Early treatment of class III Malocclusion with Modified Tandem Traction Bow Appliance and a Brief Literature Review

Akhilesh Sharma, Sourabh Ramesh Joshi, Amitha M Hegde, Rajmohan Shetty

Department of Pedodontics, Rural Dental College, Loni, Taluka Rahata, Ahmadnagar, Maharashtra, India.

Abstract

The accurate diagnosis and clinical management of class III malocclusion continues to be a challenging task for the pediatric dentist due to the poor compliance of patient and high rate of relapse. Two cases of early treatment of class III malocclusion are presented which were treated by modified tandem traction bow appliance. The correction in the cross bite was achieved in six to seven months. Children's compliance and acceptance for the appliance was good. Follow up of two years and one years showed no relapse.

Key Words: Early treatment, Class III malocclusion, Tandem traction bow appliance

Introduction

As defined by Angle, class III malocclusion represents a very small proportion of the total malocclusion [1]. The prevalence of class III malocclusion in Indian children of the age group 5 – 15 years varies from 0.3 – 3.5% [2-8]. The Class III skeletal patterns is the result of a small and/or posteriorly positioned maxilla, a large and/or prognathic mandible, or a maxilla and mandible that are normal in the sagittal plane of space but underdeveloped in the vertical dimension. Most often, the Class III malocclusion is caused by a combination of two or all three discrepancies [9]. Treatment of skeletal class III has focused on mandible [10] as the etiology conventionally, but studies suggest that 42% to 63% of skeletal Class III malocclusions display maxillary retrusion or hypoplasia, in combination with a normal or mildly prognathic mandible [11-15].

A protraction facemask along with the maxillary splint/ appliance (banded/bonded type) has been used to correct malocclusion associated with maxillary deficiency or mandibular prognathism [15-19]. Protraction facemask demands special patient compliance because they are worn extra orally, and are not as esthetic or comfortable as intraoral appliances and difficulty in maintaining proper oral hygiene. Tandem Traction Bow Appliance (TTBA) introduced in 1999 overcomes the above mentioned problems [20].

Case Report 1

A male patient of 7 years reported to department with the chief complaint of irregular teeth. On examinatiom, profile was concave with early mixed dentition period (*Figure 1*). Maxillary and mandibular permanent first molars and lower permanent right and left central incisors were erupted. Permanent first molar relation was Angles' class III. Stainless steel crowns were placed after pulpectomy in lower right and left primary second molar. The lower right and left first permanent molars had been treated for pulpotomy and restored with high strength glass ionomer cement. Maxillary left primary second molar and right primary first molar had metal modified glass ionomer restoration. Maxillary left primary first molar and maxillary right primary second molar were grossly decayed and were indicated for extraction. Maxillary retrusion was observed and bilaterally molars were in end on relation. There was no familial tendency of class III malocclusion as the parents and siblings had normal occlusion. Since there was maxillary retrusion and SNB was ahead of SNA and maxillary incisors were in cross bite, decision was taken to move the maxilla to a forward position. Initially a chin cup was decided when the patient had reported at the age of 5 years 6 months, patient did not follow the instructions of wearing the appliance. When patient reported at age of 6 years 5 months, a reverse twin block was planned as patient compliance was poor. Initially patient did wear the appliance for few weeks but then again reported displeasure of wearing the appliance to school. Thus tandem traction bow appliance was chosen.

Maxillary splint consisted of rapid maxillary appliance and wire extension for engaging elastics at the canine area. The acrylic portion covered occlusal surface of posterior teeth and 2-3mm extending buccally. It was cemented to the maxillary arch. The lower appliance consisted of a removable acrylic retainer with occlusal coverage and buccal headgear tubes embedded in the area of the lower first molars. A 0.045" headgear facebow with the inner bow was inserted into the buccal tubes and the outer bow was used for engaging the elastics. The mandibular appliance was removable. The parents were instructed to activate the rapid maxillary appliance screw, a half a turn twice a day for one week was advocated followed by activating half a turn once a day for every alternate day. The method of activating the screw was demonstrated to the

Figure 1. Photograph for Case 1. The concave profile can be seen.

