologies, Figure 12) to provide more stable support and improved visualization of posterior teeth when direct-bonding.¹⁶ We’ve adopted an anatomical arch form (Natural Arch Form III, American Orthodontics, Figure 13) with the intent of creating more natural smiles rather than the obvious “orthodontic or denture look” characteristic of overly expanded results. We have incorporated the “Orange Box System”¹⁶ with Eagle No-Drift™ bonding adhesive (American Orthodontics, Figures 14A and 14B) to efficiently and consistently “pre-coat” adhesive onto brackets prior to bonding; thereby, increasing clinic efficiency.¹⁶ We recently developed the Orthodontic Adhesive Removal Set (LS-7585, Axis Sybron Dental Specialties, Figure 15), a three-step system for predictable and consistent post-treatment removal of bonding adhesives and cements.¹⁷ Those are just a few examples of innovations that have enhanced the Butterfly System™ while encompassing a variety of solutions to clinical problems, but it all began with bracket concepts.

What are some of the specific features of the Butterfly Bracket System™?

There are several primary features designed to improve upon existing pre-adjusted appliance concepts (Table 1).^{4,5} These modifications were partially made in response to the findings of the ABO^{1,2} and include: progressive posterior torque, preventive mandibular anterior torque, mandibular anterior progressive angulation, convertible molar tubes with -6° angulation, and added functionality for both nonextraction and extraction treatments from reversible second premolars. Finally, the versatile and indispensable vertical slot incorporated into a low-profile bracket offers a largely untapped potential.

Soon after entering practice, 26 years ago, I became intrigued with the properties and rationale behind the development of different “philosophies” and bracket prescriptions. I gathered information to create an amalgam of ideas and features to develop an improved and streamlined pre-adjusted design. Sernetz¹⁸ stated, “For the manufacturer, it is always amazing to see how non-critical the orthodontist can be...”, and Andrews¹⁹ opined, “As a teacher, I find it interesting how unconcerned some orthodontists are about the design features of the appliance they use.” Finally, the sociologist Eric Hoffer stated, “When people are free to do as they please, they usually imitate each other.” Rather than simply continuing to follow the herd, the Butterfly System™ was created.

How does the Butterfly System™ address the most common problems described by the ABO?

Progressive posterior torque^{4,5} was designed into the Butterfly prescription to address improper buccolingual inclination of posterior teeth (Figure 16), the most prevalent error found by the ABO.^{1,2} Marshall et al²⁰ reported that, “For proper occlusion, there should be no significant difference between the heights of buccal and lingual cusps of molars and premolars.” However, these types of errors would seem to be quite common considering the extreme amount of mandibular posterior lingual crown torque “designed-into” many pre-adjusted prescriptions (Figure 17),²¹ in part, to obtain so-called “cortical anchorage.”²² In fact, Yang-Powers et al²³ discovered that “orthodontists are good at correcting spaces and are deficient in placing adequate torque in the buccal segments.” Sondhi²⁴ concluded that, “the degree of torque in the maxillary second molars is the most important factor in reducing interferences...”; however, he found that almost all popular prescriptions had only -10° of torque for the teeth in question. Compounding this dilemma is the increasingly common use of “expansive treatments” (often utilizing excessively overexpanded arch blanks²⁵) with prescriptions that generally feature insufficient maxillary posterior lingual crown torque (Figure 16). The results are an accentuated curve of Wilson, prominent palatal cusps, improper buccal cusp interdigitation, “rolled-in” lower molars, and inappropriate posterior overjet (Figure 17).²¹

Increased maxillary posterior torque was added to the Butterfly prescription to reduce buccally tipped molars. In addition, reduced mandibular posterior torque is intended to diminish the typical “rolling-in” or linguoversion of lower molars¹ often found with straightwire treatments. The combined desired effect is an improvement in the final occlusion by flattening the curve of Wilson, minimizing posterior overjet, and reducing the prominence of palatal cusps (Figure 18).

