BiTurbos 2 (BT2) system for rapid deep overbite correction

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Abstract

The aim is to introduce a new, miniaturised BiTurbo 2 device (BT2) as part of an overall, four-component system to treat severe, skeletal deep overbite malocclusion. Methods: Clinical applications of the first generation of BiTurbo (BT1) devices initially manufactured as one-piece were evaluated over a 2-year period in the private orthodontic clinic of Dr J. Voudouris. Improvements were implemented to develop a second generation BT2. The BT2 was manufactured by SIA Orthodontic Manufacturer, in Italy as a four-piece unit including a body brazed to the bonding pad for greater flexibility, braze, for the separate curved bonding pad, and 80-gauge mesh for higher bond strength against lingual shearing forces. Two BT2s were positioned and bonded on the palatal aspects of the upper central incisors located at the incisal-third of the crowns. BT2s were the central device of a 4-component system to treat severe skeletal mandibular overclosure with deep overbite. The second component of the system included BT2s bonded simultaneously with a full Siamese twin, active self-ligating brackets to use the lower resistance in the appliance, shown in systematic review in vitro. The third component included new initial i-Arch wires with light forces that had a higher vertical dimension than horizontal dimension (for example .018 X .014"). This was used to improve moments of torque closer to the centre of resistance at the upper and lower incisors with compensating curve in the upper archwires, while the lower arches incorporated reverse curve of Spee and where both facilitated mild incisor intrusion. The fourth component of the system included 2 vertical elastics at the buccal segments, in rhomboid-patterns from the upper canines and first molars to the lower first premolars and lower second molars. These were medium 1/4", 4.5 oz elastics for moderate buccal segment extrusion in conjunction with the BT2s. Clinical Results: The ready-made metal BT2s were found to be highly efficient chairside and effective for Rapid Bite Correction (RBC). No clinically significant root resorption was not found that was possibly associated with the biocompatible forces applied. Conclusion: BiTurbos are recommended for rapid opening of overbites for a minimum of 6 months since they raise the vertical dimension automatically and reduce muscle hyperactivity to permit extrusion of the buccal segments into the excessive freeway space.

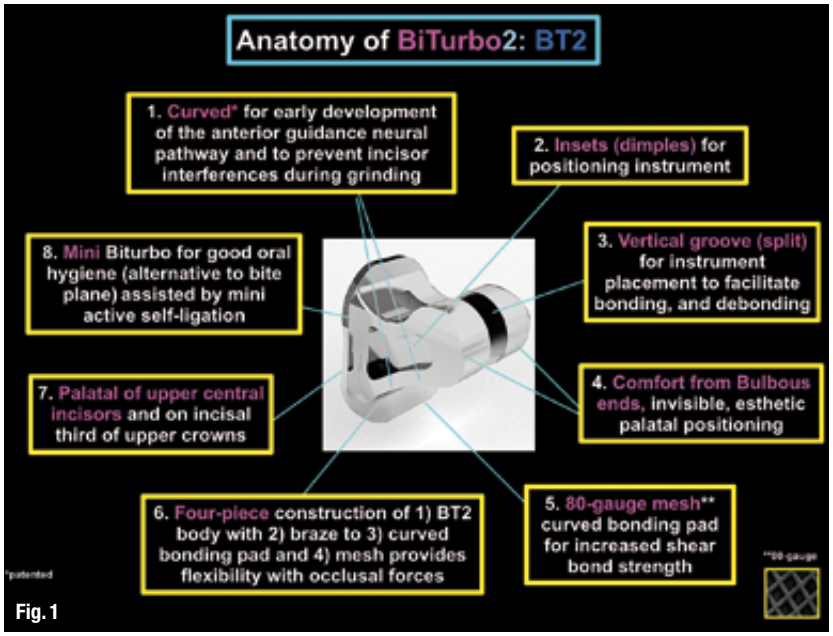

Fig. 1: Anatomy of BiTurbo2: The eight main characteristic features of the second generation BT2 are shown.

