

# Correction of Class III Malocclusion in Late Adolescent Patient with Hyrax Appliance and Facemask Using Alt-RAMEC Protocol: A Case Report

KHYATI GUPTA<sup>1</sup>, RAHUL MUCHHADIA<sup>2</sup>, PIYUSH GUPTA<sup>3</sup>, PRIYANKA NIRANJANE<sup>4</sup>

## ABSTRACT

Class III malocclusion is always a challenging treatment and has been the subject of interest in many investigations due to the challenges it poses. It can be caused by maxillary retrognathism, mandibular prognathism, or a combination of the two. In around 40% of Class III patients, the cause is maxillary retrognathia. The condition can be treated either by camouflage or by surgery to correct the skeletal disharmony. However, camouflage treatment doesn't result in a drastic change to the facial profile when it involves skeletal disharmony and may recur after treatment is completed. To increase the stability of this treatment, the patient's growth and age phase are decisive factors. In young children, the circumaxillary sutures are patent, and protraction of the maxilla can be aided by opening these sutures with orthopaedic force. Protraction appliances like face masks are used to support the growth of a deficient maxilla in cases of maxillary retrognathism. The current case report of a 13-year-six-month-old male presented the correction of class III skeletal malocclusion with an anterior crossbite in a growing patient using the "Alternate Rapid Maxillary Expansion and Constriction (Alt-RAMEC) protocol" and face-mask treatment with the Hyrax appliance. Skeletal class III can be due to mandibular excess, maxillary deficiency, or a combination of both. The treatment time was 18 months, and a notable improvement was observed in the soft tissue profile when assessed through cephalometric measurements and photographs.

**Keywords:** Alternate rapid maxillary expansion and constriction, Growing patient, Non surgical, Petit-facemask, Skeletal class III

## CASE REPORT

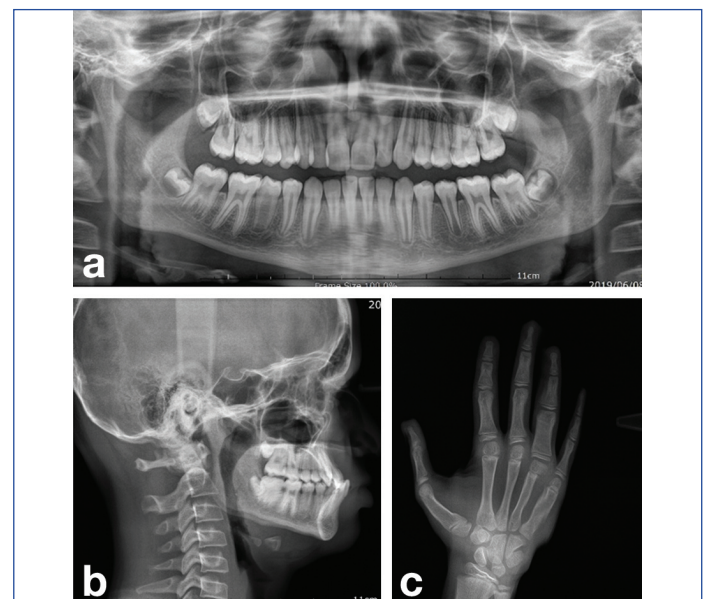
### Diagnosis and Aetiology

A 13-year-six-month-old male presented to the Department of Orthodontics and Dentofacial Orthopaedics with a chief complaint of a forwardly placed lower jaw. Upon clinical examination, he exhibited a concave facial profile, everted lower lip, acute nasolabial angle, and a retrusive maxilla [Table/Fig-1]. Intraorally, he displayed Angle's class I molar relation and Class III canine relation with an anterior crossbite and a palatally blocked-out right lateral incisor, with no significant crowding in the mandibular arch. During functional examination, the patient exhibited laterocclusion, and there was a Centric occlusion- Centric relation (CoCr) discrepancy of 3 mm.



[Table/Fig-1]: Pretreatment extraoral and intraoral photographs.

