

TWO-PHASE MANAGEMENT OF A SKELETAL CLASS III MALOCCLUSION WITH CROWDING USING THE COMBINATION OF MAXILLARY PROTRACTION AND SELF LIGATION : A CASE REPORT

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ABSTRACT

A 14 year old boy with skeletal Class III malocclusion was treated in two phases. In phase one, rapid maxillary expansion (RME) and facemask was applied for intervention. After RME and facemask treatment, an improved skeletal Class III jaw relationship with reduction of the A point-nasion-B point (ANB) angle was obtained. Later in phase two, a full mouth, fixed, edgewise, self-ligating appliance was used to resolve the crowding without any extractions and give the patient overall an aesthetic profile and functional occlusion.

KEY WORDS

skeletal class III, rapid maxillary expander(RME), facemask, self-ligation

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INTRODUCTION

Orthopedic treatment with a facemask and rapid maxillary expansion (RME) is a common technique for correction of Class III growing patients.¹ Many studies have indicated that facemask treatment may have an orthopedic effect to advance the maxilla in conjunction with downward and backward rotation in the mandible. RME was first reported by Edward H. Angell in 1860.² In 1970, Haas presented a theory to correct patients with maxillary deficiency by opening the midpalatal suture. The circummaxillary sutures (frontomaxillary, nasomaxillary, zygomaticotemporal, zygomaticomaxillary, pterygopalatine, intermaxillary, ethmoidomaxillary, and lacrimomaxillary sutures) are disengaged by palatal expansion. According to the hypothesis of Haas, as the palate of maxilla are separated, these sutures begin to open. The force produces an effect similar to growth, so that the maxilla could be moved downward and forward.² The main advantages of self-ligating brackets are the low friction between bracket and archwire, potentially reduced treatment time, shorter appointments, longer intervals between appointments, greater patient comfort, and less plaque accumulation. Another central benefit is the possibility of avoiding extractions, thanks to the arch expansion that can be obtained with self-ligating appliances.

CASE REPORT

A 14 year old boy sought treatment to correct his crooked front teeth. He had a concave profile and a protrusive lower lip (Fig1). His dental development was in permanent dentition. He had a 5mm overbite and a 1 mm negative overjet with skeletal Class III malocclusion. The molar and incisor relations were both class III. The upper anteriors were proclined and lower anteriors were retroclined. There was an anterior crossbite wrt 11, 12, 13, 21, 22. 12 and 22 were palatally locked in. 33 and 43 were rotated (Fig2). The lateral cephalometric analysis revealed a skeletal Class III jaw relation (A point-nasion-B point [ANB] angle, -5.0°, Wit's appraisal: -8mm) and an anteriorly divergent facial pattern. SNA of 79° gave the inference of "maxillary retrusion" as the cause of the skeletal class III relation.



Fig1: Extraoral pretreatment photographs



Fig 2: Intraoral pretreatment photographs

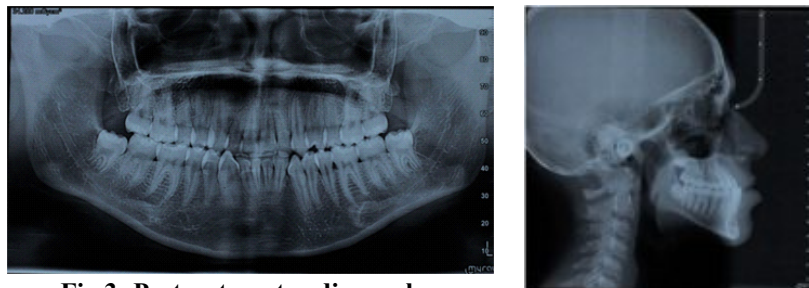


Fig 3: Pretreatment radiographs

TREATMENT OBJECTIVES

Our initial treatment objectives were to correct the skeletal class III relation and crossbite w.r.t 11, 12, 13, 21 and 22. The other treatment objectives were to improve facial profile and correct his dental Class III malocclusion to achieve a positive overbite and

overjet. Treatment alternatives were Miniscrew Assisted Rapid Palatal Expander (MARPE) or extraction of teeth to gain space and decrowd the dentition or extraction of teeth followed by distalization of the mandibular arch (camouflage treatment).

TREATMENT PLAN

After explanation of the possible treatment alternatives to the parents, two-phase orthodontic treatment was decided. The sequence of treatments included the followings : 1) Phase one : an RME combined with a facemask for improvement of jaw relation; 2) Phase two : full mouth, fixed orthodontic, non-extraction treatment using an edgewise, self-ligating system for decrowding and stable interdigitation. The retention protocol planned was fixed spiral wire lingual retainer from canine to canine in both arches.

TREATMENT PROGRESS

A bonded RME was cemented in place and was activated twice a day (opened and closed, Alt-RAMEC protocol), 0.25 mm (90 degrees) per turn (Fig 4).



