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Case Report

Early Treatment of Class III Malocclusion Using Alternate Rapid Maxillary Expansion and Constriction (Alt-RAMEC) Protocol with Facemask Therapy: A Case Report.

Dr Shilpa Pharande[1*], Dr Nandlal Toshniwal[2], Dr Ravindra Manerikar[3], Dr Abhijit Misal[4] and Dr Kishor Chougule[5]

[1]*Dept. of Orthodontics & Dentofacial Orthopaedics Sinhagad Dental College, Pune Maharashtra India*

[2]*Dept. of Orthodontics & Dentofacial Orthopedics, Rural Dental College; Pravara Institute Of Medical Science (Deemed to be University); Loni (BK)-413736; Maharashtra, India*

[3]*Dept. of Orthodontics & Dentofacial Orthopedics, Rural Dental College; Pravara Institute Of Medical Science (Deemed to be University); Loni (BK)-413736; Maharashtra, India*

[4]*Dept. of Orthodontics & Dentofacial Orthopedics ,YCMM & RDF Dental College, Ahmednagar Maharashtra India*

[5]*Dept. of Orthodontics & Dentofacial Orthopedics ,Tatyasaheb Kore Dental College; Kolhapur, Maharashtra, India*

Abstract: Orthodontists face difficulty when it comes to treating Class III malocclusion. It is best to treat it at the growing stage with dentofacial orthopedics. Maxillary protraction using the Alternate Rapid Maxillary Expansion and Contraction (Alt-RAME) technique is an effective approach for treating skeletal Class III malocclusion at an early age. A 9-year-old female patient came to the Department of Orthodontics with a complaint of backwardly placed upper teeth and un-aesthetic dental as well as facial appearance. Intraoral examination revealed an anterior cross-bite of 1 mm. Molar relation was class III on the right side and super Class I on the left side. Slight crowding in lower arch and spacing in maxillary arch due to unerupted teeth was seen. The patient was diagnosed with Class III skeletal pattern associated with maxillary retrusion, average growth pattern, Class III molar relation on right side, super Class I molar relation on left side and a protrusive lower lip. The early treatment of such cases is essential, so that maxillary retrusion can be corrected with the help of orthopedic intervention. It was decided that the correction of skeletal Class III malocclusion will be done using Alt-RAMEC protocol along with facemask. Use of Alt-RAMEC protocol for correction of Class III malocclusion due to maxillary retrusion can help in early correction of Class III skeletal pattern and helps improving overall profile of the patient. This case report shows the result of using a hyrax bonded maxillary expander with Alt-RAMEC protocol along with a facemask to treat a Class III malocclusion associated with maxillary hypoplasia. A 9-year-old patient with skeletal class III malocclusion and anterior crossbite was treated using this protocol.

Key-words: Alt-RAMEC (Alternate Rapid Maxillary Expansion and Contraction protocol), computed cone beam tomography (CBCT), skeletal Class III malocclusion, growth modification.

***Corresponding Author**

Dr Shilpa Pharande , Dept. of Orthodontics & Dentofacial Orthopaedics Sinhagad Dental College, Pune Maharashtra India

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1. INTRODUCTION

Class III malocclusions are characterized as facial dysplasia that can be produced either by excessive growth or disharmony of the mandible in size, form and position with respect to the maxilla and/ or cranial base or by deficient growth of maxilla in realtion to mandible. A significant percentage of the skeletal Class III malocclusion cases are due to maxillary retrusion. The incidence of Class III malocclusion among Chinese and other Asian populations can be as high as 14%. The aetiology of Class III malocclusion can be categorized as either genetic or environmental which includes mouth breathing, forward posture of the mandible and chromosomal defects.[1,2] The clinicians face a dilemma while treating a Class III malocclusion. Treatment varies in timing, from early intervention during the pre-pubertal stages of development to intervention after the patient has undergone active growth. The treatment modalities range from dentofacial orthopaedic treatment to the combination of orthognathic surgical and orthodontic approaches, but dentofacial orthopedics help in camouflaging the need of orthodontic treatment. In cases of early intervention of skeletal Class III malocclusion due to mandibular prognathism, chin cap is used to prevent and direct the development of the mandible.[2] If the skeletal Class III malocclusion is due to maxillary retrognathism, maxillary protraction treatment is performed with use of facemask.[3-5]