If additional posterior torque is to be added or subtracted during treatment, then Beta-Ti wires with third-order progressive torque appears to be the most effective and comfortable method compared to using stainless-steel wires. The selection of an arch form demonstrating an anatomically correct shape (e.g., Natural Arch III) helps to maintain intercuspid widths and, with appropriate arch coordination, it may be more likely to approach the original dimensions of the patient’s dental arches (for better post-treatment stability and more natural smile and facial esthetics;

Table 1: Features of the Butterfly System™

- Low profile miniature twin bracket with v-slot
- 17% reduction in standard dimensions
- More esthetic, comfortable, and hygienic
- Versatile vertical slot with multiple auxiliary options
- No need for hooks molded as part of bracket fabrication
- Offset premolar brackets with larger bonding bases
- 80-gauge mesh and photo-etched Maximum Retention bases
- Preventive anterior torque: options for -5 or -10 lower incisor brackets
- Progressive anterior tip: “tent-posting” lower incisors for stability
- Reversible second premolar brackets to enhance both extraction/nonextraction results
- Progressive posterior torque to improve occlusion
- Angulated convertible tubes to match molar/premolar marginal ridges
- Optional low-profile bonded molar tubes (LP tubes)
- .018” or .022” slot options (combined for Bidimensional)



Figure 15: The Orthodontic Adhesive Removal Set¹⁷ was designed to efficiently remove residual adhesive after appliance removal and to produce a smooth final finish (Sybron Axis)

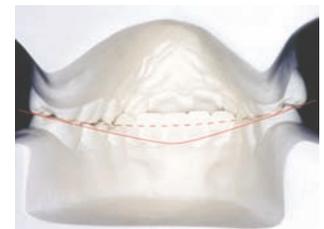


Figure 16: Inappropriate posterior torque creates an excessive curve of Wilson, incorrect intercuspation, insufficient posterior overjet, and increased incidence of occlusal interferences. (dotted line = ideal curve of Wilson; solid line = buccally-tipped upper molars and “rolled-in” lower)



Figure 17: Insufficient maxillary posterior lingual crown torque combined with excessive mandibular crown torque, inherent to many popular pre-adjusted appliances, may cause inappropriate posterior occlusion

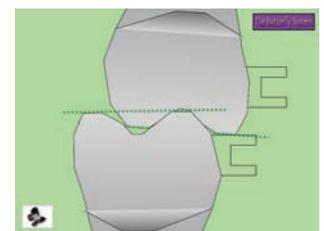


Figure 18: Butterfly System™ features increased, progressive crown torque for upper posteriors and decreased, progressive crown torque for lowers, to improve posterior occlusion



Figure 19: The esthetic effect and resulting occlusion from the Butterfly System™ combined with coordination of Natural Arch III arch forms

Figure 19).

In terms of smile design, we have also eliminated torque from the upper canines. It is certainly curious to examine the extreme amounts of cuspid torque found in popular prescriptions: from as much as $+7^\circ$ in the Bioprogressive camp to -7° for MBT.²¹ Interestingly enough, Sondhi²⁴ concluded that negative torque of maxillary cuspids produces lingual displacement or “offset,” rather than upright canines. In regards to premolars, Zachrisson²⁶ has recommended mild, individualized, labial tipping, especially for extraction cases, to improve smile esthetics.

A similar situation exists for lower canines with ranges from -11° from Roth and Andrews³ to $+7^\circ$ of Hilgers and Ricketts.²² To match our more upright posterior torque, the 0° torque for maxillary canines, and the “flare” resistance of our lower incisor torques, we have selected -3° for the mandibular cuspids in the Butterfly prescription. It is most important to note that this prescription will still require individualization for each patient’s situation. The notion that just a series of “straight wires” will achieve ideal results for every patient has never been a realistic expectation.

What solutions are offered for the overjet problems described by the ABO?

