

THE MBT™ VERSATILE+ APPLIANCE SYSTEM

3M Unitek

THE MBT™ VERSATILE+ APPLIANCE SYSTEM

THE DEVELOPMENT OF A TREATMENT MECHANICS AND APPLIANCE PHILOSOPHY

The first fully programmed pre-adjusted appliance was developed by Dr. Lawrence F. Andrews in the late 1960's. This appliance was based on his evaluation of 120 non-orthodontic normal study models.¹ Soon after this, other pre-adjusted appliances became available, and the orthodontic specialty had moved into the era of the pre-adjusted orthodontic appliance. After using the original "standard" Straight-Wire® Appliance for a period of time, Andrews determined that for extraction cases, anti-tip, anti-rotation and power arms were needed in the posterior segments to properly control space closure. He also recommended the use of three sets of incisor brackets with varying degrees of torque for different clinical situations.²

Dr. Ron Roth,² in an attempt to minimize the inventory of a multiple bracket system, developed a single appliance system to manage both extraction and non-extraction cases. It is important to note that the appliance prescriptions developed by these two clinicians were based on the treatment mechanics used in their practices.

The authors found that in moving away from previously used edgewise forces to light continuous forces (with lacebacks and bendbacks), brackets with the above compensations were not necessary. They returned to the use of the original Straight-Wire Appliance. After using this system for approximately six years, certain modifications were made. These included additional palatal root

torque in the upper incisor area, additional labial root torque in the lower incisor area, reduced lingual crown torque in the lower second molar areas, and a tip adjustment in the upper molar areas. After using this system for an additional eight years and reviewing more recent research on measurements of the dentition, it was determined that further modifications were needed to optimize treatment efficiency. Thus, to date the authors' have a combined sixty years of experience with the pre-adjusted appliance. They are most grateful to 3M Unitek for providing these modifications to produce the MBT Versatile+ Appliance. The appliance is discussed segmentally to provide a clearer perspective of its various features.

| | Incisor Tip | | | | Cuspid Tip | |
|------------------------------|---------------|---------------|---------------|---------------|------------|-------|
| | Upper Central | Upper Lateral | Lower Central | Lower Lateral | Upper | Lower |
| Andrews' norms ³ | 3.59° | 8.04° | 0.53° | 0.38° | 8.4° | 2.5° |
| Sebata's data ⁴ | 4.25° | 7.74° | -0.48° | -1.2° | 7.7° | 1.5° |
| Watanabe's data ⁵ | 3.11° | 3.99° | 1.98° | 2.28° | 7.7° | 5.4° |
| Original SWA ³ | 5.0° | 9.0° | 2.0° | 2.0° | 11.0° | 5.0° |

Table 1. Anterior tip measurements from the Andrews non-orthodontic normal study,³ from two Japanese normal studies^{4,5} and from the original Straight-Wire® Appliance³.

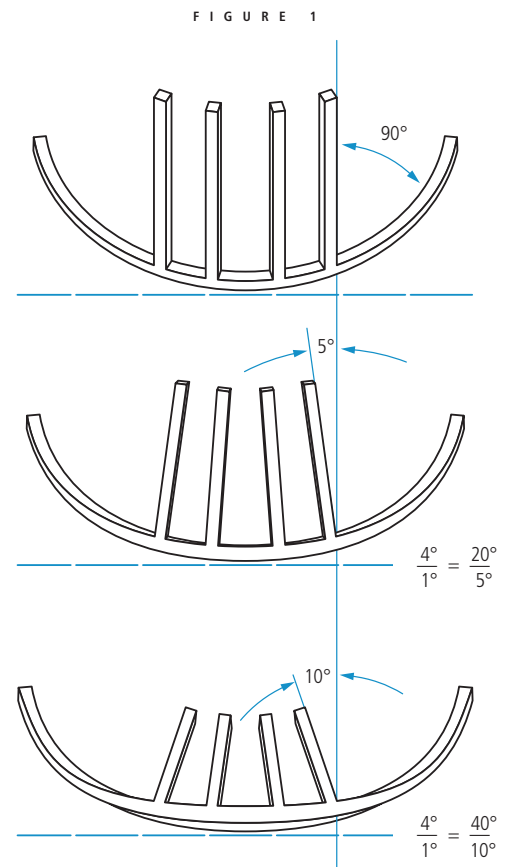
FEATURES OF THE MBT™ VERSATILE+ APPLIANCE

Anterior tip

Table 1 shows the anterior tip measurements from the Andrews non-orthodontic normal study,³ from two Japanese studies,^{4,5} and from the original Straight-Wire Appliance.³

