Having many cases with severe crowding in Japan, we tend to level the dental arches after premolar extraction. This often results in tipping of the adjacent teeth into the extraction site, slowing the leveling process and causing the anterior teeth to elongate due to the angulation built into the canine bracket in a preadjusted appliance system. In principle, .016 and .019 X .025 HANT wires with the anterior form of the arch wire matching the patient’s arch form should be sequentially used to level the buccal segments and canine bracket slots before proceeding to premolar extraction and bracketing of the anterior teeth.

In the MBT™ System, .019 X .025 stainless steel wires are used as final arch wires to correct the upper and lower dental midlines and close remaining spaces by sliding mechanics. This necessitates the analysis of the direction and amount of tooth movements in each quadrant to make an extraction/non-extraction decision and select appropriate anchorage.

The Dental VTO devised by McLaughlin, et al., is a useful diagnostic tool that enables clinicians to plan treatment and manage tooth movements during treatment. Two cases treated with the MBT system based on the Dental VTO will be presented.

### Charting of the Dental VTO

This analysis consists of three charts:

**Chart 1 (Initial Midline and Molar Position)** records initial midline and first molar positions. These must be recorded with the mandible in centric relation.

**Chart 2 (Lower Arch Discrepancy)** records the lower arch discrepancy. Six primary lower arch factors, ① through ⑥, are estimated and recorded separately from canine to midline and from second molar to midline on each side. These values are then added to obtain the initial discrepancies a1, a2, A1 and A2. Four secondary factors ⑦ through ⑩, which are sometimes used to gain additional space, are then recorded from canine to midline and from second molar to midline on each side and added up to derive the remaining discrepancies b1, b2, B1 and B2 for the respective segments.

**Chart 3 (Anticipated Treatment Change, VTO)** records anticipated direction and amount of movements relative to first molars, canines and midline correction.
**Initial crowding/spacing in the lower arch**
1. Crowding/spacing from canine to midline on each side
2. Crowding/spacing in the premolar area
3. Crowding/spacing in the molar area
4. Space required for Curve of Spee leveling
5. Space required for midline correction
6. Space required for desired correction of protrusion or retraction of the lower incisors

**Initial discrepancies**

a1: Crowding/spacing from right canine to midline  
a2: Crowding/spacing from left canine to midline  
A1: Crowding/spacing from right second molar to midline  
A2: Crowding/spacing from left second molar to midline

**Spaces expected to be gained with treatment**
7. Additional space from interproximal enamel stripping
8. Additional space from expansion
9. Additional space from uprighting or distal movement of lower first molars
10. Additional space from extraction

**Remaining discrepancies**

b1: Crowding/remaining space from right canine to midline  
b2: Crowding/remaining space from left canine to midline  
B1: Crowding/remaining space from right second molar to midline  
B2: Crowding/remaining space from left second molar to midline

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**Case 1: A crowding case with mesial displacement of the upper left first molar**

Hideyuki Iyano, Department of Orthodontics, Ohu University School of Dentistry

**Diagnosis and treatment plan**
An 11 year 6 month old male presented with crooked anterior teeth (Fig. 1). The upper left lateral incisor was palatally displaced. His molar relationship was Angle Class II on the left side. There was 1.0mm of crowding in the lower left anterior area. The lateral cephalogram showed ANB of $2^\circ$, Wits of $-4.0$mm and no abnormality of A-P jaw relationship (Fig. 2). The inclination of the upper incisor was within a normal range, while the lower incisor was inclined labially. The upper left first molar was displaced 3mm mesially (Fig. 3). The upper midline was deviated 2mm to the left.

The above lower arch information was recorded on chart 2 (Fig. 4). From the primary factors for the lower anterior segment such as crowding, Curve of Spee and midline deviation, the initial discrepancy from canine to midline was calculated to be $-2.0$mm on the right side and $-1.0$mm on the left side. The initial discrepancy for the entire lower arch thus totaled $-2.0$mm on the right side and $-1.0$mm on the left side.

**Diagnosis:** Crowding with mesial displacement of the upper left first molar.

**Dental VTO:** Additional space from expansion of the lower arch with a full appliance was estimated to be $2.0$mm for the right anterior area, $1.0$mm for the left anterior area, $2.0$mm for the right side of the whole arch, and $1.0$mm for the left side of the whole arch.