Fig 4: Intraoral bonded RME



Fig 5: Extraoral photograph of patient wearing facemask



Fig 6: Retention appliance following phase one therapy



Fig 7: Mid treatment extraoral photographs

After 8 weeks, the petit type facemask was worn, for at least 14 hours per day to advance the maxillary growth (Fig 5). The facemask wear was continued for 6 months.

The extraoral elastics protocol followed was:

1. 3/8", 8 ounces
2. 1/2", 14 ounces
3. 5/16", 14 ounces.

After 8 months (2 months of Alt-RAMEC and 6 months of RME with facemask), the RME was removed and facemask use was discontinued. A retention plate was put in place for 3 months (Fig 6).

The ANB angle improved from -5° to -1° , the mandibular plane angle had increased, the anterior edge to edge bite was corrected, the overjet was increased and the upper incisors were slightly labially inclined. Later, the full mouth, fixed, edgewise, self-ligating, orthodontic treatment was initiated. Inter proximal reduction was selectively done to gain space for correction of crowding and to prevent further proclination. Frictionless mechanics of the self-ligating bracket system allowed faster decrowding. After 13 months of treatment, an acceptable occlusion, a better overbite and overjet were achieved (Fig 10).



Fig 8 : Intraoral mid treatment photographs

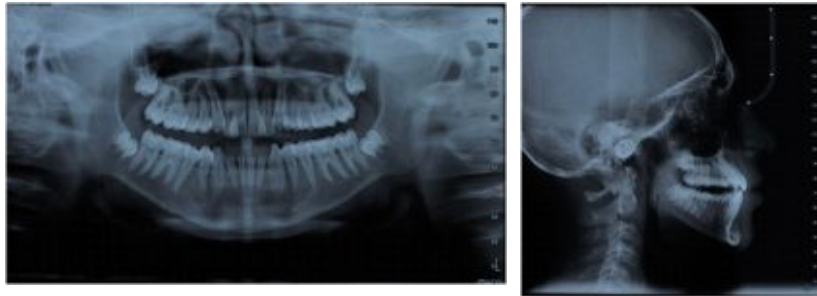


Fig 9: Mid treatment radiographs



Fig 10: Intraoral photographs of phase two therapy

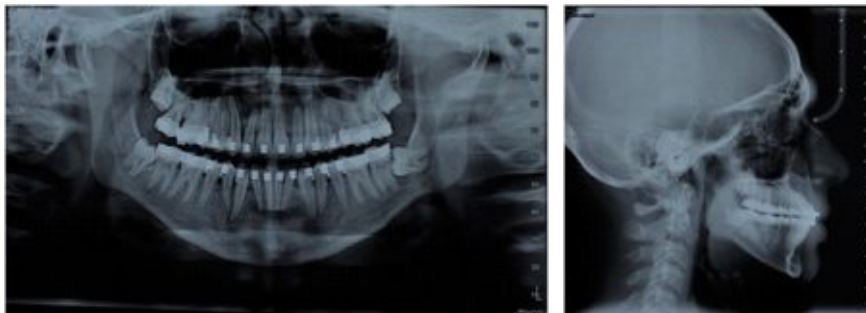


Fig 11: Radiographs at the end of phase two therapy



Fig 12: Extraoral photographs after debonding fixed appliance



Fig 13: Intraoral photographs after debonding

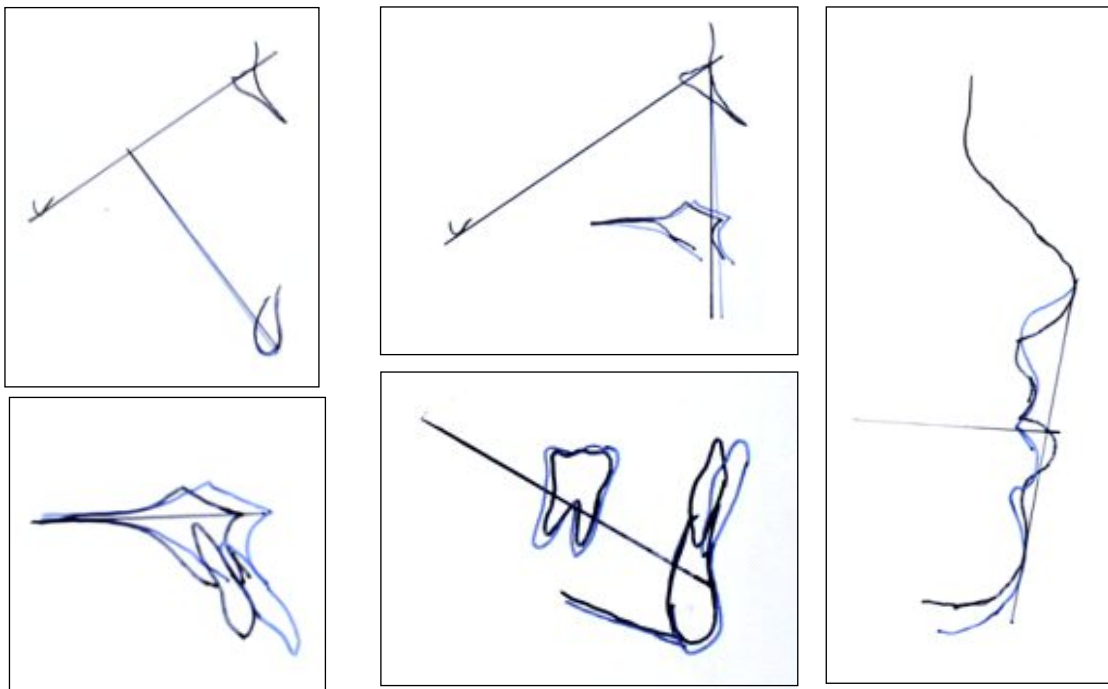


Fig 14: Cephalometric superimpositions of pre and post treatment cephalograms

TREATMENT RESULT

The skeletal class III relation and concave profile were corrected. Decrowding was done, maxillary anterior teeth were well aligned, the rotations were corrected and a harmonious smile was achieved (Fig 12). The patient still requires long-term follow-up for his facial skeletal growth changes.