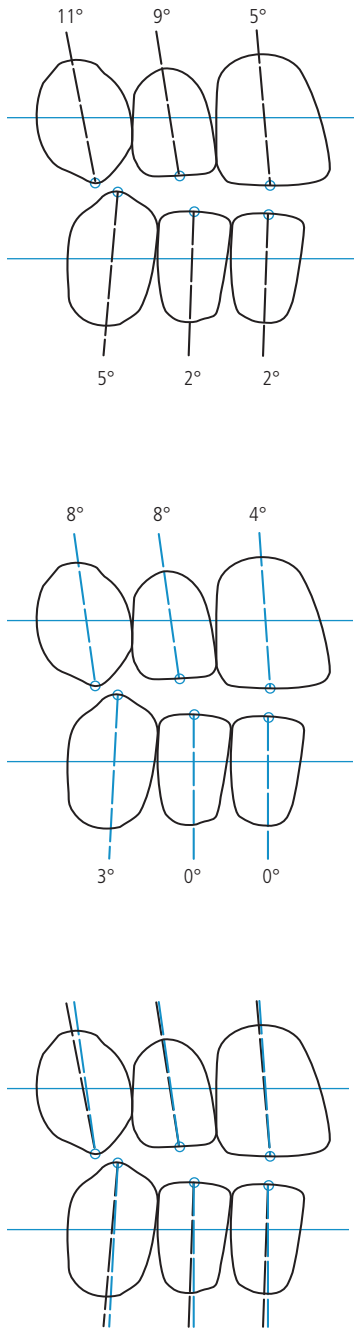
The anterior tip measurements for the original Straight-Wire Appliance are all greater than those found in Andrews research. This was presumably done to control what Andrews referred to as the “wagon wheel” effect that torque places on anterior crown tip.³ This is somewhat similar to the compensating anti-tip, anti-rotation and power arms built into the extraction brackets for the treatment of bicuspid extraction cases.

It has been observed by the authors that with light continuous force mechanics, tip is well controlled by the pre-adjusted appliance. By using “lacebacks” and “bendbacks” during leveling and aligning and elastic module “tie-backs” during space closure, very little adverse tipping occurs during these stages of treatment. And by the finishing stage of treatment, completely levelled upper and lower rectangular wires are normally in place, indicating that full expression of both anterior and posterior crown tip has occurred.



The “wagon wheel” effect.³ As palatal root torque is added to the anterior segment, mesial crown tip is reduced.

FIGURE 2



| | Incisor Tip | | | | Cuspid Tip | |
|---------------------------|---------------|---------------|---------------|---------------|------------|-------|
| | Upper Central | Upper Lateral | Lower Central | Lower Lateral | Upper | Lower |
| MBT Versatile+ | 4.0° | 8.0° | 0° | 0° | 8.0° | 3.0° |
| Original SWA ³ | 5.0° | 9.0° | 2.0° | 2.0° | 11.0° | 5.0° |

Table 2. Anterior tip measurements in the MBT™ Versatile+ Appliance and the original Straight-Wire® Appliance.

Thus, additional tip is not seen to be necessary in the anterior segments. In fact, this additional tip creates a significant drain on molar anchorage. If the original research values for tip are used, a total of 10° less distal root tip in the upper anterior segment and 12° less distal root tip in the lower anterior segment is needed (compared with the original Straight-Wire Appliance). This significantly reduces the need for anchorage control, which

normally translates into a reduced need for patient cooperation. Since these measurements are identical to Andrew's original research figures, there is no compromise in ideal static occlusion. And if the condyles are in centric relation, there is no compromise in ideal functional occlusion as described by Roth.⁶ Table 2 compares the anterior tip values in the MBT Versatile+ Appliance with the original Straight-Wire Appliance.

The MBT Appliance provides anterior tip measurements that correspond to Andrews norms. This reduced tip provides a significant reduction in anchorage needs.

Upper posterior tip

Table 3 shows tip measurements for the upper bicuspids and molars from the Andrews' non-orthodontic normal study,³ two Japanese studies,^{4,5} and the original Straight-Wire Appliance.³

For the MBT Versatile+ Appliance, 0° of tip, as opposed to 2° of tip, has been selected for all upper bicuspid brackets. This places the crowns of these teeth in a slightly more upright position, which is more in the direction of Class I. It also provides for slightly reduced anchorage needs for these teeth.