The Alt-RAMEC protocol was introduced by Liou in 2005.[6] It allows for sutural mobilisation by opening and closing the RME screw for 7-9 weeks without the need for excessive expansion. Alt-RAMEC protocol was created to open the circumaxillary sutures without the drawbacks of maxillary overexpansion. In contrast to traditional RME, implementing alternative rapid expansion and constriction increased efficiency of maxillary expansion.[7,8] The extent of anterior maxillary displacement was found to be two times greater with the Alt-RAMEC protocol than with the traditional RME protocol. The purpose of this case report is to demonstrate early correction of Class III malocclusion using Alt-RAMEC protocol along with facemask.

1.1 Case history

A 9-year-old female patient came to the Department of Orthodontics with a complaint of backwardly placed upper teeth and un-aesthetic dental as well as facial appearance. On extraoral examination, she had a straight facial profile. Intraoral examination revealed an anterior cross-bite of 1 mm. Molar relation was class III on the right side and super Class I on the left side. Slight crowding was seen in the lower arch. Maxillary arch had spacing due to unerupted teeth. The etiology of malocclusion was considered genetic as similar malocclusion was present in patient's father. (Figure 1, Figure 2)

Fig 1 – Pre-treatment photographs

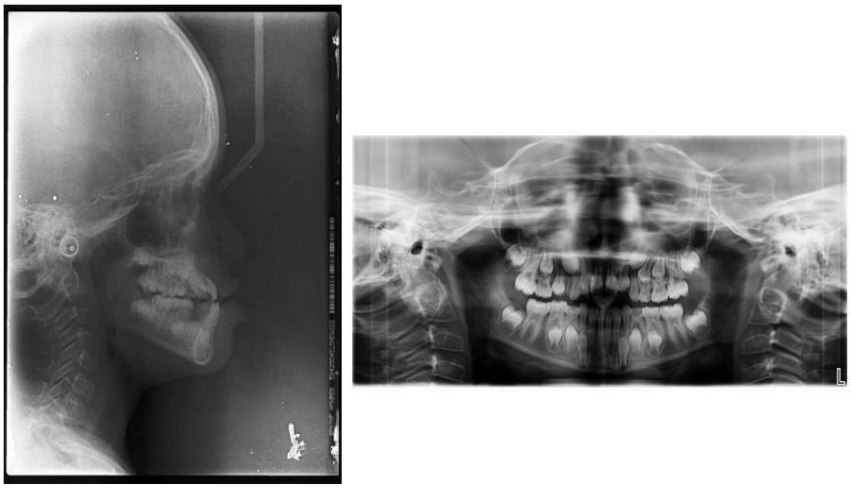

Fig 2 – Pre-treatment radiographs

1.2 Diagnosis

The patient was diagnosed with the Class III skeletal pattern associated with maxillary retrusion, average growth pattern, Class III molar relation on right side, super Class I molar relation on left side and a protrusive lower lip. (Cephalometric Analysis needed)