Introduction

Experienced orthodontic clinicians often report that severe, deep overbites ranging from 75–120% are one of the most challenging orthodontic treat-

Figs. 2a & b: Severe overbite of 120 % associated with CNS-Muscle hyperactivity and skeletal vertical mandibular overclosure (VMO). Freeway space at rest was excessive of 10 mm at the molars (Figs. 4a & b) where the norm is 3 mm.


Fig. 2a


Fig. 2b

ments. New tools to address deep overbite are desirable (Fig. 1). Research has verified deep overbites are also highly susceptible to one of the highest levels of relapse.[1-6] One of the main reasons appears to be centred around increased muscle hyperactivity that has long been associated with the cause of deep overbite. However, this muscle hyperactivity is secondary to our current clinical perception. The central nervous systems (CNS) plays a higher role through CNS hyperactivity, tension, or stress that is a precursor to producing muscle hyperactivity (in conjunction with other implicating factors such as dental interferences, crossbites and TMD). Due to the primary nature of the CNS ethology, today the differentiating term CNS-Muscle hyperactivity is preferred to the blended and often lost term of neuromuscular activity used in the past. The genetic CNS disposition and personality of the patient is a primary factor compared to simply muscle hyperactivity in severe overbite. A good medical and social history is vital in the diagnosis of patient disposition such as a Type A (e. g. proactive, ambitious, overachiever) for instance, prior to treatment planning and prior to retaining deep overbite long-term.

Figs. 3a–d: The first generation BT1 was a rigid one-piece (a). The BT1 prototypes are shown in test-polycarbonate with a positioning instrument used in the vertical groove (b). Anterior guidance is produced by the curved design of the BiTurbo2 (c). The vertical groove permits easier debonding when needed, than past solid form bite supports (d).

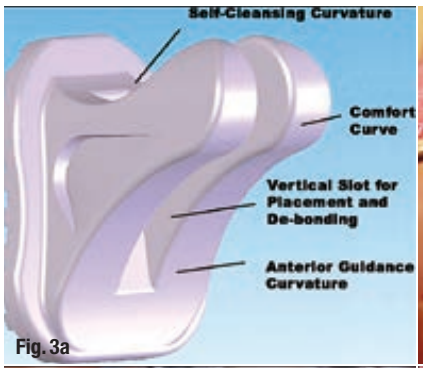

Fig. 3a

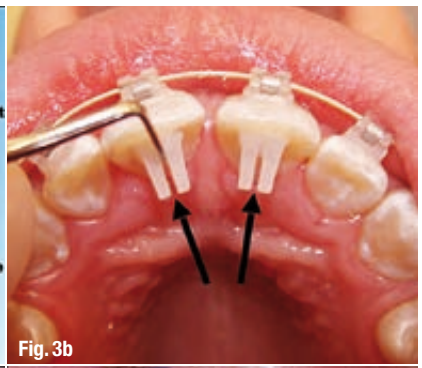
Fig. 3b

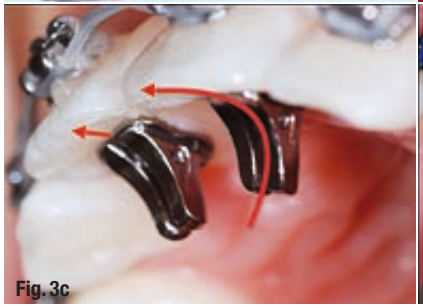
Fig. 3c

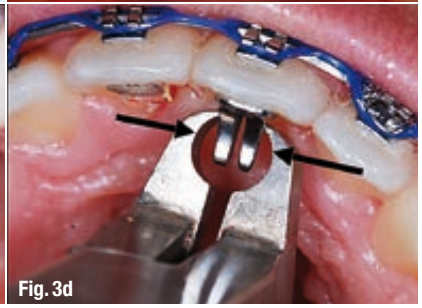
Fig. 3d

CNS-Muscle hyperactivity may additionally influence the malalignment of the dentition. In vertical mandibular overclosure into the maxilla, termed VMO, found in Class II division 1 malocclusion with severe overjet, the lower incisal edge can be crowded by the cingulum of the upper incisor. In fact, lower incisal edges have been found to impinge the palatal gingiva in severe overbite (Figs. 2a & b). Secondly, VMO also provides less space for the dentition vertically where tongue space is also restricted, which can result in proclination of the lower incisors into the strong perioral musculature. Thirdly, it is clinically significant that muscle hyperactivity be viewed from the labial and lingual since it includes the masseter-medial pterygoid sling and temporalis, but also tongue hyperactivity associated with buccal segment intrusion. In the transverse dimension, it is not unusual to find the lateral borders of the confined tongue to be scalloped with dental impressions as it attempts to find space by spreading out and pressing onto the occlusal surfaces of the lingual cusps during swallowing and at rest, associated with further buccal segment intrusion.