The reference for crown tip in the upper molars is the buccal groove. This buccal groove shows a 5° angulation to a line drawn perpendicular to the occlusal plane. There are two methods of achieving the accepted 5° of tip in the upper first and second molars. First, a 5° bracket can be

| | Bicuspid Tip | | Molar Tip | |
|------------------------------|--------------|--------------|-------------|--------------|
| | Upper first | Upper second | Upper first | Upper second |
| Andrews' norms ³ | 2.7° | 2.8° | 5.7° | 0.4° |
| Sebata's data ⁴ | 3.5° | 6.2° | 5.2° | -0.3° |
| Watanabe's data ⁵ | 4.7° | 5.2° | 4.9° | 4.1° |
| Original SWA ³ | 2.0° | 2.0° | 5.0° | 5.0° |

Table 3. Measurements for the upper bicuspids and upper molars from the Andrews' non-orthodontic normal study,³ two Japanese studies^{4,5} and the original Straight-Wire® Appliance.³

| | Upper Bicuspid Tip | | Upper Molar Tip | |
|---------------------------|--------------------|--------------|-----------------|--------------|
| | Upper first | Upper second | Upper first | Upper second |
| MBT Versatile+ | 0° | 0° | 0° | 0° |
| Original SWA ³ | 2.0° | 2.0° | 5.0° | 5.0° |

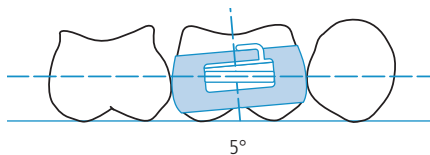
Table 4. Upper posterior tip measurements in the MBT™ Versatile+ Appliance and the original Straight-Wire® Appliance.

used, with the bands seated more gingivally at the mesial aspect (Fig. 3A). This method makes it more difficult to actually position the band in that it is necessary to seat the band up on the mesial surface and frequently trim band material from the distal marginal ridge. When this 5° bracket is placed parallel to the occlusal plane, it actually provides 10° of tip to the upper first and second molars which is excessive (Fig. 3B).

Alternatively, the authors prefer to use a 0° tip bracket with the band and bracket slot placed parallel to the occlusal plane. This introduces the correct 5° of tip in the upper first and second molars as measured from the buccal groove (Fig. 3C).

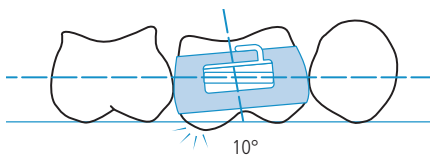
In summary, then, all of the upper posterior brackets are provided with 0° of crown tip for the reasons described above.

FIGURE 3 A



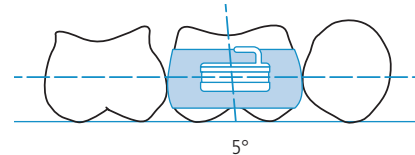
If a 5° bracket is used, the band must be seated more gingivally at the mesial.

FIGURE 3 B



If a 5° bracket is used, and the band is seated parallel to the buccal cusps, this will result in an effective 10° tip on the first molar.

FIGURE 3 C



The authors prefer a 0° tip bracket, with the band seated parallel to the buccal cusps.

| | Lower Bicuspid Tip | | Lower Molar Tip | |
|------------------------------|--------------------|--------------|-----------------|--------------|
| | Lower first | Lower second | Lower first | Lower second |
| Andrews' norms ³ | 1.3° | 1.54° | 2.0° | 2.9° |
| Sebata's data ⁴ | 2.5° | 6.70° | 5.7° | 7.3° |
| Watanabe's data ⁵ | 3.8° | 3.91° | 3.7° | 3.9° |
| Original SWA ³ | 2.0° | 2.0° | 2.0° | 2.0° |

Table 5. Measurements for the lower bicuspids and lower molars from the Andrews' non-orthodontic normal study³ two Japanese studies;^{4,5} and the original Straight-Wire[®] Appliance.³

| | Lower Bicuspid Tip | | Lower Molar Tip | |
|---------------------------|--------------------|--------------|-----------------|--------------|
| | Lower first | Lower second | Lower first | Lower second |
| MBT Versatile+ | 2.0° | 2.0° | 0° | 0° |
| Original SWA ³ | 2.0° | 2.0° | 2.0° | 2.0° |

Table 6. Lower posterior tip measurements in the MBT[™] Versatile+ Appliance and the original Straight-Wire[®] Appliance.

| | Incisor | | Torque | |
|------------------------------|---------------|---------------|---------------|---------------|
| | Upper Central | Upper Lateral | Lower Central | Lower Lateral |
| Andrews' norms ³ | 6.11° | 4.42° | -1.71° | -3.24° |
| Sebata's data ⁴ | 9.42° | 7.48° | 3.55° | 1.66° |
| Watanabe's data ⁵ | 12.8° | 10.4° | 0.71° | 0.53° |
| Original SWA ³ | 7.0° | 3.0° | -1.0° | -1.0° |