Cephalometric readings indicated sagittally a skeletal Class III malocclusion (SNA angle-  $74^\circ$ , ANB-  $-8^\circ$ ) with a retrusive maxilla (N perpendicular to Point A- 6.5) and a counterclockwise rotation of the mandible {Mandibular plane angle Frankfort Mandibular Plane Angle (FMFA)-  $11^\circ$ , (Go-Gn) to (Sn)-  $24^\circ$ }. The lower incisors were retroclined {(Lower incisor) to Gonion-Menton angle Incisor Mandibular Plane Angle (IMPA),  $85^\circ$ }, and the maxillary incisors were proclined {upper incisor (U1) to (Nasal plane),  $7/34^\circ$ } [Table/Fig-2a-c,3]. It was noted that the patient's father also had mandibular prognathism.



[Table/Fig-2]: Pretreatment (a) Orthopantomography (OPG), (b) Lateral cephalogram, (c) Handwrist radiograph showed patient was growing, 25-65% growth remained.

Parameters	Norm	Value	Inference
<b>SKELETAL</b>			
<b>Sagittal relation</b>			
SNA (°) (Tr-N'-Sn')	82°	74°	Retrognathic maxilla
SNB (°)	80°	82°	
ANB (°)	2°	-8°	Skeletal class III malocclusion
N perpendicular to A (°)	0+2 mm	-6.5 mm	Retrusive maxilla
N perpendicular to pogonion (pog) (mm)	0-1 mm	-2 mm	
Beta angle (°)	27-35°	39°	Skeletal class III malocclusion
Effective maxillary length (mm)		70	
Effective mandibular length (mm)		88	
<b>Vertical relation</b>			
GO-GN to SN (°)	32°	24°	
FMPA (°)	25°	11°	Counter clockwise rotation of mandible
Jaraback ratio (°)	62-65°	76°	
Bjork sum (°)	396°	380°	
Saddle angle (°)	123+5°	124°	
Gonial angle (°)	128°	123°	
Articulating angle (°)	143+6°	133°	
Y axis (°)	66°	73°	
<b>DENTAL</b>			
U1-NA (°)	4 mm/22°	7 mm/34°	Proclined upper incisor
L1-NB (°)	4 mm/25°	5 mm/25°	
IMPA (°)	90°	85°	
U1-L1 (°)	130°	151°	Increased inter incisor angle
U1 to SN (°)	102°	114°	
L1 to NB angle (°)	25°	20°	
L1 to A-pog (mm)	1-2 mm	9 mm	
<b>Soft-tissue</b>			
S line to Upper lip (mm)	-2	-2	
S line to lower lip (mm)	0	4	
Nasolabial angle (°)	90 -100	60	

**[Table/Fig-3]:** Pretreatment cephalometric analysis.

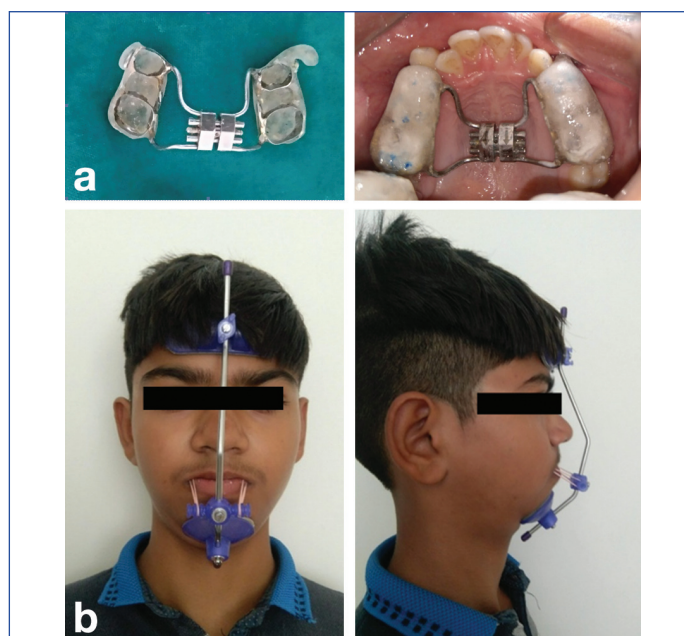
SNA: Sella-nasion-A point; SNB: Sella-nasion-B point; ANB: A point-nasion-B point; SN: Sella-nasion; GoGn: Gonion-gnathion; FMA: Gonion-menton to Frankfort horizontal plane; U1-SN: Upper incisor to sella-nasion; IMPA: Lower incisor to gonion-menton; U1-E: Upper lip to E line; L1-E: Lower lip to E line