Both anterior and posterior overjet problems can be improved by appropriate torque and the selection of more anatomical arch forms. The adjustment in progressive torque in the Butterfly System™ (reduced values in the mandibular posteriors and increased in the maxillary) helps to reduce flared maxillary molars and rolled-in mandibular posteriors. Also integral to this concern is the management of arch form that often suffers from the contemporary use of significantly overexpanded, commercial arch blanks.²⁵ When these broad arch forms are combined with the popular expansive treatment therapies, the result may include: a flared dentition (i.e., bimaxillary protrusive), a discrepancy in overjet (both anteriorly and posteriorly), and distal tip to lateral incisors. The effect is a distinctive “orthodontic or denture look,” as has been described by Dr. Bill Proffit.

Consequently, it may be important to select an arch form that, whenever possible, is similar to the patient’s pretreatment shape, while also attempting to maintain the pretreatment inter-canine widths to improve stability.^{21,26} Individualized coordination of the arch forms throughout treatment should be accomplished with these principles in mind. The goal is to produce stable, yet natural esthetics. In conclusion, an orthodontist’s signature should not appear on his/her orthodontic artwork (in contrast to that of an “artist”). In other words, the patient should not look like they had orthodontic care: overly expanded smiles with flared incisors or, in contrast, overly upright and retracted incisors.

Why are there two options for mandibular anterior torque included in the system?

Some undesired tendencies might occur with pre-adjusted appliances, especially during Class II correction. These include: a tendency for maxillary and mandibular anteriors to be tipped labially^{27,28} (increasing instability, lip protrusion, and taxing anchorage); clockwise rotation of the mandibular plane (worsening Class II relationships and decreasing stability); and extrusion of maxillary incisors (increasing gingival display). Consequently, lingual crown torque is designed into the prescription for lower anterior brackets. Preventive lingual crown torque of -5° in the mandibular incisors of the Butterfly System™ is intended to resist their inherent labial tipping during leveling.^{27,28} Butterfly brackets with an optional -10° of torque for the four lower incisors are recommended for use in Class II cases to reduce the labial tipping from Class II elastics^{8,21} or fixed functional appliances such as Jasper Jumpers or Herbst. Perhaps, the clinician may want to keep a smaller inventory of the four -10° mandibular incisor brackets

with the remainder as the standard -5° . These two torque options reduce the amount of wire bending required to prevent labially tipped incisors. If less torque is desired for a specific situation, then simply use smaller dimension rectangular wires.

What is the significance of adding angulation for the mandibular incisors?

The ABO was specifically concerned about errors in anterior root angulation.¹ The majority of pre-adjusted appliances feature no “tip” or angulation in the lower incisor brackets. Because the edgewise slot is commonly never “filled” with full-size wires in typical orthodontic practices, often the lower incisor roots still converge, and crowns of lower incisors are tipped distally at the conclusion of treatment (Figures 20A and 20B). Progressive mandibular mesial crown tip for lower incisor Butterfly brackets was designed to reduce those errors and improve stability of finished cases by “tent-posting” the incisors²⁸ (Figure 21). This will reduce the distal crown tip of lower incisors and the associated undesirable convergence of the roots.

Was the ABO also concerned about errors in marginal ridge match for finished cases?

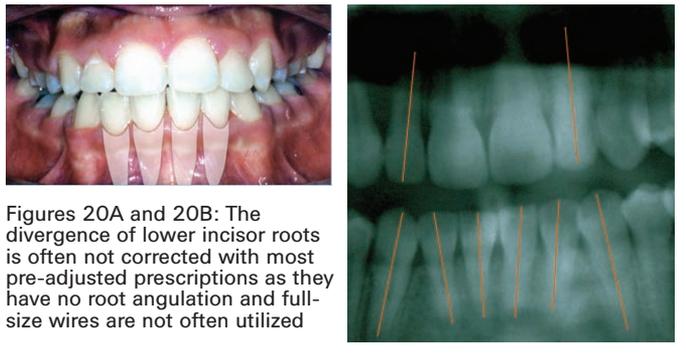
Third in prevalence of problems noted by the ABO were marginal ridge discrepancies, with 55% of the errors found between the maxillary and mandibular first and second molars and 33% found between the second premolars and first molars.¹ This dilemma arises due to the difference in heights of the mesial and distal marginal ridges of, primarily, the first molars. Standard molar bands are often positioned too apically in the distal aspect; thereby, tipping the molar buccal tube distally. The result is extrusion of the distobuccal cusps of the first molar, marginal ridge discrepancies, occlusal interferences, and an open-bite tendency at the mesiobuccal cusp (Figure 22).