Table 1: Pre-treatment Cephalometric analysis

Measurement	Mean	Pre Rx	Inference
Steiner's Analysis			
SNA	82°	76°	Retruded maxilla
SNB	80°	80°	Normal mandible
ANB	2°	-4°	Class III skeletal pattern
Go-Gn to Sn	32°	25°	Horizontal growth pattern
U1 to NA angle	22°	44°	Proclined maxillary incisors
U1 to NA mm	4mm	5 mm	Forwardly placed maxillary incisors
L1 to NB angle	25°	22°	Average
L1 to NB mm	4mm	-2 mm	Backwardly placed mandibular incisors
Occlusal plane – SN	14°	9°	Horizontal growth pattern
L1 to NB mm	4mm	-2 mm	Backwardly placed mandibular incisors
Tweed's Analysis			
FMA	25°	23°	Horizontal growth pattern
FMIA	65°	86°	
IMPA	90°	71°	Retroclined mandibular incisors
Wit's appraisal BO is ahead of AO by **-5 mm. Class III skeletal pattern.**			
Rickett's Analysis			
Facial axis(Ba-Na to Pt-Gn)	90± 3.5°	99°	Class III skeletal pattern
Facial angle(N-pg to FH)	87± 3°	90°	Average
Mandibular plane angle	26± 4.5°	23°	Horizontal growth pattern
Convexity at Pt.A	2± 2mm	-3 mm	Retruded maxilla
L1 to A – Pg	1± 2 mm	-4 mm	Retroclined lower incisors
U6 to Ptv	Age + 3 yrs	17 mm	Average
L1 inclination	22± 4°	25°	Average
Lower lip to E plane	-2 ±2 mm	3 mm	Average
McNamara's Analysis			
N perpendicular. – A	0 - 1mm	-2 mm	Retruded maxilla
N perpendicular. to Pog	0-4 mm	2 mm	Average
Facial axis angle	0± 3.5°	9°	Class III skeletal pattern
Mand. Plane angle	22 ± 4°	23°	Average
Effective. Maxillary Length	85 ± 2.3 mm	74mm	Reduced
Effective. Mandibular Length	106 ± 3.4 mm	104 mm	Average

Maxillomandibular differential	21.1 ± 2.7 mm	30 mm	Increased
Lower ant. Facial ht.	60 ± 2.9 mm	57 mm	Average
U1 to Pt. A	4-6 mm	7 mm	Proclined maxillary incisors
L1 to A- Pog	1-3mm	-3 mm	Retroclined mandibular incisors
Nasolabial angle	102 ± 8°	96°	Normal
Holdaway's Soft Tissue Analysis			
Facial angle	90± 3°	97°	Class III pattern
H line angle	7 – 15°	12°	Average
Upper sulcus depth	5 mm	4 mm	Average
Upper lip thickness	15 mm	15 mm	Average
Upper lip strain	2 mm	2 mm	**Average**
Lower lip to H line	-1 to +2mm	1 mm	Average
Lower sulcus depth	5 mm	4 mm	Average
Soft tissue chin thickness	10-12 mm	11 mm	Average

Notes- perp.- perpendicular, eff.- effective

1.3 Treatment objectives

The treatment objectives were to obtain a normal profile by skeletal correction, correct the Class III dental relationship and obtain Class I canine and Class I incisal relationship.

1.4 Treatment plan

It was decided that the correction of skeletal Class III malocclusion will be done using Alt-RAMEC protocol along with facemask and evaluation for fixed orthodontic treatment will be done after use of facemask. Parents were informed about the various treatment modalities with their benefits and limitations. Once the parents gave permission for Alt-RAMEC protocol along with facemask, Informed consent was obtained from patient's parent for the treatment and use of patient's photographs and images for educational and publication purpose.

1.5 Treatment progress

The patient was delivered a bonded type of RME appliance with a Hyrax expansion screw in the middle and an occlusal splint (extending from the distal of the canines and encompassing the posterior teeth) for the Alt-RAMEC protocol. (Figure 3,4) The maxilla was expanded and contracted in alternating weeks by 4 one-quarter turns per day (0.25 mm each quarter turn, 1 mm) and this was continued for 9 weeks ending with expansion. After completion of Alt-RAMEC protocol, a petit type of facemask was given to the patient for protraction of maxilla. The elastics were engaged on the hook near the maxillary canines with a downward and forward pull of 20 °- 30 ° to the occlusal plane. (Figure 5) With the help of a Dontrix gauge, the elastic force was maintained at 350-400 gm on each side. Patient was advised to wear the facemask 12-14 hours per day. The traction was continued for 4-5 months till sufficient protraction of the maxilla was obtained