Corresponding author: Sourabh Ramesh Joshi, Department of Pedodontics, Rural Dental College, Loni, Taluka Rahata, Ahmadnagar, Maharashtra, India; Tel: +91 8698636946; e-mail: sj3040829@gmail.com

parents. Patient was instructed to wear the appliance 8 – 10 hours daily and to increase the wearing time to 12 to 14 hours in a span of 3 weeks. Approximately 300-500 g/side of force is delivered through elastics from the traction bow of the lower splint to the buccal hooks of the upper splint, at an angle of 20° below the occlusal plane to minimize the counterclockwise rotation tendency. Patient was recalled after 1 month duration, 3 months, 5 months and 7 months duration after appliance insertion. By seven months the cross bite was corrected and a cephalogram was taken and the post-operative findings showed improvement (*Table 1, Figures 2 and 3*)

Patient was asked to continue wearing of appliance for additional 3 months and during which the RME screw was not activated. Thus the total active phase consisted of 10 months. Follow up after 2 years did not show any relapse (*Figure 4*). Patient and parents were satisfied with the treatment.

Case Report 2

A 7 year old male child with concave profile reported to department for a routine dental examination (*Figure 5*). On examination anterior cross bite was observed. Child had mixed dentition and maxillary lateral incisors were erupting. Permanent molars were in class III relationship. Lateral Cephalogram was taken and the findings were recorded. Patient and the parents were informed of the problem and treatment plan was explained. Consent from parents was taken and treatment was done with TTBA. Appliance construction was similar as described for Case 1. A modification was done on the outer bow of the lower splint. A ball of solder was soldered on either side of the U bend on the outer part of face bow to prevent the elastic from slipping. Patient was instructed to wear the appliance 8 – 10 hours daily and to increase the wearing time to 12 to 14 hours. Force was applied in the same manner as described in case 1. Patient was followed up for 1, 3, 6 months. By six months the cross bite was corrected and the post operative cephalometric findings showed improvement (*Table 2, Figures 6 and 7*). Patient was asked to continue wearing of appliance for additional 3 months and during which the RME screw was not activated. Thus the total active phase consisted of 9 months. Follow up to 12 months did not show any relapse (*Figure 8*).

Discussion

Early orthodontic treatment refers to starting treatment during primary dentition or early transitional dentition. The benefits of which are greater ability to modify skeletal growth, improved patient self esteem and parental satisfaction, less extensive therapy required later and also the possibility of iatrogenic tooth damage like root resorption, decalcification and trauma is considerably reduced [21].

Table 1. *Pretreatment and posttreatment cephalometric measurements of Case 1.*

Cephalometric mesurements	Normal	Pre-treatment	Post-treatment
ANB(Steiner) (degrees)	+2	-1	+2
SNA (degrees	82	74	75
SNB (degrees)	80	75	73
Wits appraisal (mm)	-1	-4	-2
Midfacial length (McNamara) (mm)	81.7 ± 3.4	80.5	82
Mandibular Length (McNamara) (mm)	99.3 ± 3.6	98.3	99
Maxillomandibular differential (mm)	17.5 ± 3.1	18	18
SN-GoGn (Steiner)	32	27	29
ANS-Me (McNamara) (mm)	58.4 ± 3.1	55	62
U1 to SN(mm)	52	50	47
IMPA(degree0	90	88	86
Interincisal angle	130	144	125
Y axis(degree)	62-65	58	60

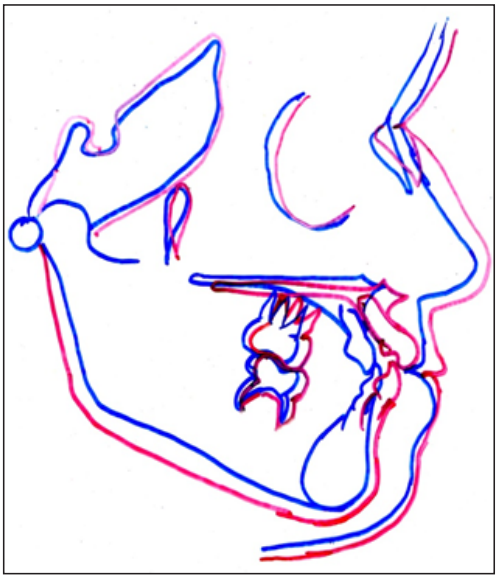

Figure 2. Cephalogram for Case 1 after the treatment.