### Treatment Options

As the patient was at a growing age, two treatment options were presented to him. The first plan involved using functional appliances like reverse twin blocks, while the second plan included face-masks with the Hyrax appliance and the Alt-RAMEC protocol. Maxillary protraction with face masks and reverse twin blocks {Petit Face Mask (PFM) and Reverse Twin Block (RTB)} is particularly effective for early treatment of Class III malocclusion with maxillary deficiency. Face masks can also be beneficial when used in conjunction with orthognathic surgery for certain cases. In instances where treatment focuses solely on mandibular growth control, relapses are more common, highlighting the importance of comprehensive consideration of both maxillary and mandibular growth patterns [1]. The patient opted for the second plan for his treatment, and thus, the treatment commenced with a banded and bonded type of Hyrax appliance.

### Treatment Progress

The Rapid Maxillary Expansion (RME) Hyrax appliance with a 1 mm thickness of acrylic coverage on the posterior teeth was cemented. It had a soldered stainless steel wire on the buccal side, forming



**[Table/Fig-4]:** (a) Hyrax appliance with 1 mm acrylic; (b) Petit-facemask.

a J hook in the canine region [Table/Fig-4]. Before commencing the protraction of the maxilla, the Alt-RAMEC protocol was utilised to open the screw. The patient and his parents were instructed to open the screw (Leone, Italy) a couple of times a day for one week, followed by closing it for the subsequent week with the same protocol (0.50 mm per day). This alternating opening and closing protocol was repeated for six consecutive weeks. By the seventh week, the screw opening was discontinued as expansion was no longer required for the maxillary arch. After two weeks of consecutive opening and closing the screw, the Petit-facemask was introduced.

During the seventh week, the screw was adjusted for a week, and a Petit-type facemask was applied with a force of around 500 gm on both sides, directed anteroinferiorly at an angle of approximately 30° to the occlusal plane from the I-shaped miniplate hooks. Monthly evaluations were conducted, with the patient instructed to wear the appliances for a minimum of 20 hours daily until achieving a 2 mm positive overjet. The protraction treatment spanned 6 months, starting at 350 gm with three pink elastics on each side and gradually increasing to 500 gm. The daily wearing time was 12-14 hours over the 6 month period [2]. Subsequently, fixed orthodontic mechanotherapy was initiated using the McLaughlin, Bennett, and Trevisi bracket system (MBT) with a 0.022 \* 0.028 slot bracket for alignment. For retention, a Trans palatal arch with nighttime passive facemask wear was provided during the fixed orthodontic treatment. The overall treatment duration was 18 months before debonding. Post-treatment retention involved a planned removable wrap-around retainer for the maxillary arch for one year.

**Treatment outcome:** The post-treatment extraoral and intraoral photographs [Table/Fig-5] demonstrated improvement in the patient's facial profile following maxillary protraction. His upper and lower arch midlines were coincident with the facial midline. The post-treatment cephalometric analysis [Table/Fig-6,7] revealed excellent changes achieved through treatment. Protraction of the maxilla occurred (SNA-82), the upper and lower incisors were uprighted, and the FMA angle increased to 23°, indicating clockwise rotation of the mandible. A comparison of pre- and post-treatment changes [Table/Fig-8] that were achieved was also shown.