The Butterfly System™ helps to address these concerns in a number of ways. First, we have added -6° of tip to the attachments on first molar bands (Figures 23A and 23B) to compensate for the difference in the mesial and distal marginal ridge heights of these teeth. These bands can then be easily fit with the marginal ridge of band and tooth matching, yet the molar tube will be level: a simple solution to a common clinical error. In contrast to Dr. Arnold Stoler, who was a proponent of the Universal technique and preferred prominent distobuccal cusps (i.e., “Stolerized molars”), we prefer more upright molars, roots parallel to the premolars, and with more emphasis on seating the upper palatal cusp to the lower central fossa and the upper mesiobuccal cusp oriented to the central groove of the lower molar (Figures 24A and 24B).

What type of molar tube is suggested for the Butterfly System™?

Although bonding brackets on molars has become more popular, we prefer to band first molars due to the versatility of double and triple convertible buccal tubes (Figure 25). The convertibility of the main buccal tube permits easy application of larger-dimension arch wires to both first and second molars, while the auxiliary tube facilitates the addition of secondary sectional or continuous “overlay” arch wires. For instance, a superelastic round wire may be inserted into the main buccal tube for initial alignment while a rectangular wire is placed into the auxiliary tube to simultaneously initiate bite opening and/or to maintain or expand arch width. These overlay or auxiliary wires can be held in place using our simple auxiliary, called the Double Up (American Orthodontics, Figure 26). The small, edgewise tube of the Double Up permits it to be slid along an archwire to a desired position. It is then connected to the other arch wire using the crimpable tube on the other end of tiny auxiliary. Finally, a headgear tube is useful for the application of a cervical headgear, fixed functionals (e.g., Jasper Jumpers), lip bumpers, or other auxiliaries. In less complex clinical situations,

Interview



Figures 20A and 20B: The divergence of lower incisor roots is often not corrected with most pre-adjusted prescriptions as they have no root angulation and full-size wires are not often utilized

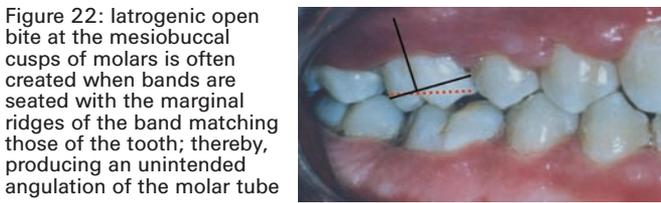


Figure 22: Iatrogenic open bite at the mesiobuccal cusps of molars is often created when bands are seated with the marginal ridges of the band matching those of the tooth; thereby, producing an unintended angulation of the molar tube



Figures 24A and 24B: Angulated first molar attachments assist in paralleling the molar tubes to the buccal cusps and also the roots of the molars to premolars, preventing formation of an open bite at the mesiobuccal cusps



Figure 27: Optional low profile (LP) tubes feature 80-gauge mesh over a photo-etched base, as does the entire Butterfly Bracket System™



Figure 28: Low-profile offset premolar brackets significantly reduce premature loss of brackets³⁰