Aetiology of deep overbite includes:

1. CNS hyperactivity, tension or stress
2. Masticatory muscle hyperactivity, particularly the elevators masseter and temporalis muscles
3. Facial muscle hyperactivity such as the orbicularis oris in Class II division 2 patients affecting upper central incisors
4. Skeletal restriction of the dentoalveolar growth of the buccal segments
5. Skeletal upward and forward or counter clockwise growth of the mandible at the chin (brachycephalics)
6. Dental interferences, crossbites, missing buccal dental units, TMD and severe posterior enamel wear reducing the posterior vertical support of the dentition related to CNS-Muscle hyperactivity.

Several appliances have been developed to control the CNS-muscle hyperactivity including traditional removable or cemented anterior bite planes soldered to molar bands, and bondable resin or brackets on the palatal of the upper incisors or molars. The resin bite ramps were easily worn and swallowed by the patient, often requiring resin additions, and when placed at


Fig. 4a


Fig. 4b


Fig. 4c

Figs. 4a–c: Severity of the restriction of buccal segment eruption with the first CNS-Muscle de-programmer (a & b). BiTurbos and active self-ligating brackets with rhomboid 1/4", 4.5 oz., combine with compensating curve in the upper arch and reverse curve of Spee in the lower arch for rapid bite correction from 120 % (Figs. a & b) to 50 % in 3.5 months (c).

the molars produced molar intrusion that was contraindicated. Bondable metal bracket type bite planes were more effective and efficient to apply chairside, however, they were often difficult to remove because of their solid form and design that made them rigid and uncomfortable during the debonding phase, particularly at the sensitive upper central incisors. The purpose of this clinical study was to develop and test a small bondable and curved bite plane device with a groove in the middle and whether it was more efficient and effective in application by being easier to place, had good gnathogical function and was easier to debond. The second objective was to develop a system whereby the bondable BT2 device could produce Rapid Bite Correction (RBC).

What is a BiTurbo 2?

The first BiTurbo was developed in 2014 with a groove in the long-axis of the bondable bite opening device that was also curved to establish anterior guidance early in treatment. It was manufactured as a one-piece bracket and tested clinically for 2 years by one of the authors in his private orthodontic clinic in Toronto, Canada. This first generation BiTurbo was found to be effective in controlling the vertical dimension by rapid deep bite correction. As a result, new modifications were implemented by Dr Voudouris to improve the first generation BiTurbo (BT1).

The second generation BT2 was made by SIA Orthodontic Manufacturer, in Italy as a four-piece unit and included:

1. Bracket body with vertical groove (split), with incisal surface curvature
2. Braze (for flexibility)
3. Curved bonding pads to complement and adapt to the curved palatal anatomy of the upper central incisor for improved bond strength
4. Separate 80-guage mesh for greater bond strength.

The vertical groove along the long axis of the BT2 permits the use of a periodontal probe or other instrument to position and press-bond the BT2 to the enamel more efficiently and accurately. The separate application of 80-gauge bonding mesh is used to improve bond strength against palatal shearing forces. BT2s are miniaturised in size similar to bondable buttons but with a curved, shield shape bonding pad to be comfortable for patients and to facilitate oral hygiene. In addition, side dimples were developed to permit purchase points for tweezers during positioning on the palatal of the upper incisors. BT2s are required commonly in deep overbite treatment that is associated with severe CNS-Muscle hyperactivity (Figs. 2a & b).

Methods: Where to place BiTurbo 2?