### DISCUSSION

The treatment of Class III malocclusion has been extensively studied, with various approaches proposed. The Alt-RAMEC protocol is one such approach that has shown effectiveness in correcting Class III malocclusion. Liou EJ suggested that Alt-RAMEC can provide more extensive opening of the circummaxillary sutures than traditional RME,

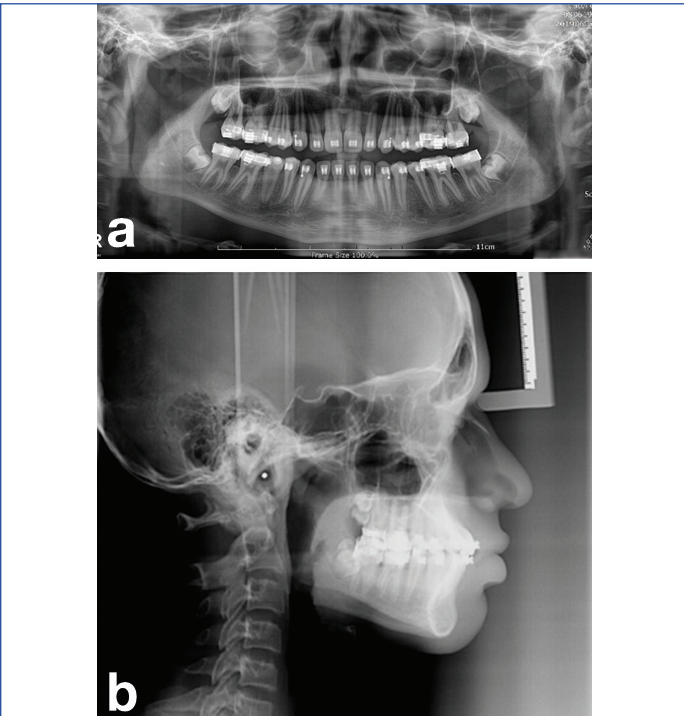




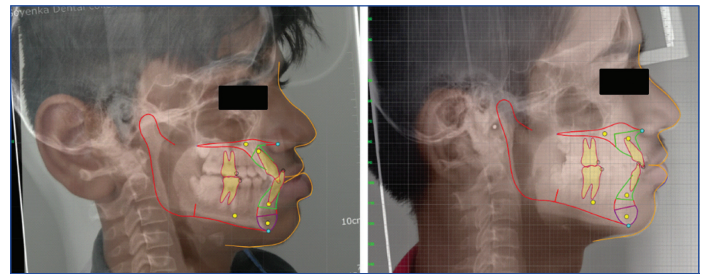
**[Table/Fig-5]:** Extraoral and intraoral photographs after alignment.

Saddle angle (°)	123+/-5°	124°	125
Gonial angle (°)	128°	123°	113
Articulating angle (°)	143+/-6°	133°	145
Y axis (°)	66°	73°	60
<b>DENTAL</b>			
U1-NA (°)	4 mm/22°	7 mm/34°	4/28
L1-NB (°)	4 mm/25°	5 mm/25°	5/25
IMPA (°)	90°	85°	93
U1-L1 (°)	130°	151°	131
U1 to SN (°)	102°	114°	107
L1 to NB angle (°)	25°	20°	27
L1 to A-pog (mm)	1-2 mm	9 mm	1
<b>Soft-tissue</b>			
S line to Upper lip (mm)	-2	-2	2
S line to lower lip (mm)	0	4	1
Nasolabial angle (°)	90 -100	60	93

**[Table/Fig-7]:** Comparison of pretreatment and post-treatment cephalometric analysis.



**[Table/Fig-6]:** Post-treatment: (a) OPG; and (b) Lateral cephalometry.



**[Table/Fig-8]:** Cephalometric comparison of pre- and post-treatment: (a) Pretreatment; (b) Post treatment.

particularly in a shorter period of five weeks, as shown in an animal study. Additionally, Alt-RAMEC has shown promising results in cleft palate patients when used in combination with intraoral protraction springs, resulting in notable anterior movement of Point A [3,4].