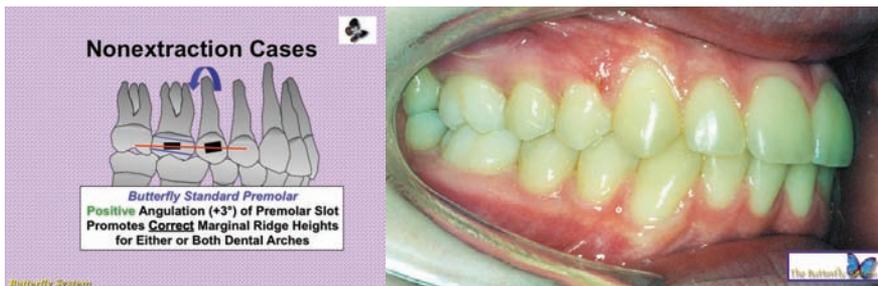


Figure 30: Angulated second premolar brackets improve marginal ridge adaptation of the second premolar to the first premolar in nonextraction situations

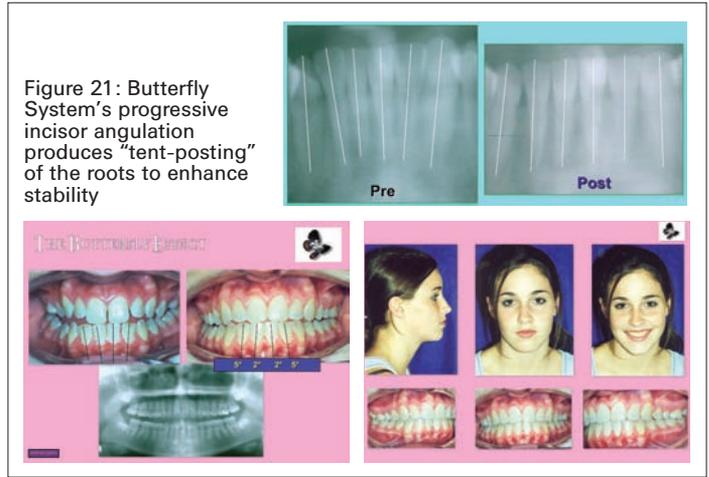
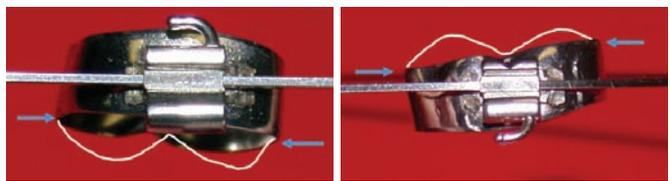


Figure 21: Butterfly System's progressive incisor angulation produces "tent-posting" of the roots to enhance stability



Figures 23A and 23B: Angulated first molar attachments of the Butterfly System™ to match the marginal ridges of the first molars of the bands



Figure 25: Optional triple molar tubes feature a convertible main tube, an auxiliary tube for sectional or continuous "overlay" wires, and a headgear tube for fixed functionals or headgear



Figure 26: Double Up auxiliary facilitates the connection of an auxiliary "overlay" wire to the main, base archwire. The auxiliary features a closed tube to slide along one of the wires and, on the other end, a crimpable tube to attach to the second wire (American Orthodontics)

Figure 29: Reversible second premolar brackets in both upper and lower arches enhance both nonextraction and extraction treatment options (solid line = extraction; dotted line = nonextraction)

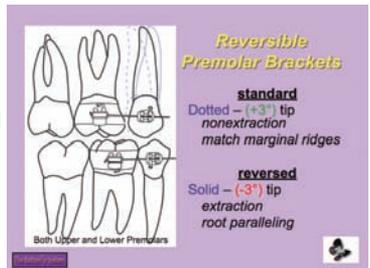
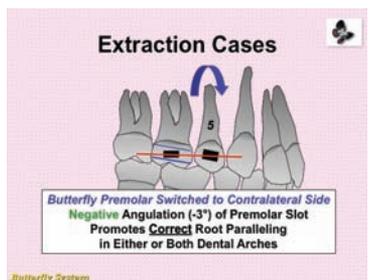


Figure 31: Switching second premolar brackets (in both dental arches) from right to left and vice versa assists in root paralleling for extraction treatments



Figures 32-34: Patient treated with extractions using the Butterfly System™. Reversing the right and left second premolar brackets in both dental arches enhanced root paralleling during space closure