Clinically, BT2s are bonded on the incisal-third region of the upper central incisors in Class II malocclusions. This provides a total of 2 BT2s on the day of first bonding of a full Siamese twin, active self-ligating (SL) appliance. In addition, for each deep overbite treatment BT2s are applied in conjunction with 2 buccal box elastics (1/4", 4.5 oz, see Fig. 6b) in rhomboid patterns for Class II correction. The elastics are applied from the labial aspects of the upper canine to the upper first molar, down to the lower second molar and first premolar bilaterally to facilitate rapid bite correction.

Results: Why apply BiTurbos 2?

It is well known from electromyographical studies that muscle activity of the masticatory muscles is generally reduced when the vertical dimension of the anterior lower face height is increased with overbite correction.[7-9] In addition, adults with untreated deep overbite with CNS-muscle hyperactivity often suffer from generalised enamel wear that can then induce a cycle for further reductions in the vertical dimension. When the vertical dimension is reduced, muscle hyperactivity increases further. This tends to set-off the destructive cycle of mutilation and collapse of the lower anterior face height characterised by progressively greater enamel wear with age. This reduction in enamel support produces further progressive increases in muscle hyperactivity leading to progressively deeper overbite (Figs. 4a & b). Progressive deepening of the overbite in children restricts skeletal eruption of the dentoalveolar structures of the buccal segments that is maintained for life without orthodontic treatment.


Fig. 5a

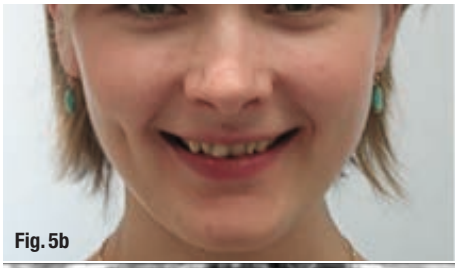
Fig. 5b


Fig. 5c


Fig. 5d


Fig. 5e


Fig. 5f

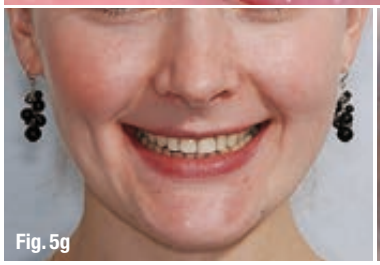
Fig. 5g


Fig. 5h

Figs. 5a & b: A severe, skeletal mandibular overclosure is characterised by a counter clockwise rotation of the mandible associated with CNS-Muscle hyperactivity including clenching and parafunction that is ideal for BT2 application..

Figs. 5c & d: A deep overbite with wear of the cusp tips associated with CNS-Muscle hyperactivity are shown in the Class II division 2 malocclusion on the patient's left side. In addition, periodontal gingival recession is evident.

Fig. 5e: Panoramic radiograph reveals the intrusive effect on the buccal segments classified as skeletal restriction of eruption, with CNS-Muscle hyperactivity. Early periodontal bone loss is additionally observed.

Fig. 5f: Downward and backward rotation of the mandible during BT2 treatment that improves the initial severe chin protrusion.

Figs. 5g & h: Good harmony and balance are restored to the smile with a Class I functional occlusion and good incisor torque. Extensive gingival allografting was also successfully undertaken that was associated with parafunction and possibly toothbrush abrasion causing the initial, severe gingival recession.

Humans use only approximately 10% of their muscle activity for chewing (25lbs). However, it is well known during clenching and other parafunctional activity that these forces can exceed 10 times the chewing force (250 to 300 lbs). Normal swallowing takes place approximately 600–1000 times/day or more (including during chewing and speaking) that maintains the restriction of dental eruption in the buccal segments into adult life (Figs. 4a &b). BT2s are used in conjunction with active self-ligating appliances due to the low resistance of the appliance shown in vitro, to permit unobstructed and controlled extrusive movements of the archwires at the upper and lower buccal segments. Once the posterior vertical dimension increases and the incisors begin to develop a positive overbite relationship, the tongue generally begins to rebalance vertically into the greater vertical space and more posteriorly into a more natural tongue position. This assumes the aetiology of the deep overbite has been additionally controlled long term with an anterior bite plane to be worn for one-year post-treatment, then overnight every night.