Bilateral Class I molar relationships with acceptable overjet and overbite were achieved. Radiographs indicated parallel roots, proper root alignment, and no obvious root resorption (Fig 11).

The cephalometric analysis at the end of treatment demonstrated an improved skeletal relationship (Table 1). His soft tissue facial profile also improved after treatment (Table 5).

DISCUSSION

Studies related to skeletal changes after RME revealed that changes consist of a forward and downward movement of the maxilla in conjunction with a backward and downward rotation of the mandible; the related dental effects include extrusion

Parameter	Mean	Pre treatment	Mid Treatment	Post Treatment
SNA	82°	79°	81°	81.5°?
SNB	80°	84°	82°	83°
AB Plane to NPog	0° to -9° (-4.6°)	+3.5°	-2°	+1°
ANB	02°	-5°	-1°	-2°
Wit's Appraisal	-2mm to +2mm	-8mm	-2mm	-3.5mm
Pog -Na perp	Small -8 to -6mm Medium -4 to 0 mm Large -2 to +2 mm	+1mm	0mm	+1mm
Na perp to point A	0-1 mm	-3.5 mm	0mm	-1mm

Table 1: Serial cephalometric analysis of maxillary and mandibular skeletal parameters

Parameter	Mean	Pre treatment	Mid Treatment	Post Treatment
Upper CI to A-Pog	+5 to -1 mm(2.7 mm)	1mm	4mm	8mm
Interincisal angle	130°-150°(134°)	143°	132°	120°
Upper CI to NA (linear)	04mm	4mm	6mm	9mm
Upper CI to NA (angular)	22°	25°	27°	33°
Upper incisor Protrusion	4-6 mm	7mm	9mm	10mm
Upper CI to SN	102°	107°	109°	118°

Table 2: Serial cephalometric analysis of maxillary incisor position

Parameter	Mean	Pre treatment	Mid Treatment	Post Treatment
Lower CI to NB (linear)	04mm	3 mm	3mm	5mm
Lower CI to NB (angular)	25°	17°	20°	22°
IMPA (Tweed)	76°-99° (90° norm)	80°	81°	90°
Lower incisors Protrusion	1-3 mm	4.5mm	4mm	5mm

Table 3: Serial cephalometric analysis of mandibular incisor position

Growth Pattern	Mean	Pre treatment	Mid treatment	Post treatment
Y (growth) axis	53°-66° (59.4°)	56°	57.5°	58°
F M A	16°-35° (25° norm)	26°	27°	27°
MPA (Steiner`s)	32°	29°	31°	32°
MPA (Down`s)	17° to 28° (21.9°)	21°	22°	22.5°
L A F H	Small 60-62 mm Medium 65-67 mm Large 70-73 mm	49mm	52mm	53mm
JARABAK`s ratio	62% to 65%	69%	68.5%?	68.3%
Facial Axis Angle	0 ± 3.5°	-2°	-4°	-4°