A decision was made to distalize the upper left first molar 3.0mm and move the upper dental midline 2mm to the right in order to create space for the palatally displaced upper left lateral incisor (Fig. 5).
Course of treatment and results

A unilateral headgear was used for 4 months, resulting in 4mm distal movement of the upper left first molar. As Class I molar relationship was established on the left side, full appliance treatment was initiated. Three types of arch wires were used during treatment: .016 HANT wires, .019 X .025 HANT wires and .019 X .025 SS wires, all in OrthoForm™ III (ovoid type).

Upper and lower .016 HANT wires were placed to level the lower canines with lacebacks (Fig. 6). With the placement of upper and lower .019 X .025 HANT wires, the buccal segments were leveled and the overbite was closed (Fig. 7, 1 mo.). The upper and lower anterior teeth except the upper left lateral incisor were bracketed (Fig. 8, 2 mo.). Upper and lower .019 X .025 SS wires were inserted, and an open coil spring was used to gain space for the upper left lateral incisor (Fig. 9, 4 mo.). The upper left lateral incisor bracket was placed upside down (Fig. 10, 5 mo.). The palatally displaced upper lateral incisor was moved labially into the arch by under-laying the .016 HANT wire. In the upper arch, a .019 X .025 HANT wire was placed (Fig. 11, 6 mo.), followed by a .019 X .025 SS wire (Fig. 12, 12 mo.). After the upper lateral incisor was torqued adequately, the settling process was initiated (Fig. 13, 13 mo.). Active treatment time was 14 months (Fig. 14, 15, 16). The post-treatment panoramic X-ray shows that root paralleling has been accomplished.

The torque of the palatally displaced upper left lateral incisor was effectively controlled with the inverted bracket.
Case 2: A functional anterior crossbite case
Hideyuki Iyano, Hideki Ogawa, Department of Orthodontics, Chu University School of Dentistry

Diagnosis and treatment plan
A 13 year 3 month old female presented with a crossbite. The anterior teeth were in crossbite (Fig. 17). Her molar relationship was Angle Class I. The lateral cephalogram showed that the mandible was in front of the maxilla with ANB of –2.0° and Wits of –8.0mm (Fig. 18). The inclinations of the upper and lower incisors were 124.0° and 94.0°, respectively, both being labially inclined. The upper dental midline was deviated 2.0mm to the left (Fig. 19). The Curve of Spee was 2.0mm. Her arch showed 1.0mm of crowding in the lower premolar area on each side.

These numbers were entered into chart 2 (Fig. 20). The initial discrepancy for the lower anterior segment consisting of incisor position, crowding, Curve of Spee and midline deviation amounted to –3.0mm on the right side and –3.0mm on the left side. The initial discrepancy for the entire lower arch totaled –4.0mm on the right side and –4.0mm on the left side.

Diagnosis: Functional anterior crossbite

Dental VTO: Extraction of four first premolars was required due to the amount of discrepancy. The lower central incisors needed to be retracted 3.0mm. The analysis also called for 3.0mm of lower canine retraction on each side and 3.3mm of mesial movement of the lower first molar on each side. The upper first molars needed to be moved forward 3.3mm per side in order to maintain Angle Class I molar relationship.

It was decided to shift the upper midline 2mm to the right (Fig. 21).
Course of treatment and results

Three types of arch wires were used during treatment: .016 HANT wires, .019 X .025 HANT wires and .019 X .025 SS wires, all in OrthoForm™ III (ovoid type). A Nance holding arch was placed in the upper, while the lower arch was started with a .016 HANT wire (Fig. 22). Considering the need to intrude the lower incisors, the lower buccal segments were leveled first, followed by leveling of the lower canines with lacebacks. An upper .016 HANT wire and a lower 019 X .025 HANT wire were then placed (Fig. 23, 2 mo.). These wires were replaced with an upper 019 X .025 HANT wire and a lower 019 X .025 SS wire (Fig. 24, 8 mo.). Following the intrusion of the lower incisors, which was accomplished in 2 months, the upper incisors were bracketed (Fig. 25). Midline correction was initiated after overbite improvement (Fig. 26, 16 mo.). After one month of settling, active treatment was completed in 23 months (Fig. 28, 29, 30). The post-treatment panoramic X-ray shows that root paralleling has been achieved. The use of lacebacks for lower canine retraction minimized anchorage loss of the molars.

Summary

The Dental VTO was found to be a useful aid in diagnosis, treatment planning and management of three-dimensional tooth movements at chairside.