New JVBarre maxillary segmental distaliser and BiTurbo2 system for greater aesthetics, effective and efficient skeletal Class II treatment: Control of canine over-extrusion and bodily maxillary molar distalisation

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Introduction to Class II skeletal mandibular retrognathism

Epidemiological studies have shown that over 30% of malocclusions are skeletal Class II, one of the most challenging dentofacial orthodontic conditions to treat. A skeletal Class II division I malocclusion (Fig. 1) is often associated with moderate or severe overbite, and overjet with several aetiologies.

Prior Class II fixed functional appliances

Several removable and functional appliances, such as twin block, Forsus (3M) and pendulum, have been employed for skeletal Class II treatment. These functional appliances are generally bulky and time-consuming to apply and often need to connect to the mandibular arch with thick maxillomandibular metal springs, rods or tubes that are susceptible to fracture or dislocation, resulting in molar tipping. In addition, several fixed functional appliances require banding.

Why the JVBarre maxillary segmental distaliser? Solving canine over-extrusion and molar tipping

Since ready-made maxillary segmental distalisers (MSDs) are placed only in the maxillary arch (segmental), this makes them small and simple to bond. MSDs use thin Class II elastics and are less bulky than fixed functional appliances, making MSDs easier to use clinically. However, complications observed clinically with past MSDs are moderate to severe canine over-extrusion and distal molar tipping. Canine over-extrusion can be significant owing to ensuing periodontal complications and for aesthetic reasons (Figs. 1a–f). These problems are clearly associated with the long distance from the maxillary molar to the anterior end position of the hook located on the canine bonding pad (red arrows, Fig. 1f). The pre-instructed heavy Class II elastic forces of 8 oz exacerbate these issues. Compliance with the removable mandibular liner is critical to prevent mandibular incisor crowding and proclination.

Figure 1f shows pre-treatment and post-treatment positions of maxillary canines in two adult patients (top and bottom). The photographs demonstrate the complication of severe canine over-extrusion with prior MSDs with a straight bar and hook located at the anterior end canine (metal Carriere Motion 3D Class II appliance in top case and Carriere Motion Clear appliance in bottom case). A change in the barre geometry and hook position from the anterior end location on the canine pad (shown here) is indicated. This is to control and reduce the long lever arm effect shown (red arrows, bottom image). Note, from the frontal view, the unesthetic “dracula-like” canine positions, and the periodontal
changes. The top image also suggests molar tipping. This is the impetus to correct the problems (biomechanically long lever arm effect; red arrow, Fig. 4).

The purpose of this clinical study was to develop and test a new bonded MSD to be effective and efficient in skeletal Class II treatment. The second objective was to develop a protocol using a system of auxiliary components, such as a BiTurbo2 (BT2), at the palatal surfaces of the maxillary incisors to uncouple the molars vertically. The BT2 would facilitate the correction of the skeletal Class II molar relationship using the bondable JVBarre appliance.

What is the JVBarre appliance?

New and premade MSDs have two main advancements, an arched barre and mid-hook on this barre (as an alternative to a prior canine pad). This produces bodily molar distalisation and direct force to the molar (rather than indirect) for highly efficient Class II treatment and retention long term (Fig. 2). The JVBarre MSD locates the arched barre closer to the centre of resistance of the molar and maxilla with a mid-hook on the bar (Fig. 4) used with a lower aligner and bondable button on the lower first molar. In Figure 2, note the other good option of lower, fixed self-ligating mini-brackets that will receive large-dimension rectangular archwire tied back for maximum anchorage and that do not require compliance.

The JVBarre consists of a molar component and canine barre as a ready made unit with seven main characteristic features (Fig. 3). A barre is defined in French as a resting place, for instance that which ballet dancers rest upon. An arched barre (which replaces the original stepped-up barre in a pilot clinical study of the first-generation design, Figs. 4 & 7, and bypasses the premolars) permits positioning of the mid-hook more gingivally (and distally) to be closer to the centres of resistance of the maxillary molar and of the maxilla (red square, Fig. 4). The canine attachment includes clinically a completely optional canine tube (Figs. 7a–l), and the molar tube has a buccal groove to align with the molar central groove.

