Modified fixed nanobite tandem appliance for rapid correction of developing Class III malocclusion

K. C. Prabhat, MDS¹
Maheshwari Sandhya, MDS, FICD²
Kumar Verma Sanjeev, MDS³
Tariq Mohd, MDS¹
Naved Zahid Syed, MDS¹

**Aim:** Rapid correction of developing Class III malocclusion in pediatric patients using a method with decreased reliance on patient compliance and increased patient comfort. **Method:** The modified fixed nanobite tandem appliance (MFNTA) consists of three components, two fixed and one removable. The maxillary fixed appliance consists of a nickel-titanium fixed maxillary expander and a soldered buccal arm used for Class III elastic traction. The mandibular appliance consists of modified fixed nanobite and buccal headgear tubes welded to the mandibular first molar band for facebow attachment. **Result:** Pre- and posttreatment records revealed significant skeletal improvement without increase in the vertical dimension and marked improvement in facial balance and esthetics. **Conclusion:** MFNTA has the potential to be an effective tool in the treatment of developing Class III malocclusion and relief of the psychologic trauma caused by an anterior crossbite. *Orthodontics (Chic)* 2013;14:e178–e185. doi: 10.11607/ortho.924

**Key words:** Class III malocclusion, midface deficiency, MFNTA

Class III malocclusion is a growth-related facial deformity characterized by a forward mandibular position with respect to the cranial base and/or maxilla.¹ Historically it was thought that skeletal Class III malocclusion resulted primarily from overdevelopment of the mandible. More recently, however, several authors have reported maxillary retrusion to be the most common contributing factor, affecting up to 60% of all cases.²⁻³ In addition to the anteroposterior discrepancy, Class III malocclusions also frequently display an anterior or posterior crossbite.⁴ The incidence of Class III malocclusions in the white population of the United Kingdom and Scandinavia has been estimated at 3% to 5%.⁵ This may be increased to as high as 14% in Japanese and Chinese populations.⁶ The prevalence of Class III malocclusion in the Indian population⁷ was reported at 3.4%.

Treatment options for skeletal Class III malocclusions include: growth modification, dental camouflage, or orthognathic surgery, based on age and severity of malocclusion. Typically, growth modification has been aimed at young patients through the use of appliances such as a chin cup, protraction headgear,
or functional regulator. In patients with midfacial deficiency, the current clinical protocol for orthopedic maxillary protraction is by means of elastics attached to either an extraoral facemask or a chin cup. A maxillary expander is often used to enhance the orthopedic effect. This has been reported to be most beneficial before the age of 8, before the posterior maxillary sutures have been closed.

Correction of maxillary hypoplasia during growth by orthopedic maxillary protraction was pioneered by Delaire in the 1970s. If the patient is motivated enough to wear a facemask, treatment is likely to be successful. Downward and forward movement of the maxilla, an increase in overjet, and a backward rotation of the mandible with increased anterior facial height have all been documented with facemask therapy. The main disadvantages of Delaire facemask therapy are noncompliance due to discomfort, dentoalveolar compensation, and clockwise rotation of the mandible. One of the major problems associated with facemask therapy is the compliance of the child in wearing it due to both physical appearance of the extraoral appliance and skin irritation from the anchorage pad. The present article discusses the construction and clinical procedure for an intraoral appliance with much better patient compliance in the treatment of Class III malocclusion in young patients.

APPLIANCE DESIGN AND MECHANICS

The modified fixed nanobite tandem appliance (MFNTA) consists of three components, two fixed and one removable. The maxillary component of the appliance consists of a fixed maxillary expander inserted into the welded lingual sheath of maxillary first molar bands. A fixed expander can be a traditional maxillary expander with or without palatal acrylic, a quad-helix, a Nance appliance, or a nickel-titanium (Ni-Ti) expander. The authors prefer the Ni-Ti expander because its continuous forces provides a more effective approach to separating sutures. A soldered buccal arm on the maxillary first molar band is used for Class III elastic traction on both sides.