Table 7. Measurements for incisor torque from the Andrews' non-orthodontic normal study,³ two Japanese studies;^{4,5} and the original Straight-Wire[®] Appliance.³

Lower posterior crown tip

Table 5 shows tip measurements for the lower bicuspids and lower molars from the Andrews' non-orthodontic normal study,³ two Japanese studies,^{4,5} and the original Straight-Wire Appliance.³

The authors prefer to maintain 2° of mesial crown tip in the lower bicuspids. Angling these teeth slightly forward in this manner moves them more in a Class I direction. 2° of tip is also preferred in the lower first and second molars. This is accomplished in a manner similar to the tip placed in the upper molars. The lower buccal groove lies 2° off of a line drawn perpendicular to the occlusal plane. As with the upper molars, introducing this 2° of tip to the lower molars can be accomplished by placing a 0° tip bracket parallel to the occlusal plane. In summary then, the lower bicuspid brackets show 2° of mesial crown tip and the lower molar brackets show 0° of crown tip with the bands being placed parallel to the occlusal surface.

| | Incisor | | Torque | |
|---------------------------|---------------|---------------|---------------|---------------|
| | Upper Central | Upper Lateral | Lower Central | Lower Lateral |
| MBT Versatile+ | 17.0° | 10.0° | -6.0° | -6.0° |
| Original SWA ³ | 7.0° | 3.0° | -1.0° | -1.0° |

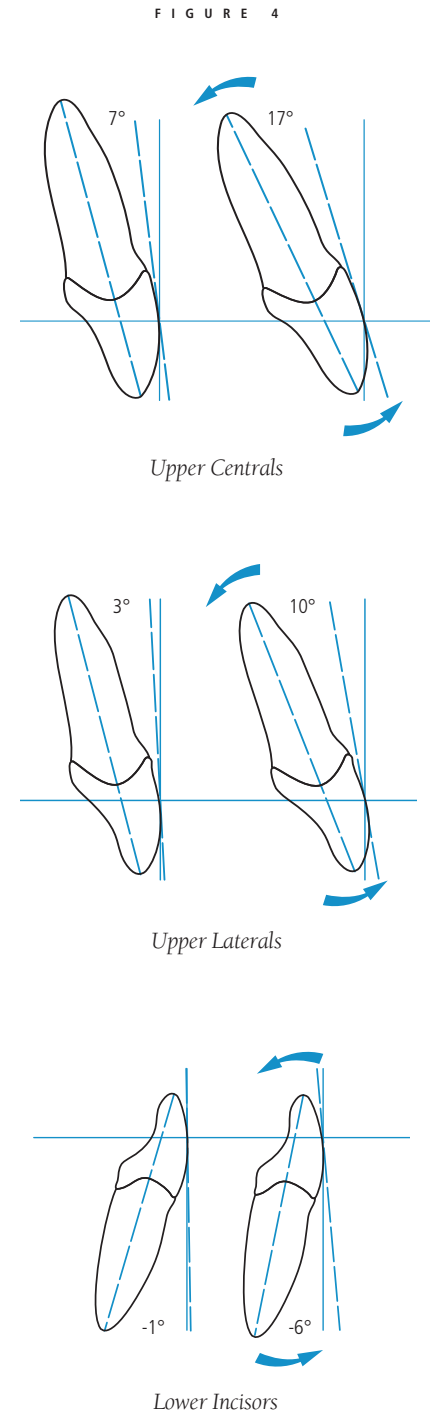
Table 8. Comparison between the incisor torque values of the original Straight-Wire® Appliance and the MBT™ Versatile+ Appliance.

Incisor torque

Table 7 shows torque values from the Andrews' non-orthodontic normal study,³ two Japanese studies,^{4,5} and the original Straight-Wire Appliance:³

The authors observed that torque is rather poorly controlled with the pre-adjusted appliance system. This is due to the fact that the torque movement is a difficult one and less than 1mm of contact between the arch wire and the bracket must bring about this movement. In general, here lies the greatest challenge to bracket design in the pre-adjusted appliance. In the majority of orthodontic cases, because of this lack of torque control, torque tends to be lost in the upper incisor region during overjet reduction and space closure.

The lower incisors frequently tend to procline forward during curve of Spee leveling and when eliminating lower incisor crowding. Because of these tendencies there is generally a need for greater palatal root torque of the upper incisors and for more uprighting with labial root torque of the lower incisors. For these reasons, the authors recommend +17° of torque for the upper central incisors, +10° of torque for the upper lateral incisors, and -6° of torque for the lower incisors. Table 8 shows a comparison between the torque values of the original Straight-Wire Appliance and the MBT Versatile+ Appliance.