The JVBarre includes:
1. A smooth canine pad (with optional smooth canine tube with zero torque, Figs. 7f);
2. A smooth arched-up barre between the canine and molar;
3. A hook positioned gingivally and distally on the arched-up bar to be closer to the three centres of resistance of the maxillary molar, maxilla and maxillary dentition (small red dot, Fig. 4);
4. A molar tube positioned mesially, and posterior wall accepts contact with the distal end of the arched-up barre and that has a marker for the central groove of the maxillary molar.

How does a JVBarre appliance work?

The new JVBarre uses the mid-hook on the barre to significantly reduce the long lever arm effect of prior MSDs and control canine over-extrusion. The vertically arched barre brings the elastic forces closer to the centres of re-
sistance of the maxillary molar for more bodily molar movement and of the maxilla (Fig. 4). In addition, since the mid-hook is on the barre, the Class II elastic forces are closer and more direct to the molar, compared with prior hooks at the canine that produce indirect force to the maxillary molar. There are six sizes available, three long for maxillary canine to first molar and three short for maxillary first premolar to first molar. The long sizes for the JVBarre are 26 mm, 24 mm and 22 mm and the short sizes are 19 mm, 17 mm and 15 mm.

The first-generation JVBarre (Fig. 4) had a stepped-up barre that has now been curved (Figs. 2 & 3) for improved aesthetics. Biomechanically, the moment of tipping from the JVBarre’s shorter lever arm (orange arrow, Fig. 4) is lower, owing to the more gingival and more distally located mid-hook to the centres of resistance of the molar, \( M = F \times D \), and of the maxilla (red square) compared with the long lever arm (red arrow) arising from prior MSDs. The reason is that prior devices had an anterior end hook to the centre of resistance of the molar, \( M = f \times d \). The JVBarre barre-hook reduces over-extrusion and is shown to produce more direct force. Note also that this original stepped-barre has been replaced by a smoother, curved barre that provides additional comfort to the aesthetics (Fig. 3). The use of premolar brackets, shown, for ideal anchorage is optional clinically.

The clinical views in Figures 5a and b are that of a patient aged 11 pretreatment and after molar distalisation, in which the palatal cusps of the maxillary molars were moved parallel to the mid-palatal suture, gaining space of approximately 6 mm per side. Figure 5c shows diagrammatically the occlusal view of the maxillary left molar pretreatment rotated clockwise (in a Class II position) and after distalisation with de-rotation (below) with the buccal cusps parallel to the mid-palatal suture. The molar in a Class II relationship takes up more space than when it is de-rotated, saving an average of 2.6 mm per side at the molar (totalling 5.2 mm). In Figure 5d, the occlusal views of the JVBarre show the Class II mesial molar rotation before treatment on the left and the entire JVBarre displaced distally (top blue arrow) on the right, with derotation shown by the red curved arrow (on the left). Distalisation is assisted by transseptal fibre pull between the buccal dentition for “Flow-back” mechanics.

The JVBarre is required commonly in Class II malocclusion treatment that is associated with more rapid growth of the maxilla compared with the mandible. The use of intermaxillary elastic forces on the arched barre-hook are closer to the centre of resistance of the maxilla and may have the potential to restrict maxillary growth (Fig. 4).

In the vertical dimension, where the overbite is commonly associated with neuromuscular hyperactivity, the JVBarre is combined with BT2s,\(^5\) which reduce muscle activity.\(^5\) The BT2s are bonded to the palatal surfaces of the two maxillary central incisors to disarticulate the molars for unrestricted movement and can contribute to direct maxillary incisor intrusion (Figs. 6a, 6b & 7a–l). In severe overjet, greater than 8 mm, BT2s may be placed at the maxillary canines (Figs. 6a & b). BT2s are also split in the middle to permit easier placement and removal post-treatment. Metal BT2s are indicated for buccal segment eruption, rather than then resin bonding on the occlusal surfaces of the first or second molars. In fact, bonding resins at the molars is contra-indicated, since they intrude the palatal cusps of the maxillary molars, which deepens the overbite, and are easily worn down, with bis-6mA bisphenols swallowed particularly with neuromuscular hyperactivity. Applications of anteriorly positioned resin bite pads have also been found to be time-consuming, and these bite pads have been found to wear down easily and be less stable than ready-made metal BT2s.