Figure 3. Intra-oral photographs of Case 1 showing improvement.

Figure 4. Follow-up of patient in Case 1 after 2 years showed no relapse.

Figure 5. Concave Profile for patient in Case 2.

Figure 6. Cephalogram for Case 2 after the treatment.

Figure 7. Intra-oral photographs of Case 2 showing improvement.

***Table 2**. Pretreatment and posttreatment cephalometric measurements of Case 2.*

Cephalometric mesurements	Normal	Pretreatment	Posttreatment
ANB(Steiner) (degrees)	+2	-1	+1
SNA (degrees	82	80	81
SNB (degrees)	80	81	80
Wits appraisal (mm)	-1	-3	-2
Midfacial length (McNamara) (mm)	81.7 ± 3.4	80	82
Mandibular Length (McNamara) (mm)	99.3 ± 3.6	96	97.6
Maxillomandibular differential (mm)	17.5 ± 3.1	18	18
SN-GoGn (Steiner)	32	26	28
ANS-Me (McNamara) (mm)	58.4 ± 3.1	55.6	61.7
U1 to SN(mm)	52	49	47
IMPA(degree)	90	87	85
Interincisal angle	130	138	128
Y axis(degree)	62-65	56	58

Treatment of class III in young age has the advantage of growth, and thus appliances like traction head gear, Frankel III [22,23], reverse twin block [24], chin cup [25] have been used. Majority of class III cases are due to maxillary retrusion or smaller maxilla, thus apart from the traditional thought of concentrating attention to the mandible, maxillary protraction is needed most often in combination with rapid maxillary expansion.

In both the treated cases, maxillary protraction with expansion showed favorable changes in correction of class III malocclusion. Studies have also suggested the change in mandibular position back wards and downwards with the movement of maxilla anteriorly [26-28].

In Case 1, treatment was initially started with chin cup and then reverse twin block. The patient compliance was poor thus TTBA was chosen. Frankel would be of choice when there is increased deep bite and muscular problems. TTBA did not require much of patient compliance as the maxillary splint was cemented and appliance wear timings were in evenings and night. Patient was satisfied with the timings and thus regularity of wear showed positive results. A positive patient compliance seen in Case 1 motivated us to begin with Tandem Traction Bow Appliance in case 2. Surprisingly Case 2 also showed a very positive compliance and regularly wore the appliance.

Table 3. *Table showing different studies and case reports carried out for the treatment of class III malocclusion.*

Author and year	Type of evidence	Methods	Results
Chun Y S et al. [20]	Case report.	Introduced TTBA and reported a case of 11 year 3 month old female with class III malocclusion with anteriorly placed mandible and normal maxilla.	Correction of anterior cross bite. Better compliance to the appliance, better comfort and esthetics to the patient compared to Face mask.
Klempner S Leon [36]	Report of a case.	Modified TTBA.	TTBA was effective in class III correction, Good patient compliance.
Kim HJ et al. [38]	Longitudinal clinical Study.	88 Korean (42 boys, 46 girls) children mean age of 7.5 years. Mean treatment time was 13 months.	Maxillary protraction was achieved.
Atalay Z and Tortop T [29]	Longitudinal clinical study	45 children divided into 3 groups of 15 each, Group I – modified TTBA (MTTBA), early treatment, Group II – MTTBA, late treatment, Group III, control no treatment.	Dental and skeletal correction of class III in both the groups , Significant maxillary movement in both the groups Decrease in SNB significantly greater in early treatment vs control group.
Tortop T et al. [37]	Comparative longitudinal clinical study.	Total of 65 children were divided into 3 groups. First group 21 patients (mean age: 10 years, 6 months) were treated with a Delaire-type facemask (FM). In the second group 22 patients treated (mean age: 10 years) with MTTBA. The remaining 22 children (mean age: 9 years, 7 months) were observed without treatment for 11 months.	Increase in SNA, N-FH / – A, and ANB angles were significantly greater in the treatment groups compared to the control group. However, ANB angle showed a significantly greater increase in the FM group (2.8 6 0.30u) than in the MTTBA group. Dental and skeletal effects showed differences due to the design of the appliance.
Sukh R, Singh G P , Tandon P [34]	Case report	Deficient and retrognathic maxilla and normal mandible in a 8 year old boy.	Modified TTBA showed complete correction of class III malocclusion in 3 months and over correction with positive overjet was maintained for 4 months.
Jeevarathan J et al. [35]	Report of two cases.	Class III malocclusion in 6 year old boy and 11 year old girl treated with modified TTBA, active treatment phase being 16 months and 9 months respectively.	Complete correction of cross bite and positive cephalometric changes.