The MBT™ Versatile+ Appliance provides increased palatal root torque for the upper incisors and increased labial root torque for the lower incisors, the most common requirement in orthodontic cases.

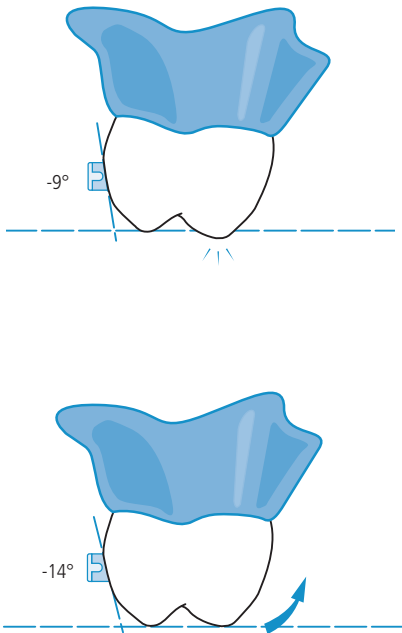
| | Upper Cuspid, Bicuspid and Molar Torque | | | | |
|------------------------------|---|--------------|--------------|-----------|-----------|
| | Cuspid | 1st Bicuspid | 2nd Bicuspid | 1st Molar | 2nd Molar |
| Andrews' norms ³ | -7.3° | -8.5° | -8.9° | -11.5° | -8.1° |
| Sebata's data ⁴ | 0.7° | -6.5° | -6.5° | -1.7° | -3.0° |
| Watanabe's data ⁵ | -5.3° | -6.0° | -7.2° | -9.8° | -9.5° |
| Original SWA ³ | -7.0° | -7.0° | -7.0° | -9.0° | -9.0° |

Table 9. Measurements for cuspid, bicuspid and molar torque from the Andrews' non-orthodontic normal study,³ two Japanese studies,^{4,5} and the original Straight-Wire[®] Appliance.³

| | Upper Cuspid, Bicuspid and Molar Torque | | | | |
|---------------------------|---|---------------------|---------------------|------------------|------------------|
| | Upper Cuspids | Upper 1st Bicuspids | Upper 2nd Bicuspids | Upper 1st Molars | Upper 2nd Molars |
| MBT Versatile+ | -7.0° | -7.0° | -7.0° | -14.0° | -14.0° |
| Original SWA ³ | -7.0° | -7.0° | -7.0° | -9.0° | -9.0° |

Table 10. Upper posterior torque measurements in the MBT[™] Versatile+ Appliance and the original Straight-Wire[®] Appliance.

FIGURE 5



Increasing the buccal root torque in the upper molars reduces the possibility of palatal cusp interferences in this area.

Upper cuspid, bicuspid and molar torque

Table 9 shows upper cuspid, bicuspid and molar torque values from the Andrews' non-orthodontic normal study,³ two Japanese studies,^{4,5} and the original Straight-Wire Appliance.³

The upper cuspid and bicuspid torque values of -7° have proven to be satisfactory in most cases and have been selected for the MBT Versatile+ Appliance. The upper molars, on the other hand, frequently show excessive buccal crown torque with palatal

cusps “hanging down” and creating centric, balancing side and working side interferences. For this reason the authors prefer -14° of buccal root torque in these teeth, as opposed to -9° of buccal root torque.

Lower cuspid, bicuspid and molar torque

Table 11 shows torque values for lower cuspids, bicuspids and molars from the Andrews' non-orthodontic normal study,³ two Japanese studies,^{4,5} and the original Straight-Wire Appliance.³

| | Lower Cuspid, Bicuspid and Molar Torque | | | | |
|------------------------------|---|--------------|--------------|-----------|-----------|
| | Cuspid | 1st Bicuspid | 2nd Bicuspid | 1st Molar | 2nd Molar |
| Andrews' norms ³ | -12.7° | -19.0° | -23.6° | -30.7° | -36.0° |
| Sebata's data ⁴ | -4.7° | -14.8° | -22.6° | -26.2° | -31.0° |
| Watanabe's data ⁵ | -11.1° | -18.4° | -21.8° | -31.2° | -32.9° |
| Original SWA ³ | -11.0° | -17.0° | -22.0° | -30.0° | -35.0° |

Table 11. Measurements for lower cuspid, bicuspid and molar torque from the Andrews' non-orthodontic normal study,³ two Japanese studies,^{4,5} and the original Straight-Wire® Appliance.³