In addition to CNS-muscle hyperactivity, deep overbites are associated with skeletal counter clockwise rotation of the mandible as part of the archial growth path of patients with brachyfacial types.[10-11] This can explain why it is not unusual that as the orthodontist attempts to increase the vertical dimension in a growing child with strong anterosuperior growth of the condyles and a counter clockwise mandibular rotation pattern compounded by severe CNS-muscle hyperactivity, the deep overbite is highly resistant to orthodontic correction. This strong skeletal growth pattern is another reason deep overbites are one of the most difficult challenges, and where BT2s are valuable in controlling or breaking the pattern of CNS-muscle hyperactivity.

When to apply BT2s?

BT2s are recommended at all ages, including for both early interceptive treatment in children, and in adults (Figs. 5a–h). Prior to the placement of BT2s, all patients, particularly sensitive adults are informed most importantly, that the new BT2 technology will save several months (up to 3–4 months) of orthodontic treatment of the overbite that is the largest challenge. Sensitive patients are instructed it will possibly take 2–3 days to accommodate to the new vertical height, and to the feeling of the BT2s where wax is also provided to place over the BT2s for 3 days. Eating may temporarily be affected requiring soft foods, and they may also possibly affect speech mildly and temporarily (that is uncommon with the bulbous ends of two BT2s).

The ideal recommended time of BT2 placement is at the time of the bracket placement (that are regularly positioned on the labial aspects). BT2s and active self-ligating brackets are ideal with synergistic, specialised i-Arch wires (SIA Orthodontic Manufacturer) that have a higher vertical dimension than horizontal dimension (for example .018 X .014") for early moments of torque for control of the roots required in deep overbite correction.

The archwires, once again, incorporate compensating curve on the upper archwire and reverse curve of Spee for the lower archwire to further facilitate incisor intrusion. BT2s are worn for at least 6 months and tooth movements are facilitated by the eruption (or extrusion) of the buccal segments, where the rhomboid-shaped elastics (1/4", 4.5 oz) are place bilaterally. No clinically significant root resorption is

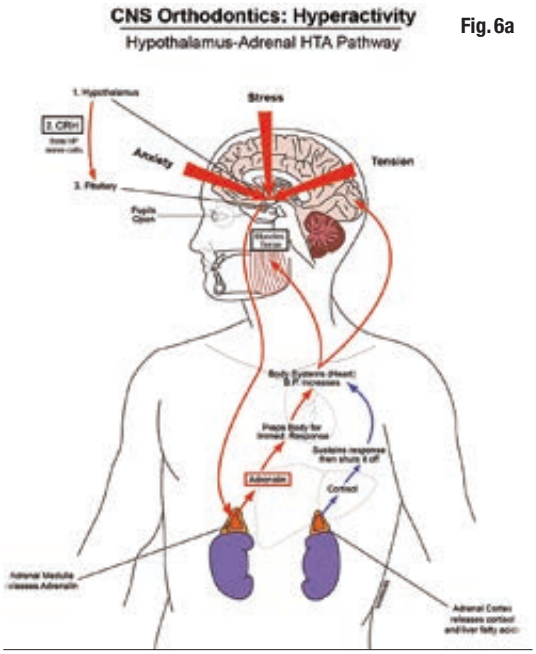

Fig. 6a

found with the use of this biocompatible force system as it gradually reduces the vertical mandibular overclosure and muscle activity.

How do BiTurbos 2 work?

The BT2 mechanism of action is that it increases the vertical dimension and reduces the muscle hyperactivity related to CNS tension through the hypothalamus-adrenal pathway (Fig. 6a). As the bite is opened with the application of BT2s, elastics in a rhomboid pattern (1/4", 4.5 oz) are used posteriorly to erupt the buccal segments by lifting the curved archwires occlusally, and to intrude the incisors mildly with low resistance in the brackets (Fig. 6b). In Class II correction Differential Eruption is used by placing a full dimension upper arch wire .018" X .025" stainless steel to act more as an anchorage unit and a lower dimension mandibular archwire in .016" X .022" stainless steel. This permits the lower molars and premolars to be differentially erupted upward and forward to correct the Class II malocclusion (Figs. 5f–h). In addition, this also allows the BT2s to work effectively by simultaneously increasing the anterior vertical dimension to correct the Class II malocclusion in conjunction with the rhomboid elastics bilaterally for Rapid Bite Opening (RBC).