The JVBarre is combined with BT2s in deep overbites that are frequently associated with severe Class II malocclusion. The BT2s are generally positioned on the palatal surfaces of the maxillary canines (Fig. 6a) and in severe overjets, where there is little contact with the maxillary incisors. BT2s are positioned on the maxillary canines (shown in Fig. 6b), which are more proximal to the mandibular incisors. BT2s allow bite opening to remove occlusal interferences for the maxillary molars for optimum molar rotation and distalisation (Figs. 6a & b).

Figures 7a–e show a pretreatment end-to-end skeletal Class II malocclusion with 100% overbite complicated by severe neuromuscular hyperactivity, including parafunction. There was mandibular retrognathia with Class II canine positions. The initial progress views in Figure 7f show placement of the JVBarre, combined with BT2s, at the palatal surfaces of the maxillary incisors and demonstrate the severity of the overjet of 7.5 mm. Note the first-generation JVBarre with the stepped-up barre (for the application of the mid-hook to reduce canine over-extrusion) and the mandibular self-ligating brackets for maximum anchorage, where a mandibular aligner can be applied as an alternative.
After approximately four months of the patient wearing the JVBarre appliance, using Class II elastics (3/16 in., 6 oz), there was rapid correction of the severe overjet, forming a Class I molar occlusion and canine relationship (maxillary brackets shown are recommended immediately after the JVBarre; Figs. 7g–l). In the vertical dimension, the BT2s permitted passive buccal segment eruption, leaving the buccal dentition in a stable Class I occlusion and the overbite significantly improved, from 100% to 50%. This is because the elastics also positively erupt the buccal segment. The mandibular arch also shows a full self-ligating mini-bracket system with a large-dimension rectangular archwire (up to 0.019” x 0.025” stainless steel with a reverse curve of Spee) tied back for maximum anchorage. This mandibular anchorage with self-ligating brackets does not require wear compliance for reliability. Compliance is mandatory with a mandibular aligner as an alternative (Figs. 10g & h).

Where to place the JVBarre appliance

The most common placement of the JVBarre is from the maxillary canine to the maxillary first molar. These lengths are measured from the centre of the maxillary canine to the buccal groove of the maxillary first molar. For additional adult aesthetics, the JVBarre may be placed further posteriorly, from the maxillary first premolar to the maxillary first molar (Figs. 8a & b). The third placement position available for the JVBarre is from the first premolar to second molar (using the longer sizes). It is important to evaluate the position of the third molars for early removal or enucleation, for any of the three placement positions of the JVBarre. This is in order to prevent root impingement against more fully developed third molar crowns during distalisation.

In addition to the standard canine to first molar placement position, a shorter JVBarre is placed from the first premolar to the first molar in adult treatment as a second option. More than 3 mm of space was produced by the MSD within 3.5 months of full-time elastic wear (3/16 in., 6 oz). In addition, note the natural distal drift of the maxillary canines and lateral incisors with transseptal fibre pull and opening of the bite as the molar moved posteriorly (Fig. 8b).

Figure 9a shows the third optional position for the JVBarre, from first premolar to second molar, that was to be applied for a patient of 24 years of age with an obtuse nasolabial angle, as a candidate for non-extraction treatment. An initial Class II division II malocclusion is shown, characterised by a right full step, Class II molar relationship and the canines in a severe Class II relationship (Figs. 9b–g). The initial occlusal view also shows first and second molar rotation mesially taking up more space in the maxillary arch immediately after insertion of the JVBarre from the first premolar to second molar (yellow stars) for aesthetics (Fig. 9h). Ceramic self-ligating brackets and coated wire were used for differential friction in the mandibular arch (Fig. 9i). The sectional maxillary brackets with archwire may have a ligature tied around the JVBarre canine pad for additional anchorage.