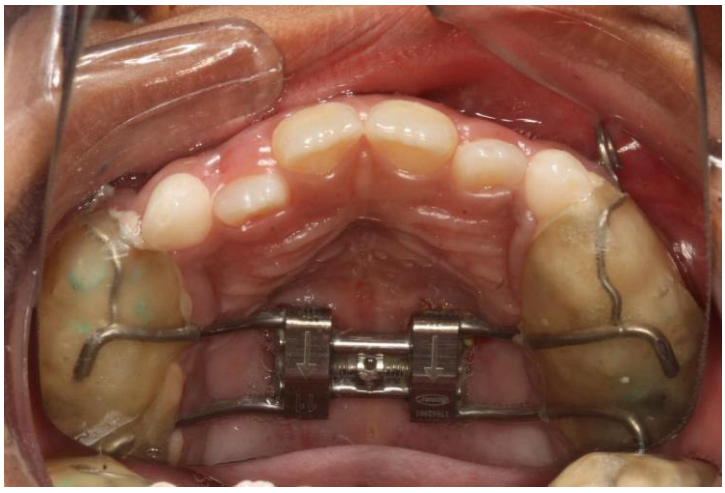

Fig 3- Hyrax Rapid maxillary expander delivered

Fig 4- Intraoral photographs after appliance delivery

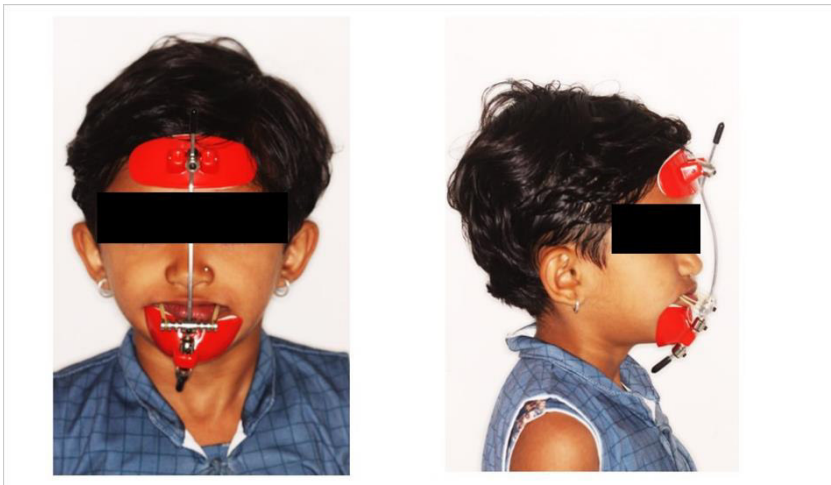

Fig 5- Facemask delivered

Extraoral and intraoral photographs and radiographs were taken after completion of Alt-RAMEC+Facemask protocol. (Figure 6,7

Fig 6- Post- facemask photographs

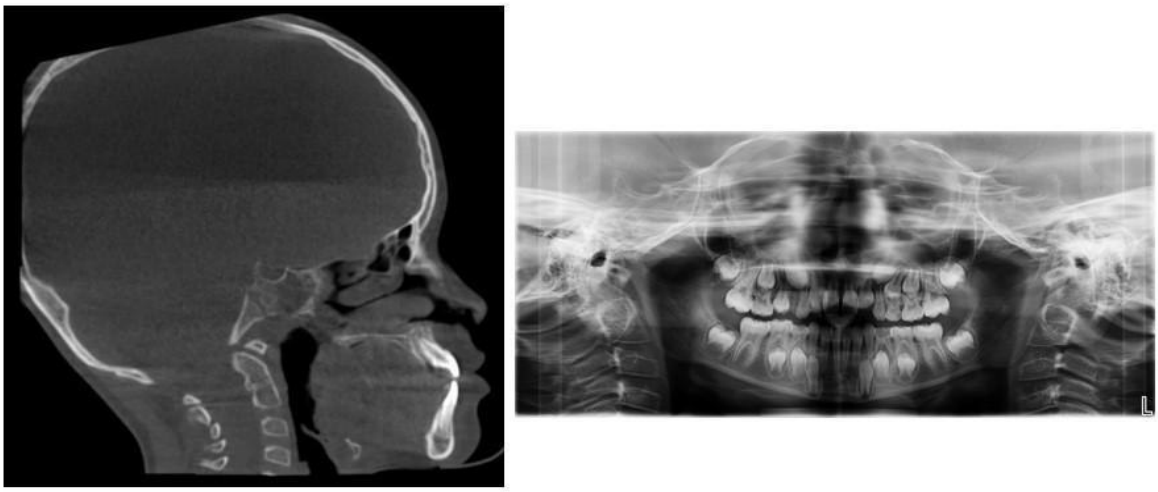

Fig 7- Post-facemask radiographs

On comparison of the patient's pre-treatment and post-treatment facial and intraoral photographs, improvement in the patient's profile was seen. The orthopaedic correction obtained with therapy was demonstrated by the post-treatment cephalometric radiographs.