Special procedures with BT2s and over-correction of deep overbites

In Class III malocclusions with lower incisor overclosure over the upper incisors anteriorly, BT2s are bonded to the lingual of the lower incisors to disarticulate the dentition and permit placement of the upper brackets (Figs. 7a-e). In Class III malocclusions the higher .018 X .025" stainless steel archwire is placed

Fig. 6a: The mechanism of how BT2s work. Application of buccal rhomboid elastics with active SL is shown.
Fig. 6b: As the bite is opened with the application of BT2s, elastics in a rhomboid pattern are used posteriorly to erupt the buccal segments by lifting the curved archwires occlusally, and to intrude the incisors mildly with low resistance in the brackets

in the lower arch and the smaller dimension .016 X .022" stainless steel lower arch is placed in the upper arch for upper downward and forward Differential Eruption using Class III rhomboid pattern elastics from the lower canine hook to second premolar and upper canine hook to first upper first molar hook.

For Class II patients with severe overjet (in conjunction with deep overbite), bonding resin may be temporarily added to the BT2s and into the vertical groove to extend them horizontally. The BT2 is roughened with a high-speed diamond bur, etched, primed with metal primer, and bonded with bonding resin. The overall objective is to overcorrect the deep overbite to within a 20 % overbite for long-term retention (it is equally important not to overly open the bite because the tongue may position anteriorly long-term). It is additionally recommended that upper and lower brackets from lateral-to-lateral be bonded 1 mm toward the incisal than the customary, average centre of the long-axis crown positions to facilitate RBC.

Conclusions: Advantages of BiTurbos 2 applications

A system was developed and tested for rapid bite correction. This included the use of new BiTurbos, lateral box elastics with active self-ligating brackets to provide freedom of movement of the system with recommended i-Arch wires for improved torquing moments.

The BT2 system for rapid bite correction includes:
1. Two BT2s at the palatal of the upper central incisors bonded more incisally
2. Active self-ligating appliance with NiTi clips, bonded more incisally lateral-to-lateral incisor
3. i-Arch wires with compensating curve on the upper arch and reverse curve of Spee on the lower arch to further facilitate incisor intrusion
4. Two elastics (1/4", 4.5 oz) in rhomboid-shaped patterns at the buccal segments.

BT2s are ideally applied in new super low profile, active self-ligating brackets, with NiTi clips for light, continuous forces, completely coated for aesthetics, and with progressively lower forces from molars to


Fig. 7a


Fig. 7b


Fig. 7c


Fig. 7d


Fig. 7e

Figs. 7a –e: BT2s in Class III treatment are bonded to the lingual of the lower incisors to increase the vertical dimension and to permit the placement of the active self-ligating appliance on the labial of the upper incisors that were previously in contact with the lower incisors and subject to shear force debonding. Note the opening of the occlusion posteriorly.

incisors. This makes use of reduced resistance in vitro and active seating of archwires for tooth control including torque (future publication).

Summary of BT2 application:

1. Metal BT2s are highly effective chairside for rapid bite correction (RBC) for a minimum of 6 months
2. Efficiency chairside is gained by ready-made, bondable BT2s, that do not wear, and have bulbous rounded ends for tongue comfort in both children and adults
3. BT2s were easier to bond with a positioning instrument due to the new vertical groove (split) that made them also significantly easier to debond. The specialised curvature also developed early anterior guidance at a new vertical
4. BT2s are directly bonded to the palatal of the upper central incisors replacing prior plastic moulds of bite ramps that required packed, light-cured resin that wears and is swallowed by patients throughout treatment
5. BT2s permit differential eruption of the molar teeth and are a significant improvement to bonded molar resin supports used for vertical correction in the past. The reason is prior molar resin supports are contraindicated since they have been shown to clinically intrude molars._

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about

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