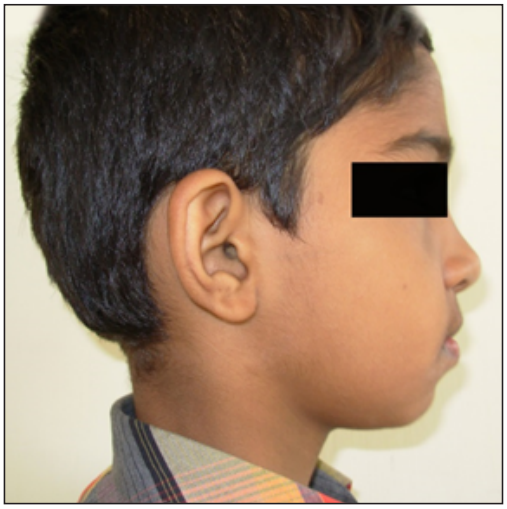

Figure 8. *Follow-up of patient in Case 2 after 12 months showed no relapse.*

Treatment with TTBA allows for a easy functional shift of the mandible and distributes the force of protraction to all the maxillary teeth [20]. The TTBA shows a slight backward effect on the mandible and forward movement of maxilla similar to face mask therapy [26-28]. Treatment with TTBA results in flaring of upper incisors and retrusion of lower incisors. Incisor mandibular plane angle decreases due to backward rotation of mandible. The decrease in SNB with TTBA was 2° and 1° in case 1 and 2 respectively. It is in accordance to results with other studies [29].

Skeletal class III discrepancies worsen with age. Children with negative ANB angle examined in three stages; primary, mixed and permanent showed an increase in protrusion from 23% to 40% to 34% respectively as dentition progressed from primary to mixed and permanent [30].

Literature review shows greater TTBA acceptance due good comfort and esthetics when compared with face mask therapy (*Table 3*).

There has always been speculation regarding early treatment. Positive factors that aid in deciding to intercept a developing class III malocclusion are good facial esthetics, mild skeletal disharmony, no familial prognathism, antero-posterior functional shift, convergent facial profile, symmetric condylar growth and growing patients with expected good co-operation [31]. Studies on maxillary protraction therapy and age suggests that it is more effective in primary and early mixed dentition [17,32,33-38].

Conclusion

While the treatment effect of the TTBA is similar to that of a facemask, the TTBA is much more convenient for both the clinician and the patient. It has the following advantages [20]:

- Promotes patient compliance, because it is more esthetic and comfortable than extraoral appliances. The TTBA is so small that it can be stored in a removable appliance case. Night-time wear is adequate for an orthopedic effect.
- Allows early treatment of any Class III malocclusion, due to optimal retention in the deciduous, mixed, or early permanent dentition.
- Distributes the force of protraction to all maxillary teeth.
- Permits free mandibular movement, with its polished occlusal surface, so that a functional shift is easily corrected.
- Maintains arch length, unlike extraoral maxillary protraction appliances that tend to produce anterior crowding.
- Requires no additional biteplate for correction of anterior crossbite.
- Can be changed to a monoblock retainer at chairside for maintenance of crossbite correction.
- Can be used in conjunction with fixed appliances if necessary.

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