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Figures 35-39: Class II Combination Therapy¹⁵ with Butterfly System™: Bowman Modification¹⁵ distalization followed by fixed functionals. T-pin hooks were added only when intermaxillary elastics were required to improve oral hygiene, esthetics, and comfort. Labial flaring of lower incisors was managed with optional -10° brackets

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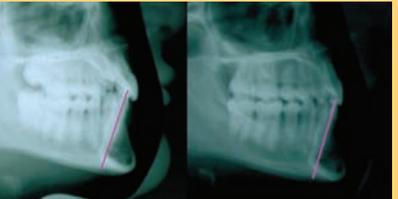
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then low-profile, LP tubes (American Orthodontics, Figure 27) are bonded onto molars as an alternative to orthodontic bands.

What are important features of the Butterfly System™ premolars?

Offset bonding bases on premolar brackets feature larger bonding surfaces (Figure 28), and like all of the brackets in the system, they have 80-gauge mesh and Maximum Retention, photo-etched bases to increase bond strength (Figure 27). The offset of the premolar bracket base permits these brackets to be positioned more gingivally; thereby, improving marginal ridge match. Thind et al³⁰ reported statistically significant reduced bond failure rates with offset premolars compared to standard brackets. In addition, these brackets are much lower in profile compared to many popular brackets, especially the bulkier self-ligation styles that inherently demonstrate more de-bonds.³¹ Perhaps, any potential chairside time savings for self-ligation is lost in repair work.

“Reversible” second premolar brackets are a unique feature of the Butterfly System™, designed to improve the results from both extraction and nonextraction mechanics, without increasing bracket inventory. Yang-Powers et al²³ concluded that, “orthodontic residents had better scores for root parallelism than ABO Diplomates.” Part of this problem may be due to the fact that full-size wires are rarely chosen, and orthodontists expect that

their pre-adjusted appliance will “automatically” produce desired results, including paralleled roots after space closure.

Attention to detail in bracket selection prior to initiating treatment will assist the clinician in achieving improved results at the conclusion of care. For instance, mesial crown angulation has been designed into the second premolar bracket prescription (Figure 29). This “tip” helps to reduce marginal ridge discrepancies between second premolar and first molar; specifically, for nonextraction treatments (Figures 30A, 30B, and 31). But, for even more versatility, these same brackets can be reversed to the contralateral side in both dental arches (i.e., right premolar brackets to left and vice versa) for extraction cases. This change will produce distal crown tip to improve root paralleling between second premolar and canine during space closure (Figures 32-35). To assist root paralleling in a second premolar extraction scenario, the second premolar brackets are simply placed on the first premolars. The Butterfly System™ was designed to cover a wide range of treatment options for the vast majority of malocclusions while simplifying bracket inventory.

In summary, what considerations went into developing a new bracket system?

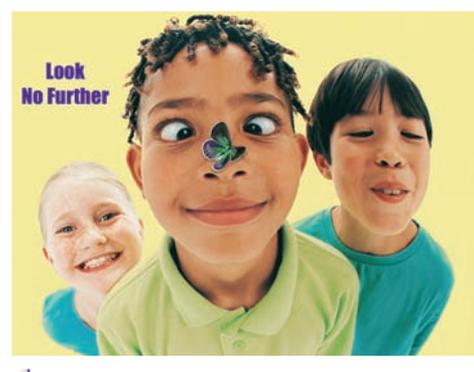
Esthetics, comfort, versatility, and “colorful” are all concepts that initially come to mind. In summary, the Butterfly Bracket System™

