

Case Report

Assessment of immediate soft tissue changes after Alternate rapid maxillary expansion and constriction- A case report

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ABSTRACT:

Treating Class III malocclusion is a challenge for orthodontists. It is best to treat it at growing stage with dentofacial orthopedics. The Alt-RAMEC protocol was introduced by Liou in the year 2005. It allows for sutural mobilisation by opening and closing the RME screw for 7-9 weeks.

Maxillary protraction after the use of Alt-Ramec protocol is an efficient method for early treatment skeletal Class III malocclusion. This case report shows the results of the using hyrax bonded maxillary expander with Alt-RAMEC (Alternate Rapid Maxillary Expansion and Contraction) protocol to treat a maxillary hypoplasia Class III malocclusion. A 12-year-old patient with skeletal class III malocclusion with anterior and unilateral posterior crossbite was treated using this protocol. CBCT scans were taken before and after expansion. These CBCT scans were used for assessing and analysing the soft tissue changes that have occurred after using Alt-Ramec protocol. The objective of this study is to assess soft tissue changes after using Alt- RAMEC protocol.

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

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INTRODUCTION:

The clinicians face a dilemma while treating a Class III malocclusion. Dentofacial orthopaedic treatment, camouflage orthodontic treatment, and a combination orthognathic surgical and orthodontic approach are among the treatment options.^{1,2} Protraction face mask (PFM) therapy combined with rapid maxillary expansion (RME) is the most common approach for early treatment of these patients. The Alt-RAMEC protocol was introduced by Liou in 2005.³ It allows for sutural mobilisation by opening and closing the RME screw for 7-9 weeks without the need for excessive expansion. The Alt-RAMEC was created to open the

circumaxillary sutures without the drawbacks of maxillary overexpansion.^{4,5} In contrast to traditional RME, its implementation technique is to increase the frequency of rapid maxillary expansion by alternating rapid expansion and constriction for many times. The extent of anterior maxillary displacement was found to be two times greater with the Alt-RAMEC protocol than with the traditional RME protocol. With the widespread use of Cone Beam Computed Tomography (CBCT), as well as the implementation of soft tissue facial reconstruction through ProFace and precision in landmark establishment through Dolphin Imaging Software in orthodontics, there are further possibilities

for research into the impact of orthodontic treatment on soft tissues.⁶ The aim of the orthodontic treatment should be a well-balanced face along with balanced occlusion. The limitations of orthodontic treatment are largely determined by soft tissues in terms of function and stability as well as aesthetics and hence the orthodontists should plan the treatment keeping the limits of soft tissue adaptation and soft tissue profile of the patient in mind.⁷ The purpose of this case report is to evaluate and analyse the soft tissue changes immediately after Alternate rapid maxillary expansion and constriction.

CASE HISTORY

The patient, an adolescent boy, age 13 years, came to Sinhgad Dental College, Department of Orthodontics with a complaint of backwardly placed upper teeth, an un-aesthetic dental and facial appearance. Patient also had anterior cross-bite in addition to unilateral posterior cross-bite of both sides. The patient had Class III malocclusion associated with maxillary retrusion.

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.



Figure 1- Pre-treatment photographs

Each 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.

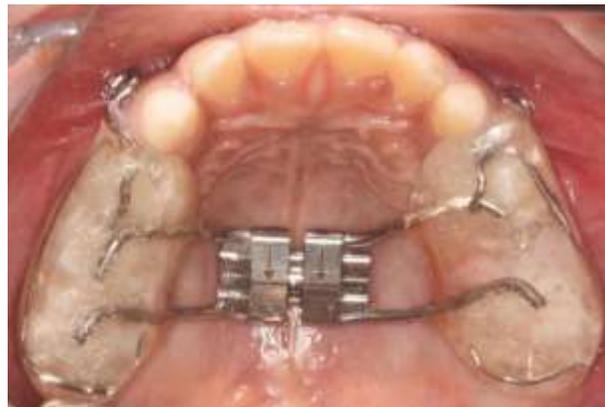


Figure 2- Rapid maxillary expander delivered

The maxilla was expanded and contracted alternating weeks by 4 one quarter turns per day (1 mm) and this was continued for 9 weeks ending with expansion.