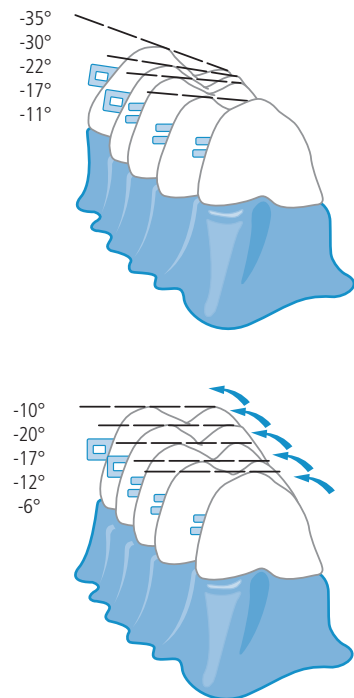
| | Lower Cuspid, Bicuspid and Molar Torque | | | | |
|---------------------------|---|---------------------|---------------------|------------------|------------------|
| | Lower Cuspids | Lower 1st Bicuspids | Lower 2nd Bicuspids | Lower 1st Molars | Lower 2nd Molars |
| MBT Versatile+ | -6.0° | -12.0° | -17.0° | -20.0° | -10.0° |
| Original SWA ³ | -11.0° | -17.0° | -22.0° | -30.0° | -35.0° |

Table 12. Comparison of torque values for the MBT™ Versatile+ Appliance and the original Straight-Wire® Appliance for the lower cuspids, bicuspids and molars.

There are three reasons for reducing the amount of lingual crown torque in the lower cuspid, bicuspid and molar areas: 1) Lower cuspids and sometimes bicuspids often show gingival recession and benefit from the roots being moved closer to the center of the alveolar process; 2) many orthodontic cases demonstrate narrowing in the maxillary arch with lower posterior segments that are compensated toward the lingual. These cases benefit from buccal uprighting of

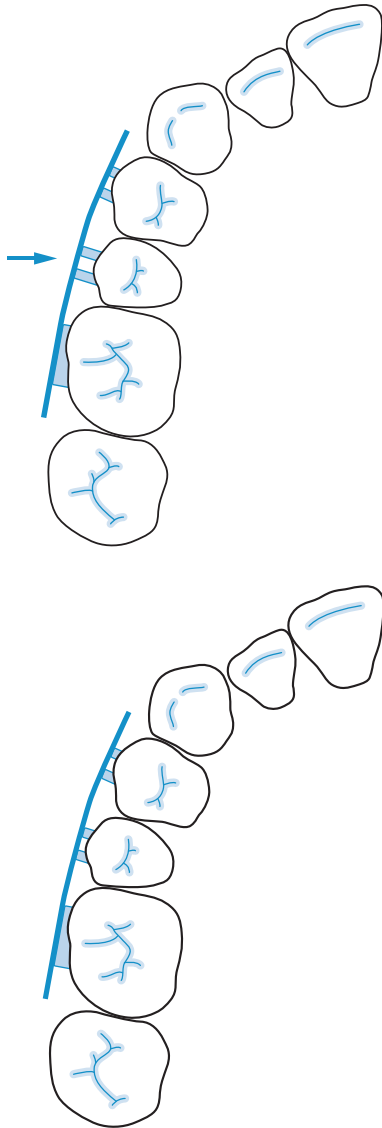
the lower posterior segment. 3) It has been consistently observed that lower second molars with -35° of torque consistently “roll in” lingually. Therefore, the authors have chosen to reduce the lingual crown torque in the lower cuspids and bicuspids by 5°, by 10° in the lower first molars, and by 25° in the lower second molars. The values for posterior torque in the lower cuspid, bicuspid and molar regions are shown in Table 12.

FIGURE 6



Progressive buccal crown torque in the lower posterior segments provides uprighting of these areas, which are frequently inclined lingually.

FIGURE 7



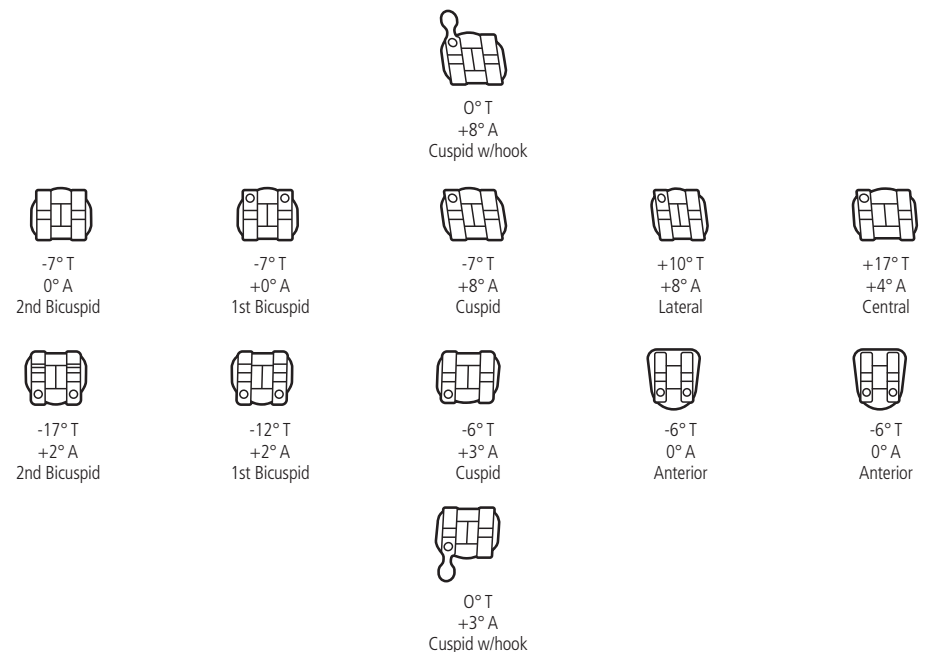
An upper second bicuspid bracket with an additional 0.5 mm of in-out compensation is provided for the common situation in which upper second bicuspids are smaller than upper first bicuspids.