The mandibular component of the appliance consists of a modified fixed nanobite with posterior occlusal covering and buccal headgear tubes welded to the mandibular first molar band for facebow attachment. The modified nanobite is constructed by adaptation of 0.019 × 0.025-inch stainless steel wire in zigzag configuration to the occlusal surface of the buccal segment and soldering of the ends of the wire on the lingual side of the mandibular first molar band (Figs 1b and 1c). The clear acrylic blocks are built up on zigzag wires to the required height for disclusion, fully cured, trimmed, and polished (Fig 1d). The third component of the appliance is a 0.045-inch headgear facebow with the outer bows bent out for elastic attachment. At the terminal end of the inner bow a stop is soldered, and this inner bow is inserted into the mandibular buccal tubes (Figs 1e and 1f). Heavy orthopedic elastic traction (400 g per side) from the facebow to the buccal arms of the maxillary fixed appliance delivers the protraction force to the maxilla (Figs 1g to 1i).

The direction of the force application is one of the most important components for anterior displacement of the maxilla. Nanda varied the point of force application in primates and showed that by changing the line of force on the midface, the center of rotation of the maxilla could be altered. Lee et al conducted a holographic interferometric study on dried skulls to demonstrate the initial reaction of that maxillofacial complex during protraction. They located the center of resistance of the maxilla on a line passing through the distal contact of the maxillary first molar perpendicular to the functional occlusal plane and half the distance between the latter and the inferior border.
Case Report

Modified fixed nanobite tandem appliance for correction of Class III malocclusion

Case Report

Modified fixed nanobite tandem appliance for correction of Class III malocclusion

of the orbit. This point is coincident to the line of force applied 15 mm above and directed 20 degrees below the occlusal plane and produces translation of maxillary complex. Functioning of this appliance is based on a candid biomechanical principle that elaborates the line of force passing ≤ 20 degrees below the occlusal plane. In this way, the force vector is closer to the center of resistance of the maxilla, which produces anterior translation of the maxilla with no or minimal upward rotation of the maxilla (Fig 2a).

The force delivered by the protraction appliance on the chin is very rarely mentioned in the dental literature. An anterior force on the maxilla applies equal and opposite force on the chin with this appliance. The direction of the force on the chin is distal and in a nearly vertical line, which is helpful in preventing undesirable downward and backward rotation of the mandible, especially in Class III patients with long vertical dimension. By changing the force

Fig 1 Laboratory procedures for the construction of an MFNTA.
application on the MFNTA, the vertical dimension of the force can be nicely controlled. This is especially important in Class III patients with a long vertical dimension and a steep mandibular plane (see Fig 2a).

If force vectors of the MFNTA were adjusted to be ≥ 25 degrees with respect to the occlusal plane, downward and forward (clockwise) rotation of the palatal plane was observed. Similarly, in Class III patients with a flat mandibular plane and a deep bite, a force below the level of the occlusal plane may be more desirable to rotate the mandible in a downward and backward direction (Fig 2b). Hence the mechanism of this appliance is different from the conventional facemask therapy and provides more freedom for line of force adjustment in patients with different facial types with much better patient cooperation and fewer adjustments.

**CASE REPORT**

A female pediatric patient, aged 5 years, 7 months, was brought to the university orthodontic center by her parents, who complained that the arrangement of her anterior teeth was not esthetic. Clinical examination revealed a Class III malocclusion with an anterior crossbite and a midfacial deficiency (Fig 3). The lateral cephalometric radiograph (Fig 4) and analysis (Table 1) showed a skeletal Class III malocclusion with retrusive upper lip and protrusive lower lip. The treatment plan for this patient was orthopedic protraction of the maxilla with correction of anterior crossbite and control of mandibular growth to relieve the patient psychological trauma caused by the anterior crossbite.
Modified fixed nanobite tandem appliance for correction of Class III malocclusion