Figure 3- Pre-treatment photographs

Two images with ProFace of each patient was taken, one prior to the delivery of the appliance and one immediately following rapid maxillary expansion using Alt-RAMEC protocol. Each data set (DICOM format) was imported to Dolphin Imaging Software. Dolphin 3D software is a powerful tool that makes processing 3D data extremely simple. Planmeca ProFace® is a unique way to produce a realistic 3D face photo and a CBCT image with a single scan and can also be taken independently of the CBCT scan thereby causing no radiation exposure. The image was oriented along the mid-sagittal plane (z plane), Frankfort's horizontal plane (x plane) and a coronal plane (y plane) extending through the anterior wall of the right and left external meatus. Placement of landmarks was accomplished using Dolphin Imaging software. This allowed for the points to be defined three-dimensionally using x, y, z Cartesian coordinate system based on the three planes of orientation. A series of 20 landmarks were placed on each pre- and post-treatment scan and their three-dimensional changes were determined by their x, y and z co-ordinates.

Table I: Definition of anatomical landmarks used in the study.

Landmark	Definition	Measured plane
Exocanthion (Ex)	Lateral commissure of the eye, Bilaterally recorded	X
Endocanthion(En)	Medial commissure of the eye, bilaterally recorded	X
Apex(AN) of nose	Soft tissue over the junction of the nasomaxillary suture and nasofrontal suture, recorded bilaterally	X
Soft tissue nasion(Na)	Point of intersection between the sella- nasion line and the soft tissue profile	Z
Soft tissue zygion (Zy)	Soft tissue over most lateral point of the zygomatic arch, point determined from frontal view, recorded bilaterally	X
Bridge(BN) of Nose	Soft tissue on mid-sagittal plane over the tip of the nasal bone, extended parallel to FH plane	Z
Soft tissue over infraorbital foramen (INF)	On frontal view located the superior anterior extent of the infraorbital foramen, landmark placed on soft tissue over that point, extended parallel to FH plane, recorded bilaterally	X, Z
Alar base (AB)	Viewed frontal and inferiorly where nasal ala meets face on the inferior border of nose, recorded bilaterally	X
Nose tip (NT)	Most anterior point of the nose recorded on the mid-sagittal plane	Z
Subnasale (Sn)	Point at which the nasal septum merges, in the mid-sagittal plane, with the upper lip	Z
Lower midface(LMF)	Soft tissue over the center of the upper first molar crown, extending perpendicular from the mesio-distal plane of the crown, Bilaterally	X
Lip commissure(LC)	Point of union of the upper and lower lip, recorded bilaterally	X
Stomion (St)	Median point of the mouth when the mouth is closed	

Footnotes:

EX- Exocanthion, EN- Endocanthion, AN- Apex of nose, Na- Soft tissue nasion, Zy- Soft tissue zygion, BN- Bridge of Nose, INF- Soft tissue over infraorbital foramen, AB- Alar base, NT- Nose tip, Sn- Subnasale, LMF- Lower midface, LC- Lip commissure, St- Stomion.

All of these measures were made using Planmeca Romexis, 4.3.0.R and Romex 3D mid-hardware with ProFace. (Figure 4,5,6,7,8,9).