2. RESULTS

The post-treatment photographs and cephalometric analysis indicate improvement in patient's profile. The SNA angle increased from 76° to 80°. The Wits appraisal improved to -1 mm. Reverse overjet was corrected and normal overjet and overbite was achieved. Super Class I molar relation was achieved from class III on the right side and from super Class I to Class I on the left side.

Table 2: Post-treatment Cephalometric analysis

Measurement	Mean	Post Rx	Inference
Steiner's Analysis			
SNA	82°	80°	Normal maxilla
SNB	80°	80°	Normal mandible
ANB	2°	0°	Class I skeletal pattern
Go-Gn to Sn	32°	25°	Horizontal growth pattern
U1 to NA angle	22°	35°	Proclined maxillary incisors
U1 to NA mm	4mm	4 mm	Average
L1 to NB angle	25°	22°	Average
L1 to NB mm	4mm	-1 mm	Backwardly placed mandibular incisors
Occlusal plane – SN	14°	9°	Horizontal growth pattern
L1 to NB mm	4mm	0 mm	Backwardly placed mandibular incisors
Tweed's Analysis			
FMA	25°	25°	Average
FMIA	65°	75°	Average
IMPA	90°	80°	Retroclined mandibular incisors
Wit's appraisal (post) BO is ahead of AO by **-1 mm. Class I skeletal pattern.**			
Rickett's Analysis			
Facial axis(Ba-Na to Pt-Gn)	90± 3.5°	94°	Average
Facial angle(N-pg to FH)	87± 3°	90°	Average
Mandibular plane angle	26± 4.5°	25°	Average
Convexity at Pt.A	2± 2mm	0 mm	Average
L1 to A – Pg	1± 2 mm	-2 mm	Retroclined lower incisors
U6 to Ptv	Age + 3 yrs	17 mm	Average
L1 inclination	22± 4°	25°	Average
Lower lip to E plane	-2 ±2 mm	3 mm	Average
McNamara's Analysis			
N perpendicular. – A	0 - 1mm	0 mm	Average
N perpendicular. to Pog	0-4 mm	2 mm	Average
Facial axis angle	0± 3.5°	4°	Average
Mand. Plane angle	22 ± 4°	23°	Average

Effective. Maxillary Length	85 ± 2.3 mm	79 mm	Reduced
Effective. Mandibular Length	106 ± 3.4 mm	104 mm	Average
Maxillomandibular differential	21.1 ± 2.7 mm	30 mm	Increased
Lower ant. Facial ht.	60 ± 2.9 mm	57 mm	Average
U1 to Pt. A	4-6 mm	7 mm	Proclined maxillary incisors
L1 to A- Pog	1-3mm	-1 mm	Retroclined mandibular incisors
Nasolabial angle	102 ± 8°	105°	Normal
Holdaway's Soft Tissue Analysis			
Facial angle	90± 3°	93°	Average
H line angle	7 – 15°	12°	Average
Upper sulcus depth	5 mm	4 mm	Average
Upper lip thickness	15 mm	15 mm	Average
Upper lip strain	2 mm	2 mm	Average
Lower lip to H line	-1 to +2mm	1 mm	Average
Lower sulcus depth	5 mm	4 mm	Average
Soft tissue chin thickness	10-12 mm	11 mm	Average