Table 4: Serial cephalometric analysis of growth pattern

Parameter	Mean	Pre treatment	Mid treatment	Post Treatment
Nasolabial angle	102° ± 8°	104°	99°	97°
Facial angle	90°-92° (91 ± 7°)	93°	92°	92°
H angle	10° (7°-15°)	12°	15°	15.5°
Upper sulcus depth	5 mm	4mm	5.5mm	5.5mm
Lower sulcus depth	5 mm	1.5mm	3.5mm	3mm
Ricket`s Lip analysis	Upper 4mm behind Lower 2 mm behind	-3 mm +2.5 mm	-3 mm +1.5mm?	-2.5mm +0.5mm
Steiner`s Lip analysis	Lips behind - flat Lips anterior-protrusive	0mm +4.5mm	0.5mm +2 mm	0mm +1.5mm
Z- angle	80° ± 9°	67°	70°	72.5°

Table 5: Serial cephalometric analysis soft tissue changes

of the upper molars and proclination of the upper incisors. These skeletal and dental changes would improve some part in patients with skeletal Class III malocclusions. However, the improvement is limited or not effective in cases with high mandibular plane angle or anterior open bite.³⁻⁹The treatment of RME is usually performed in two stages. Stage one is an active expansion of the maxilla by sutural expansion, and stage two is retention that allows for reorganization and calcification of the midpalatal suture.⁷ RME also applies force against 10 other extramaxillary osseous structures. Isaacson RJ and Ingrain AH have demonstrated that an RME appliance applies up to 30 pounds of force against the

maxilla.³This force might be conducted to other facial osseous structures in which the circumaxillary sutural growth may be promoted. Maxillary protraction is a treatment option for patients with skeletal Class III maxillary deficiency.¹⁰⁻¹² The principle of maxillary protraction is to apply tensile force on the circumaxillary sutures and then bone apposition occurred in the suture areas. The maxillary teeth become the site where the force is applied,^{13,14} and the facial bone (forehead, chin, zygoma) or occipital area are the anchorage sources.^{15,16} Not only the point A carried forward through incisal advancement movement but also the entire maxilla is displaced forward. The significant effects of forward

movement could be observed in the location as far posteriorly as in zygomaticotemporal suture.¹⁷⁻¹⁹

Many advantages that self-ligating brackets offer above conventional bracket systems include reduced friction between the arch wire and the brackets, full arch wire engagement, greater arch expansion, less incisor proclination, faster alignment and space closure, reduced chair side time, increased patient comfort, improved oral hygiene, and shorter treatment time. Another added advantage of SLBs is mild-to-moderate crowding cases can also be corrected using non-extraction approach.

In our case, after treatment with RME and facemask; the mandibular plane angle was increased (SN-MP, from 29° to 32° ; FHP-MP, from 21° to 22.5°), indicated mandible downward rotation; the upper incisors were proclined (U1-SN, from 107° to 118°); and the lower incisors were proclined (L1-MP, from 80° to 90°) (Table 2,3). The main objective of facemask treatment is to enhance forward displacement of the maxilla by sutural growth. Melsen B and Melsen F indicated that the midpalatal suture was broad and smooth during the “infantile” stage (8–10 years of age) and the suture became more squamous and overlapping in the “juvenile” stage (10–13years) in histologic findings.^{21,22} Early intervention facilitates growth modification, but the treatment effects may be difficult to retain through the whole growth period. It requires patients' compliance and long-term observation.²⁰ Orthopedic treatment during the prepubertal and pubertal periods can shorten treatment time, and if mandibular growth is directed properly after treatment, favorable anterior occlusion can be obtained.^{14,15} The improvement of the facial profile is not as effective as the achievement in surgical orthodontics because excessive mandibular length in skeletal Class III malocclusion cannot actually be reduced through the orthopedic treatment.^{23,24} In this case, we observed the growth of this patient and achieved a good occlusion result without extractions, with the two-phase orthodontic treatment. Long term monitoring of the dento skeletal changes is required to confirm the ultimate treatment outcome.

CONCLUSION

Class III malocclusion is one of the most challenging problems confronting the practicing orthodontists. The effects of maxillary protraction that revealed from the cephalometric analysis indicated forward and downward movement of the maxillary bone and dentition and downward and backward rotation of the mandible.^{26,27} These effects tend to turn Class III malocclusion into Class I occlusion and achieve an orthognathic profile in a short period. However, whether the maxillary protraction can actually stimulate growth remains unclear in prepubertal or pubertal subjects. Further studies are required to answer this basic question. The

protraction facemask in conjunction with an RME appliance has been used to correct patients with maxillary deficiency and/or mandibular prognathism.²⁹⁻³² In previous clinical studies, most investigators reported a combination of skeletal and dental contributions to overjet correction,²⁹⁻³² and an average of 2 to 3 mm of anterior movement of the maxilla.³³⁻³⁷ The mandible is usually positioned downward and backward in response to changes in the maxilla. The use of palatal expansion in conjunction with maxillary protraction helps to “disarticulate” the maxilla and initiate the cellular response in the sutures. The sutural effect could enhance a more positive reaction of the midface to the protraction forces.^{28-32,34-37}

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