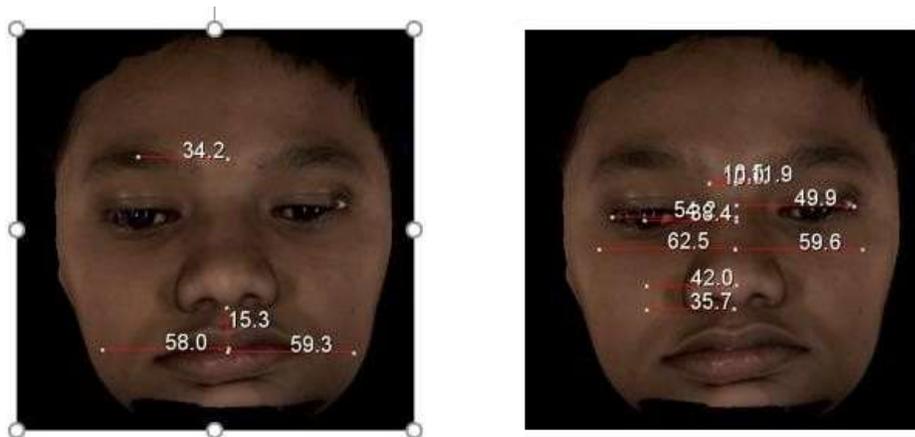


Figure 4- Measurement of transverse landmarks in pre-treatment scan. Right/Left AN, Right/Left Ex, Right/Left Inf and Right/Left LMF, Right/Left AB, Right/Left En and Right/Left Inf, Right/Left Zy) and vertical distance between Subnasale (Sn) and Stomion (St).

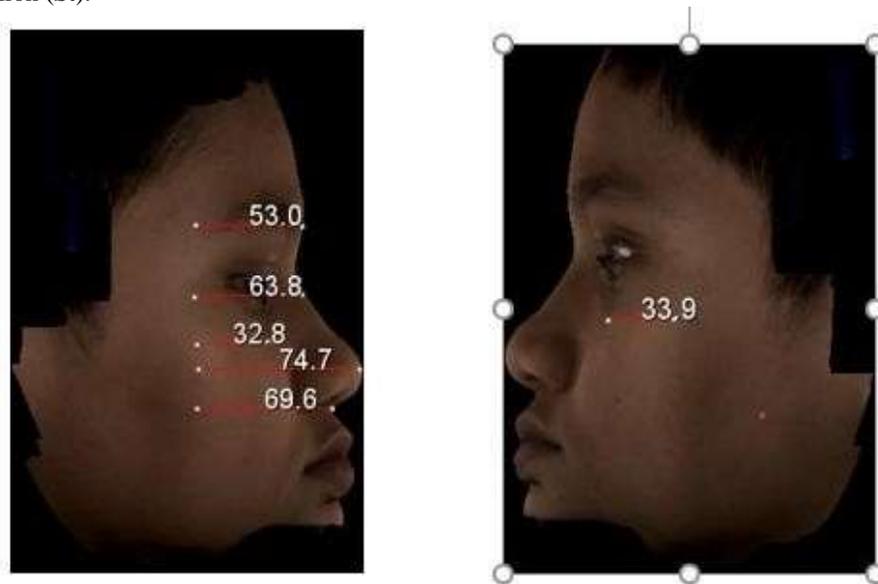


Figure 5- Measurement of anteroposterior landmarks in pre-treatment scan. Na, BN, NT, RightInf, Sn and Left Inf.

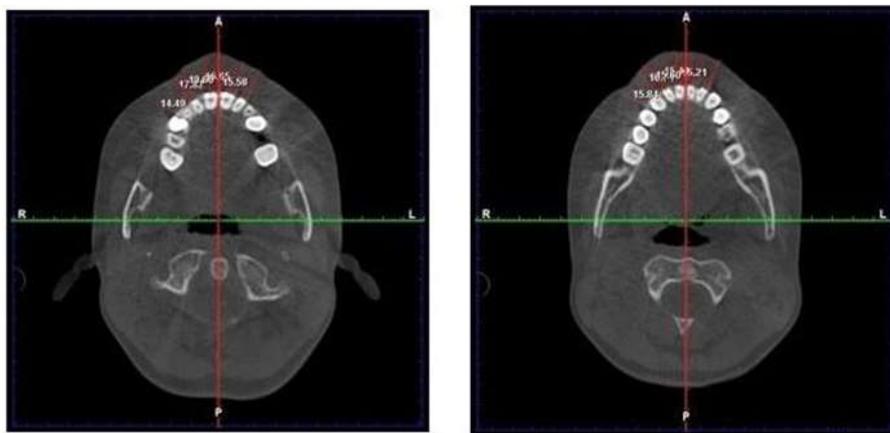


Figure 6- Measurement of upper and lower lip thickness in pre-treatment scan- 1) mid-sagittal 2)left central incisor 3) left lateral incisor 4) right central incisor 5) right lateral incisor