After four months of the patient wearing the JVBarre and BT2s with Class II elastics (3/16 in., 6 oz) and prior to the removal of the JVBarre appliance, the premolars had been corrected into a Class I relationship, with control of premolar over-extrusion (Figs. 9j & k). Note the additional, significant distal drift of the maxillary canines from a Class II to Class I relationship owing to transseptal fibre pull with the JVBarre.

When to apply the JVBarre appliance

The JVBarre appliance is recommended at all ages, including for early interceptive treatment in children (Figs. 10a–j) and in adults. Growing patients can be selected on the basis of at least four combined criteria—skeletal age...
of 12 years, start of accelerated growth in stature using height chart, carpal radiograph and CoGnMe angle of < 126°—in a systemised effort to assure good skeletal responses (cervical vertebral maturation at 3 may be used as a rough guide). 7

Figures 10a–d show the initial Class II subdivision left asymmetry and Figure 10f the situation immediately after JVBarre treatment, showing the overcorrected super Class I molar occlusion. The maxillary miniaturised self-ligating brackets shown were placed immediately after the JVBarre treatment. The mandibular brackets were placed for compliance, since they were fixed with Class II elastics. Maximum anchorage was the goal to prevent mandibular incisor proclination and crowding (Fig. 10b).

Figure 10g (pretreatment) and Figure 10h (post-treatment, liner non-compliance) demonstrate a third complication with prior MSDs and the recommendation of removable mandibular liners without full compliance in relation to the patient in Figures 10a–f. Note the severe crowding and rotation of the mandibular right first molar (back green arrow). In addition, the maxillary views of an adult patient in Figures 8a and b show similar progressive incisor crowding from not wearing the mandibular liner with Class II elastics because the patient was not wearing the mandibular liner full time with the MSD. This leads to the recommended protocol of a mandibular multi-bracketed self-ligating bracket system with a rectangular archwire tied back for maximum anchorage and compliance, as the recommendation. In addition, Figures 10i and k show a robust permanent spring with two eyelets, which can be crimped on to the malleable barre-hook (bilaterally), using Adam’s pliers to prevent removal in a non-compliant patient (Fig. 10j & k). A TAD in the area below the zygoma may also be applied with a 150-200 gm Niti coil spring to the barre-hook (Fig. 10l).

Conclusion

In an effort to reduce the complication of canine over-extrusion and molar tipping, the new JVBarre MSD with an arched-up barre and distally positioned mid-hook on the barre was developed. It has been found to be effective for direct and efficient maxillary molar distalisation in skeletal Class II malocclusions. The positioning of the Class II elastics (1/2 in., 6 oz) on the mid-hook and indirect force on the canines additionally reduce canine over-extrusions. The higher mid-hook position on the barre places the forces closer to the centre of resistance of the maxillary molar for more bodily movement.
Three-component system: JVBarre, BT2 and mandibular aligner or self-ligation anchorage

The JVBarre is recommended in combination with miniaturised fixed anterior bite planes BT2s to disarticulate the maxillary first molars and remove occlusal interferences, which in turn reduces neuromuscular hyperactivity to facilitate molar distalisation. The protocol includes a newly recommended third reliable component for an MSD system, the application of a lower aligner or mandibular self-ligating brackets with large rectangular stainless-steel archwire, tied back as an alternative to non-compliance with invisible mandibular liners. Removable mandibular liners are recommended with the JVBarre and BT2s, but the mandibular liner must be worn full time with Class II elastics. Two non-compliance protocols were presented as alternatives.

References:


Dr John C. Voudouris has been an instructor at the University of Toronto in Canada, teaching Class II maxillary segmental distalisers (MSDs) and dentofacial orthopaedic appliance treatments, since 1988 and has been practising clinical orthodontics for 31 years. He is the recipient of the Milo Hellman Research Award from the American Association of Orthodontists and the Aaron L. Posen Award for clinical excellence from the University of Toronto. Dr Voudouris is a member of the Edward H. Angle Society, and a researcher and innovator of the JVBarre.

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