Table 2: Butterfly System™ Treatment Solutions

Treatment concern	Set-up modification	Intended effect
Nonextraction	Standard	Match first molar and second premolar marginal ridges
Nonextraction (Class II)	Optional -10° lower incisors; Bowman Modification or Horseshoe Jet distalization ^{12,13,15} (Fig. 35-39)	Resist labial flaring from fixed functionals or elastics
First premolar extractions	Reverse right and left 2nd premolar brackets; optional uprighting springs	Improve root paralleling
Second premolar extractions	Place 2nd premolar brackets on 1st premolars	Improve root paralleling
Protracting molars or premolars “slip” anchorage	Uprighting springs in v-slots of cuspids; invert Mn anterior brackets	Resist anterior retraction
Rotations	U-turn v-slot springs ⁵	
Deep overbite	Invert lower cuspid brackets. Add bite-opening overlay wire into auxiliary molar tube with Double-Up Auxiliary; TAD Bite Opener Auxiliary ¹³	Assist bite opening
Open bite	Posterior intrusion with mini-screws Selective extrusion with Ulysses Spring ¹³ on mini-screw	Assist bite closure
Lingual lateral incisors	Invert lateral incisor brackets or add Compliance+ Springs ⁵	Add labial root torque
Low-friction space closure	Bidimensional .018” anterior and .022” posterior Butterfly brackets or Dual dimension wire ⁵ Asymmetrical Beta-Ti T-loop ¹⁵	Reduce sliding friction
Pseudo-Class III	Quick Fix Device ³⁹	Predictable overjet production
Class III	TPA+ hooks ^{40,41} with mini-screws or plates and optional MN retraction	En masse protraction
Arch coordination	Expanded, rectangular overlay wire into molar auxiliary tube with Double Up auxiliaries	Enhance or maintain arch expansion

(Figure 36) is an esthetic and miniature twin bracket that features the added advantages and versatility of a vertical slot. The brackets are lower in profile and feature radiused corners on the tie-wings to increase patient comfort and facilitate oral hygiene. In addition, colorful elastic ligatures are an extremely popular highlight for many patients’ treatment, permitting them to personalize their braces. In fact, Walton et al³² reported that 85% of 9-14 year old patients preferred the esthetic appearance of twin wing brackets with colored ligature ties over clear, esthetic, as well as self-ligation brackets (both metal and clear), and confirming the findings by Miles and co-workers.³³

Most recently, there have been a number of investigations into claims made regarding speculated advantages of particular types of brackets including: low friction, force, and pain, eliminating the need for extractions or mechanical expanders, improved esthetics and stability, and stimulation of alveolar bone growth while reducing treatment times. For example, a study from Ebering and associates³⁴ has been promoted to illustrate this hypothesized treatment efficiency. The average treatment time for passive ligation in a sample of 108 patients was reported to be 24.5 months (although the Hawthorne Effect may have had an influence in the methodology). In a 2002 examination of 323 consecutively treated Butterfly System™ patients, the average treatment time was 25.2 months. In a subsequent study of 295 consecutive patients in 2006, the treatment time averaged a comparable 24.8 months (in



2004, the ABO OGS mean score for consecutively completed cases for voluntary ABO recertification was 24.8 using Butterfly).

In this discussion of treatment speed, it is curious that we have forgotten that Rand Bennett reported the most dramatic reduction in average treatment times from 29 months down to 16 months (in a 1990 product catalog) using a twin, *standard ligation* bracket. More importantly, several studies and systematic reviews of different ligation methods have described no dramatic differences in the factors noted above.^{31,33,35-38} For example, the meta-analysis investigation of Fleming and Johal³⁷ concluded there is “no evidence to support the use of self-ligating fixed orthodontic appliances over conventional appliance systems or

vice versa.”

In conclusion, the Butterfly System™ is based on modifications of past pre-adjusted concepts, made in response to documented case-completion problems as described by the ABO¹ and other evidence.^{20,21,23-30} In contrast to present marketing fads, the concept of the Butterfly System™, combined with the other devices that we've developed, are simply intended to provide small, conservative, but continual improvements in clinical practice (Table 2). To paraphrase George Eliot, “What is life for if not to make things easier for each other?” The Butterfly System™ features comfort, esthetics, and improved hygiene, with a design derived from evidence-based concepts to increase efficiency and versatility, while still colorful and cost effective. 



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