Notes- perp.- perpendicular, eff.- effective

3. DISCUSSION

Alternate rapid maxillary expansion and constriction is a modification on the conventional Rapid maxillary expansion. The use of the Alt-Ramec protocol prior to maxillary protraction is a successful approach for early treatment of Class III malocclusion.[6] Angle first published his classification of malocclusion in 1899 in which he described Class III as "the relation of the jaws was abnormal, all the lower teeth occluded mesial to the normal width of one bicuspid or even more in extreme cases".[7,8] In comparison to people of Asian or Middle Eastern ancestry, Class III malocclusions are seen less often in people of Northern European ancestry. The estimates of the malocclusion in these populations ranges from 0.8% to 4.2%11-13 with a slightly higher prevalence in men of Swedish descent which has been reported to be as high as 6%.[9] The prevalence of Class III malocclusion in the Chinese population has been estimated as high as 12%.[10,11] Studies with the reverse pull headgear without RME have revealed a noteworthy amount of forward movement of the maxilla. The primary benefits of palatal expansion include expansion of a narrow maxilla and loosening of circum maxillary sutures, which causes a downward and forward movement of the maxilla.[12,13] Studies in literature show that skeletal and soft tissue changes with Alt-RAMEC is better as compared to RME.[14-17] Both studies by Viera et al. [18] and Do-delatour et al. [19] reported more forward movement in the maxilla in the RME-treated group than most other studies. In 2010, Isci et al. [20] compared the dentofacial effects of the 4-week Alt-RAMEC protocol with the 1-week RME application in cases where maxillary protraction was needed. They reported that the amount of movement of A point (4.13 mm) in the Alt-RAMEC group was twice of that of RME group (2.33 mm). Masucci et al.[21] performed face mask therapy along with the 4-week Alt-RAMEC protocol for early treatment of Class III malocclusions and reported higher SNA and ANB angles and Wits values than face mask applied with normal RME. The Alt-RAMEC protocol was introduced by Liou in 2005.[22] It was created to open circumaxillary sutures without the drawbacks of maxillary overexpansion. Alt-RAMEC protocol mechanics is analogous to that of basic tooth extraction, wherein we continuously rock the tooth buccally and lingually until it is "disarticulated" out of the alveolar socket. The Alt-RAMEC protocol is performed with an expansion screw that is alternately opened and closed for 7 to 9 consecutive weeks. Following completion of this protocol, protraction force is applied to move the maxilla forward. This protraction force is usually applied using a reverse pull headgear.[23] Liou in his introductory article reported that the amount of maxillary protraction achieved with Alt-RAMEC is significantly more than RME. The advancement of point A with the Alt-RAMEC protocol is about 3 mm and 5.8 mm after protraction whereas it is 1.5-3 mm with RME + maxillary protraction. He explained the results with justification that Alt-RAMEC opened the circumaxillary sutures more extensively than RME.[22] In this case, the cephalometric radiographs show that there was significant protraction of the maxilla with respect to the cranial base. In the studies conducted by Merwin et. al.[24] and Kapust et. al.[25], there was significant forward movement of Point A in the Alt-RAMEC group. Wang et al.[26] corroborated similarly in 2009 by concluding that 5 weeks of Alt-RAMEC is more effective than 1 week of RME. They stated that sagittally running sutures were opened slightly more than coronally running sutures, regardless of whether they articulated directly or indirectly to the maxilla. It can be seen in this case that soft tissue changes associated with hard tissue changes after Alt-RAMEC protocol collectively contribute towards improvement of the soft tissue profile in skeletal Class III malocclusion.

4. CONCLUSION

Developing skeletal malocclusions may be corrected with growth correction procedures during the growth cycle. Use of Alternate rapid maxillary expansion and constriction protocol along with the facemask for maxillary protraction is an effective method for correction of skeletal Class III. The changes in maxillo-mandibular relations obtained with this protocol contribute towards improvement in the patient's profile.

5. AUTHOR CONTRIBUTION STATEMENT

Dr. Shilpa Pharande conceptualized and designed the study and Dr. Nandlal Toshniwal and Dr.Ravindra Manerikar helped her curate the data and prepare the original draft. Dr. Abhijit Misal and Dr. Kishor Chougule discussed the methodology and analyzed the data and provided valuable inputs. All authors read and approved the final version of the manuscript.

6. CONFLICT OF INTEREST

Conflict of interest declared none.

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