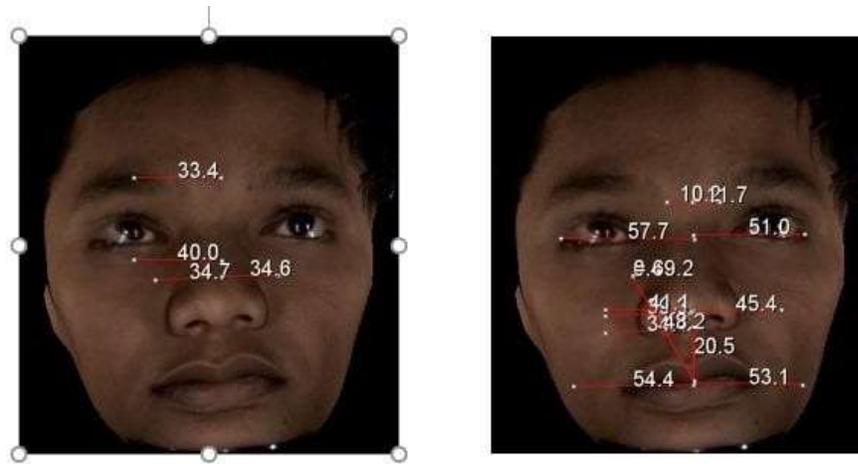


Figure 7- Measurement of transverse landmarks in post-treatment scan. Right/Left AN, Right/Left Ex, Right/Left Inf and Right/Left LMF, Right/Left AB, Right/Left En and Right/LeftInf, Right/Left Zy) and vertical distance between Subnasale (Sn) and Stomion (St).

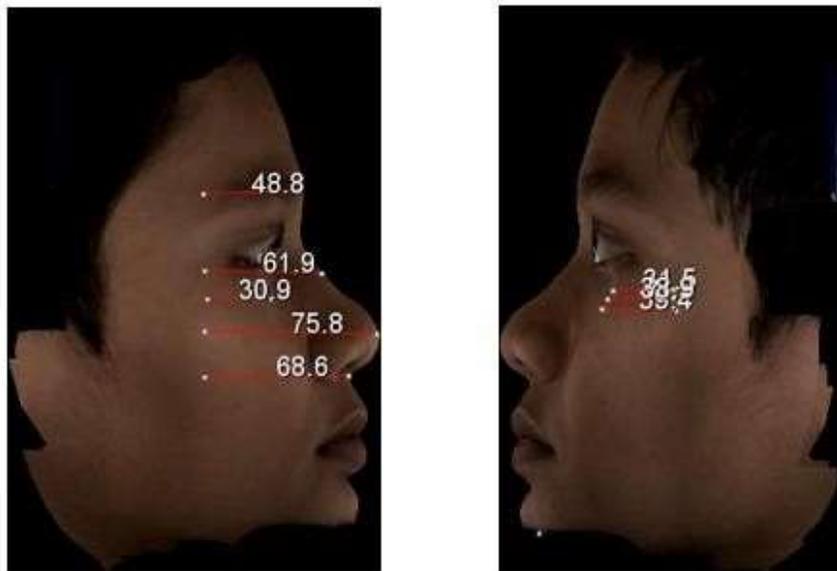


Figure 8- Measurement of anteroposterior landmarks in post-treatment scan. Na, BN, NT, RightInf, Sn and Left Inf.