**Case Report**

**Fig 3** Pretreatment patient photographs.

**Fig 4** Pretreatment cephalometric radiograph.

**Table 1** Pretreatment and posttreatment lateral cephalometric analysis data.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Pretreatment</th>
<th>After removal of MFNTA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sagittal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (Steiner) (degrees)</td>
<td>76</td>
<td>80</td>
</tr>
<tr>
<td>SNB (Steiner) (degrees)</td>
<td>79</td>
<td>80</td>
</tr>
<tr>
<td>ANB (Steiner) (degrees)</td>
<td>−3</td>
<td>0</td>
</tr>
<tr>
<td>Wits (mm)</td>
<td>−8</td>
<td>−4</td>
</tr>
<tr>
<td>Midfacial length (Co–A) (mm)</td>
<td>81</td>
<td>83</td>
</tr>
<tr>
<td>Mandibular length (Co-Go) (mm)</td>
<td>105</td>
<td>105</td>
</tr>
<tr>
<td><strong>Vertical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN–GoGn (Steiner) (degrees)</td>
<td>35</td>
<td>34</td>
</tr>
<tr>
<td>Anterior facial height (N–Me) (mm)</td>
<td>104</td>
<td>104</td>
</tr>
<tr>
<td>ANS–Me (McNamara) (mm)</td>
<td>56</td>
<td>58</td>
</tr>
<tr>
<td>Posterior facial height (S–Go) (mm)</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Björk sum angle (degrees)</td>
<td>397</td>
<td>396</td>
</tr>
<tr>
<td>Gonial angle (Ar–Go–Me) (degrees)</td>
<td>136</td>
<td>135</td>
</tr>
<tr>
<td><strong>Soft tissue</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper lip S line (mm)</td>
<td>−1</td>
<td>1</td>
</tr>
<tr>
<td>Lower lip S line (mm)</td>
<td>+2</td>
<td>0</td>
</tr>
<tr>
<td>Upper lip E line (mm)</td>
<td>−5</td>
<td>−3</td>
</tr>
<tr>
<td>Lower lip E line (mm)</td>
<td>0</td>
<td>−3</td>
</tr>
</tbody>
</table>
Having reviewed the literature on tandem appliances with a removable component, the authors planned the design of MFNTA to be more patient friendly. The appliance was discussed with the patient's parents, and written informed consent was obtained. Informed consent was also obtained for the use of records for academic purposes. The modified design of the appliance consists of maxillary and mandibular fixed appliances with the only removable component being the facebow. After the maxillary and mandibular first molars were banded, the lingual sheath was welded on the maxillary first molar band for the Ni-Ti expander on the lingual side, and a buccal arm was soldered for Class III elastic traction. On the mandibular molar band, a 0.045-inch buccal tube was welded to receive the inner bow of the facebow. The outer bow of the facebow was bent to receive the traction of Class III elastic. The modified nanobite was constructed on the buccal segment of the mandibular appliance.

Upon delivery of the appliance, the patient was instructed to wear the appliance with a lighter 8-oz (230 g per side) training elastic for 1 week, followed by a 14-oz (400 g per side) treatment elastic (Fig 5). It is well known that the duration of wear is more significant than the force of the elastic. The authors recommend a minimum of 10 to 12 hours per day of elastic wear, including while sleeping. The patient is recalled 1 week after the initial appointment to verify the compliance and check the appliance. Sometimes the soldered maxillary buccal arm irritates the cheek mucosa and requires minor adjustment. The patient was then recalled to monitor her progress every 6 weeks for 8 months, at which time the 3 mm of positive overjet was achieved. The MFNTA was then removed, and a maxillary Hawley appliance was provided to retain the expansion and orthopedic protraction achieved by the MFNTA. Maxillary incisors erupted 4 months later, and no retention appliance was used after that. Posttreatment facial photographs (Fig 6) of the patient showed marked improvement in facial esthetics. Pre- and posttreatment facial photographs (see Figs 3 and 6), study casts (Fig 7), and lateral cephalograms and analysis (Figs 4 and 8 and Table 1) revealed a significant skeletal improvement, without increase in vertical dimension, and marked improvement in facial balance. A year after treatment, the patient showed a stable Class I occlusion with good facial esthetics.
Case Report

Modified fixed nanobite tandem appliance for correction of Class III malocclusion

Fig 6  Posttreatment patient photographs.

Fig 7  Pretreatment (a to c) and posttreatment (d to f) study casts.
CONCLUSION

MFNTA has the potential to emerge as an effective tool in the treatment of developing Class III malocclusion and relieving patient psychologic trauma due to anterior crossbite. Long-term patient follow-up studies are needed to verify the stability of the result achieved by this appliance.

REFERENCES