Castrillón-Marín RA et al., reported a successful case of a Latin-American patient with Class III malocclusion treated using a combination of the Hybrid Hyrax, Face Mask, and Alt-RAMEC protocol. Similarly, Chaturvedi S et al., reported successful treatment of a Class III patient using the Alt-RAMEC protocol and facemask therapy [5,6].

Ganesh G et al. presented a case report of an adolescent with Class III malocclusion treated using a combination of orthopaedic and orthodontic treatment with Hyrax, Class III elastics on mandible miniplates, and maxillary mini-implants. Park JH et al., reported successful use of camouflage orthodontic treatment in adult skeletal Class III correction [7,8].

Büyükcavus MH conducted a comprehensive literature review of the Alt-RAMEC protocol and reported that it is an effective protocol in the treatment of Class III malocclusion. Pithon MM et al., conducted a systematic review of the literature and reported that the Alt-RAMEC protocol is effective in the treatment of Class III malocclusion, with significant improvements in both skeletal and dental relationships [9,10].

A comparison between RME with facemask (FM) groups and Alt-RAMEC with FM groups revealed that Alt-RAMEC led to increased SNA angles, anterior displacement of Point A, and reduced ANB angles. Additionally, the treatment duration was shorter, and the effects were considered more significant [11,12]. To mitigate issues related to molar eruption during maxillary expansion, a bonded expansion appliance was employed in some cases because it minimises molar eruption while providing splinting support and occlusal control [13]. Compliance and growth potential remain crucial factors influencing the success or failure of orthopaedic treatments for children with skeletal Class III malocclusions.

Parameters	Norm	Pretreatment value	Post-treatment value
<b>SKELETAL</b>			
<b>Sagittal relation</b>			
SNA (°)	82°	74°	82
SNB (°)	80°	82°	81
ANB (°)	2°	-8°	1
N perpendicular to A (°)	0+/-2 mm	-6.5 mm	0
N perpendicular to pog (mm)	0-1 mm	-2 mm	0
Beta angle (°)	27-35°	39°	33
Effective maxillary length (mm)		70	76
Effective mandibular length (mm)		88	94
<b>Vertical relation</b>			
GO-GN to SN (°)	32°	24°	29
FMPA (°)	25°	11°	23
Jaraback ratio (°)	62-65°	76°	63
Bjork Sum (°)	396°	380°	394

Mehta F et al., supported by the study they conducted, stated that the notable improvement observed in Class III malocclusion after adopting Alt-RAMEC is likely attributed to the loosening of the maxillary sutures over the initial months of treatment [14].

## CONCLUSION(S)

In conclusion, the Alt-RAMEC protocol has been shown to be an effective treatment option for Class III malocclusion. The protocol can be used in combination with other appliances, such as the hybrid hyrax and face mask, to provide adequate anchorage and expansion of the maxilla. The literature suggests that the Alt-RAMEC protocol is effective in both skeletal and dental Class III malocclusion, with significant improvements in both skeletal and dental relationships. This treatment result required the patient's co-operation. Prospective studies with a large sample size (N) should be conducted in the future to support these findings. In the post-growth stage, this method may be an alternative to orthognathic surgery.