IN-OUT MODIFICATIONS OF THE MBT™ VERSATILE+ APPLIANCE

It has been observed by the authors that the in-out measurements (including molar rotation) for the original Straight-Wire® Appliance have, for the most part, proven to be quite satisfactory. With the exception of severe rotations at the initiation of treatment (best handled by space opening in combination with facial and lingual rotation elastics) minimal modifications in archwires need to be made until the finishing stage of treatment. At that time some teeth may need to be over-rotated for stability (using rotation wedges) and first molars may need archwire offsets to complete their rotation. One important

in-out feature has been added to the MBT Versatile+ Appliance.

Upper second bicuspids are frequently smaller in size than upper first bicuspids. For this reason an upper second bicuspid bracket has been provided with an additional 0.5 mm of in-out compensation. This allows for better alignment of central fossae in the upper arch and will also provide for increased mesio-buccal rotation of the upper first molar (Fig. 3). When upper second bicuspids are similar in size to the upper first bicuspids, an upper first bicuspid bracket can be used on the upper second bicuspid.



THE MBT™ VERSATILE+ APPLIANCE SYSTEM

LIGATED APPLIANCES:

Victory Series™ Brackets – This mid-sized bracket is used by many orthodontists. It provides an excellent combination of comfort, control and aesthetics. It is most beneficial in cases with smaller teeth and minimal to moderate degrees of difficulty.

Victory Series™ Low Profile Brackets – The Victory Series Low Profile bracket has also become a popular treatment choice, featuring reduced bracket height for reduced occlusal interference. Features include torque-in-base and tie-wing undercut areas deep enough for double ligation.

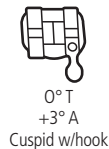
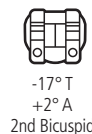
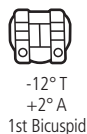
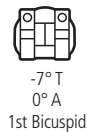
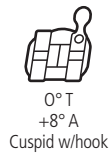
Unitek™ Full-Sized Twin Brackets – This bracket provides a great degree of control. It is beneficial in cases with larger teeth, patients with difficult malocclusions where control is essential, and with patients who are prone to breakage.

Clarity™ Metal-Reinforced Ceramic Brackets – The Clarity ceramic bracket blends nicely against the tooth surface and provides excellent aesthetics. It features a metal slot which greatly minimizes breakage and allows for better sliding mechanics. Most importantly the bracket has a stress concentrator in the base of the bracket for ease of removal.

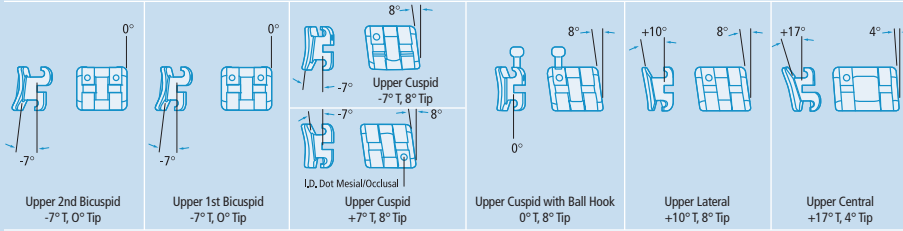
SELF-LIGATING APPLIANCES:

SmartClip™ Self-Ligating Brackets – For those preferring treatment in a self-ligating environment, SmartClip Brackets are a versatile choice. These brackets feature a true-twin design and their integration in the MBT System is extensively detailed in a text by Dr. Hugo Trevisi: “SmartClip™ Self-Ligating Appliance System – Concept and Biomechanics” (ref 014-508).