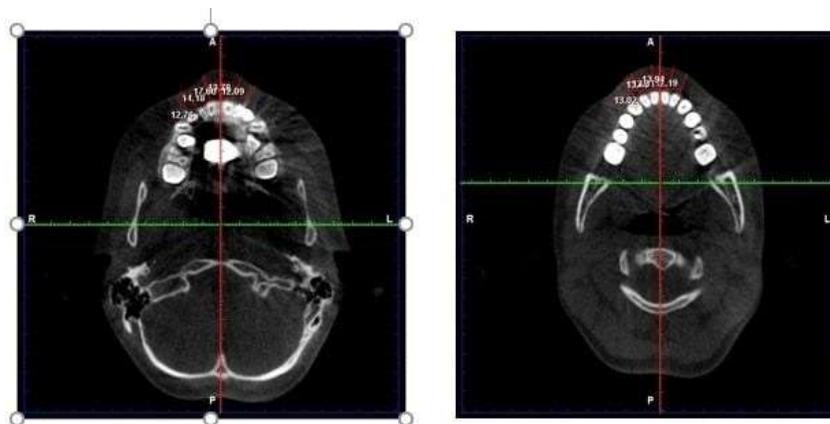


Figure 9- Measurement of upper and lower lip thickness in post-treatment scan- 1) mid-sagittal 2) left central incisor 3) left lateral incisor 4) right central incisor 5) right lateral incisor.

To detect changes in the transverse plane, the x co-ordinate values were used, using the mid-sagittal plane as a reference. To measure antero-posterior changes, the z co-ordinate values were used, and the standardization was done using grid lines. In addition to the landmarks, 10 direct measures were made between two defined points. These measures show the change in distance between two points without regard to the direction of change. All but one of these measures was made using a two-dimensional axial image generated from a three-dimensional CBCT image.

These axial images were created parallel to the Frankfort horizontal plane at the level of the centres of the crowns of the incisors in the mandible and the maxilla. They were used to measure changes in the thickness of the upper and lower lips. Five measures were made on the upper lip; one measure at the mid-sagittal, and one over each of the four maxillary incisors. This measurement was taken by determining the mesio-distal axis of each tooth and constructing a perpendicular bisector from the tooth outwardly to a point on the soft tissues. There were four similar measures taken on the lower lip one over each mandibular incisor. The tenth measurement, Subnasale to Stomion (Sn-St) was taken on the frontal view of the ProFace scan. All of the measurements were recorded in millimetres (mm).

The change was then averaged for five measures on the upper lip and the four measures on the lower lip to describe the average change in the thickness of each lip. A comparison of the pre Alt-Ramec and immediately post Alt-Ramec phase landmarks were undertaken to assess the soft tissue changes. After 9 weeks of Alt-Ramec protocol, the patients were given a protraction facemask for protracting the maxilla and restraining the mandible.

Table II - Pre-treatment and Post-treatment measurements prior to and on completion of Alt-RAMEC protocol.

Landmarks	Pre-treatment value (in mm)	Immediate post Alt-Ramec value (in mm)
Right En	22	24.4
Right Ex	54.2	55.7
Left En	20.4	21.1
Left Ex	49.9	51
Right LC	28.5	31
Left LC	29.8	30.4
Right AB	25.4	26.3
Left AB	22	22.8
Na	74.7	75
BN	62.9	63.8
Sn	68.6	69.6
Right AN	10	10.2
Left AN	11.7	11.9
Right Inf (Transverse)	33	34.7
Right Inf (Antero-posterior)	49.8	51.5
Left Inf (Transverse)	32.1	33.6
Left Inf (Antero-posterior)	61.9	63.8
NT	74.7	75.8
Right LMF	57.4	58
Left LMF	58.4	59.3
Right Zy	62.5	63.2
Left Zy	59.6	60.2
Sn to St	15.3	16.1
Mid Sagittal (U)	19.6	18.6
Left C.I (U)	16.65	15.78
Left L.I (U)	13.58	12.09
Right C.I (U)	17.82	16.81
Right L.I (U)	14.49	12.76

Footnotes:

EX- Exocanthion, EN- Endocanthion, AN- Apex of nose, Na- Soft tissue nasion, Zy- Soft tissue zygion, BN- Bridge of Nose, INF- Soft tissue over infraorbital foramen, AB- Alar base, NT- Nosetip, Sn- Subnasale, LMF- Lower midface, LC- Lip commissure, St- Stomion.

Transverse changes were assessed in pre-treatment and post-treatment CBCT scans and distance of landmarks from mid-sagittal plane was measured on both right and left sides.