## REFERENCES

- [1] Azamian Z, Shirban F. Treatment options for class III malocclusion in growing patients with emphasis on maxillary protraction. *Scientifica*. 2016;2016:8105163.
- [2] Büyükçavuş MH, Sari ÖF, Findik Y. Correction of late adolescent skeletal Class III using the Alt-RAMEC protocol and skeletal anchorage. *Korean Journal of Orthodontics*. 2023;53(1):54-64. Available from: <https://doi.org/10.4041/kjod21.337>.
- [3] Liou EJ. Toothborne orthopaedic maxillary protraction in Class III patients. *J. Clin. Orthod*. 2005;39(2):68-75.
- [4] Liou EJ, Tsai WC. A new protocol for maxillary protraction in cleft patients: Repetitive weekly protocol of alternate rapid maxillary expansions and constrictions. *Cleft Palate Craniofac J*. 2005;42(2):121-27.
- [5] Castrillón-Marin RA, Barbosa-Liz DM, Ardila CM. Treatment of Class III malocclusion using hybrid hyrax, face mask and Alt-RAMEC protocol: A case report in a Latin-American patient. *J Clin Exp Dent*. 2019;11(7):e665-e669. Available from: <https://doi.org/10.4317/jced.55939>
- [6] Chaturvedi S, Deshwal L, Phadnis P, Kamath P, Agarwal A. Nonsurgical treatment of a class III patient with alt-RAMEC protocol and facemask therapy. *J Indian Orthod Soc*. [Internet]. 2013;47:159-62. Available from: <http://dx.doi.org/10.5005/jp-journals-10021-1149>.
- [7] Ganesh G, Tripathi T, Rai P. Orthopaedic and orthodontic treatment with hyrax, Class III elastics on mandibular miniplates, maxillary mini-implants in a Class III adolescent: A case report. *Int Orthod*. 2020;18(4):827-38. Doi: 10.1016/j.ortho.2020.06.001.
- [8] Park JH, Emamy M, Lee SH. Adult skeletal Class III correction with camouflage orthodontic treatment. *Am J Orthod Dentofacial Orthop*. 2019;156(6):858-69. Doi: 10.1016/j.ajodo.2018.07.029.
- [9] Büyükçavuş MH. Alternate Rapid Maxillary Expansion and Constriction (Alt-RAMEC) protocol: A comprehensive literature review. *Turk J Orthod*. 2019;32(1):47-51.
- [10] Pithon MM, Santos NL, Santos CR, Baião FC, Pinheiro MC, Matos M Neto, et al. Is alternate rapid maxillary expansion and constriction an effective protocol in the treatment of Class III malocclusion? A systematic review. *Dental Press J Orthod*. 2016;21(6):34-42.
- [11] Saito I, Yamaki M, Hanada K. Nonsurgical treatment of adult open bite using edgewise appliance combined with high-pull headgear and Class III elastics. *The Angle Orthodontist*. 2005;75(2):277-83.
- [12] Isci D, Turk T, Elekdag-Turk S. Activation–deactivation rapid palatal expansion and reverse headgear in class III cases. *Eur. J. Orthod*. 2010;32(6):706-15.
- [13] Sarver DM, Johnston MW. Skeletal changes in vertical and anterior displacement of the maxilla with bonded rapid palatal expansion appliances. *Am J Orthod Dentofacial Orthop*. 1989;95(6):462-66.
- [14] Mehta F, Mehta S, Agrawal M. Early correction of Class III malocclusion with alternate rapid maxillary expansion and constriction (Alt-RAMEC) and face mask therapy. *J Govern Dent Coll Hosp*. 2014;1(1):51-59.

### PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Orthodontics and Dentofacial Orthopaedics, Sharad Pawar Dental College, DMIHER, Sawangi, Wardha, Maharashtra, India.
2. Head and Professor, Department of Orthodontics and Dentofacial Orthopaedics, Goenka Research Institute of Dental Science, Ahmedabad, Gujarat, India.
3. Assistant Professor, Department of Endodontics and Conservative Dentistry, Bhabah Dental College, Bhopal, Wardha, Maharashtra, India.
4. Associate Professor, Department of Orthodontics and Dentofacial Orthopaedics, Sharad Pawar Dental College, DMIHER, Sawangi, Wardha, Maharashtra, India.

### NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Khyati Gupta,  
Roots Dental Care, Near Datta Mandir, Mahadevpura,  
Wardha-442001, Maharashtra, India.  
E-mail: khyatigupta196.kg@gmail.com

### PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Dec 30, 2023
- Manual Googling: Feb 26, 2024
- iThenticate Software: Apr 22, 2024 (21%)

### ETYMOLOGY: Author Origin

EMENDATIONS: 7

### AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: Dec 29, 2023

Date of Peer Review: Feb 23, 2024

Date of Acceptance: Apr 23, 2024

Date of Publishing: Jul 01, 2024