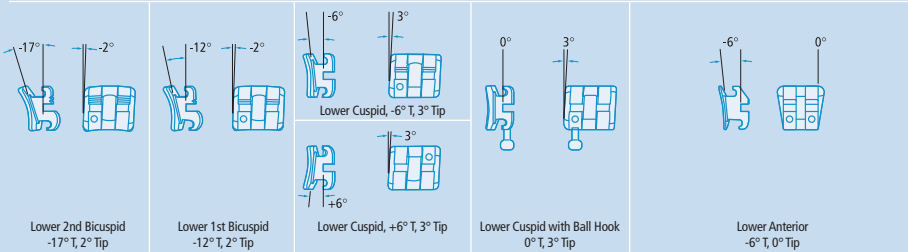
Clarity™ SL Self-Ligating Brackets – For aesthetic treatment and self-ligation, Clarity SL Self-Ligating Brackets combine the design and treatment features of the SmartClip bracket with the popular translucent appearance of the Clarity bracket, for an uncompromising treatment choice.



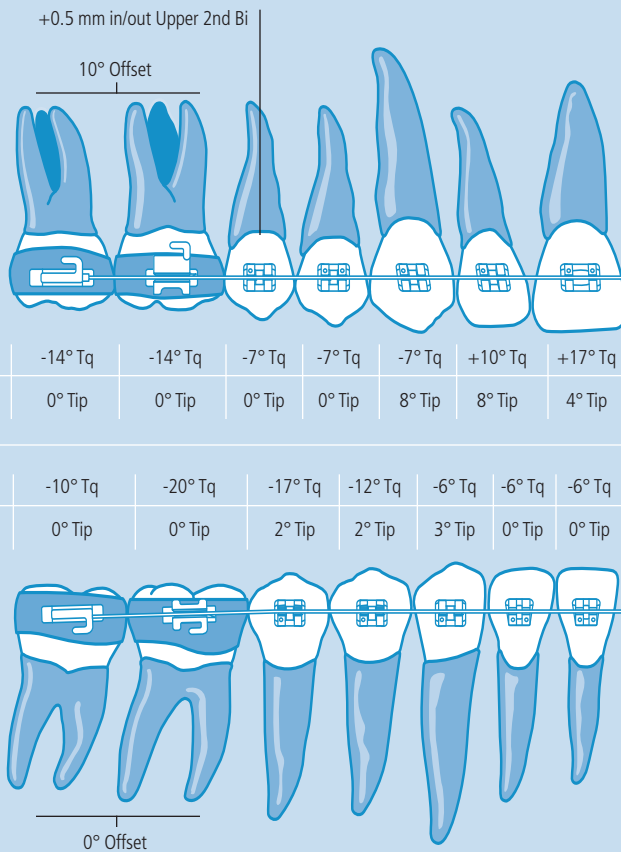
MAXILLARY



MANDIBULAR



MBT™ APPLIANCE SYSTEM



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There are a number of features and possible modifications of the MBT Versatile+ Appliance that allow for maximum versatility. These are as follows:

1. When upper lateral incisors are palatally displaced, the upper lateral bracket can be inverted 180° to provide -10° of torque. This “labial root torque” aids in bringing the root forward with the crown.
2. Lower incisor brackets show similar tip (0°) and torque (-6°) values. This provides for less confusion during placement and fewer appliance prescriptions in the system
3. The normal torque values for upper and lower cuspids are -7° and -6° respectively. This is appropriate for patients with adequate alveolar bone on the labial surface of the cuspids. However, when there is a narrowing of the alveolar processes, or when cuspid roots are prominent, possibly showing gingival recession, the cuspid brackets can be inverted 180°, providing +7° and +6° of torque respectively.
4. Upper and lower cuspid brackets with 0° of torque and a disto-gingival hook are also provided with the system. This is particularly useful for extraction cases, where it is beneficial to keep cuspid roots in the center of the alveolar process. Also, many clinicians prefer to have a hook on the cuspid bracket. Thus, there are three torque options for the upper and lower cuspids.
5. When upper bicuspid are the same size, a bracket with 0° of tip and -7° of torque can be used. This allows for less confusion during placement and fewer appliance prescriptions in the system.
6. When upper second bicuspid are smaller than upper first bicuspid, a bracket with an additional 0.5° of in-out compensation can be used on upper second bicuspid.
7. Upper second molar bands and brackets can be placed on upper first molars when a headgear tube is not needed.
8. When an occlusal interference occurs between an upper first molar and a lower first molar convertible twin bracket, a lower second molar band and buccal tube can be placed on the lower first molar, providing an additional millimeter of occlusal clearance.

MBT[™]
Versatile+ Appliance System

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