The distance of various points like En, Ex, LC, AB, AN, INF, LMF, ZY from mid-sagittal plane increases after expansion, indicating that there was transverse increase with respect to both the eye points, both the commissures, nasal base, apex of the nose, soft tissues over the infraorbital foramina, lower midface, zygoma.

Anteroposterior changes were assessed in pre-treatment and post-treatment CBCT scans and distance of landmarks from Frankfort's horizontal plane was measured from both right and left sides.

The distance of various points like Inf, BN, NT, Sn, from Frankfort's horizontal plane increases after expansion, indicating that there was anterior movement of infraorbital foramina, bridge of nose, nose tip, subnasale after using Alt-Ramec protocol.

The vertical distance in millimetres measured from Sn-St increased after Alt-Ramec indicates that the vertical increase in the length of the lips.

There was a decrease in upper and lower lips thickness.

DISCUSSION

The changes associated with Alt-Ramec in hard tissue structures have been described by several authors. But some noted that soft tissue changes do not always follow changes in the underlying hard tissue. So there was a need for studying the soft tissue changes associated with Alt-Ramec.

Points associated with the eyes, nose, soft tissue zygoma, lower midface, soft tissue over infraorbital foramen, lip commissure moved away from the mid-sagittal plane. This indicated that transverse increase in soft tissue profile was consistent with increased transverse dimension of maxilla.

Wang et al.⁸ studied the effects of both RME and Alt-RAMEC on the opening of circumaxillary sutures and observed that Alt-RAMEC opens these sutures more extensively than RME. This explains the increase in the widths of the landmarks associated with eye and zygoma.

The apex's width of the nose and the width of the alar base of the nose increased significantly. These findings were consistent with findings of Yilmaz BS and Kucukkeles N⁹ who carried out a study to evaluate skeletal, soft tissue and airway changes following Alt-RAMEC protocol. In this study, significant soft tissue changes were seen related only to nasal width.

All the landmarks on the mid-sagittal plane- soft tissue nasion, tip and bridge of nose, soft tissue infraorbital foramen, subnasale, lip commissure showed anterior movement. This in contradiction to study by Yilmaz BS and Kucukkeles N⁹ which shows no significant changes in anteroposterior landmarks.

The vertical length of the upper lip also increased.

Berger et al. did similar study¹⁰ in which it was reported a mean increase of 1.0 mm immediately following activation phase of expansion.

The thickness of both the upper and lower lips decreased significantly. This change most likely resonates with the effect of transverse expansion and stretching of the oral soft tissues.

CONCLUSION

Orthodontic treatment aims to enhance the esthetics and correct the occlusion.

Because the soft tissues largely determine the limitations of orthodontic treatment, from the perspectives of function and stability, as well as esthetics, the orthodontist must plan treatment considering soft tissue changes.

Changes in facial soft tissues caused by dental and skeletal movements determine the effectiveness of orthodontic tooth movement. To predict orthodontic success in such cases, it is important to be aware of the potential changes that different orthodontic treatments can cause.

The measurements taken in this case report shows that there is widening and anterior movement of the soft tissue structures which is in relation to the increase in dimensions of maxilla. All those changes collectively contribute towards improvement of the soft tissue profile in skeletal Class III malocclusion. There is further need for studies assessing soft tissue changes after Alt-Ramec protocol and correlating it with soft tissue changes.

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Authorship contribution:

1. Dr. Shilpa Pharande contributed in design, definition of intellectual content, literature search, clinical studies, data acquisition, data analysis, manuscript preparation, manuscript editing and manuscript review.
2. Dr. Sheetal Potnis contributed in design, definition of intellectual content, literature search, clinical studies, data acquisition, data analysis, manuscript preparation, manuscript editing and manuscript review.
3. Dr. N.G. Toshniwal contributed in design, definition of intellectual content, literature search, clinical studies and manuscript review.
4. Dr. Swetha Rangunathan contributed in design, definition of intellectual content, literature search, clinical studies, data acquisition and data analysis.
5. Dr. Sanjana Shetty contributed in data acquisition, data analysis, manuscript preparation, manuscript editing.