

รายงานผู้ป่วย

รายงานการรักษาการสบฟันของโครงสร้างขากรรไกรแบบที่ 3 ในผู้ป่วยชุดฟันแท้
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Management of Skeletal Class III Malocclusion in Permanent Dentition: A Case Report

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Abstract

Skeletal Class III malocclusion, particularly in late-diagnosed patients, presents challenges in achieving optimal facial aesthetics and function. This case report described the successful orthodontic treatment of a young female patient with this condition. The patient presented with an anterior crossbite, deep overbite, and a concave facial profile. Cephalometric analysis confirmed a skeletal Class III pattern due to a retrognathic maxilla. Treatment employed the Alt-RAMEC protocol for four weeks, followed by protraction facemask therapy and fixed appliance mechanics to achieve proper tooth alignment and occlusion. Treatment resulted in significant improvement in the maxilla's position (anteroposterior), masticatory function, and a Class I canine and molar relationship bilaterally. The patient's smile and facial profile also showed noticeable improvement. This case demonstrates the successful application of the Alt-RAMEC protocol for growth modification in a late-diagnosed Class III patient, emphasizing the importance of patient compliance.

Keyword: Skeletal Class III, Anterior crossbite, Alt-RAMEC, Facemask therapy

บทคัดย่อ

การรักษาผู้ป่วยที่มีการสบฟันผิดปกติของโครงสร้างขากรรไกรแบบที่ 3 ในผู้ป่วยที่ได้รับการรักษาช้ากว่าระยะเวลาที่ควรจะเป็น ทำให้เกิดความยุ่งยากในการให้การรักษา รายงานกรณีนี้อธิบายถึงความสำเร็จในการรักษาทันตกรรมจัดฟันของผู้ป่วยที่มีโครงสร้างขากรรไกรแบบที่ 3 ในระยะฟันแท้ ผู้ป่วยมีลักษณะฟันล่างค่อมฟันบน ฟันสบลึก และใบหน้าด้านข้างมีลักษณะเว้า การวิเคราะห์กะโหลกศีรษะยื่นยื่นรูปแบบโครงกระดูกประเภท 3 เนื่องจากขากรรไกรบนมีลักษณะที่เล็กกว่าปกติ การรักษาใช้โปรโตคอล Alt-RAMEC เป็นเวลาสี่สัปดาห์

ตามด้วยการบำบัดด้วยเครื่องมือกระตุ้นการเจริญเติบโตของขากรรไกรบน และตามด้วยการจัดฟันแบบติดแน่น ผลของการรักษาพบว่าตำแหน่งของขากรรไกรในแนวด้านหน้าหลังดีขึ้น การทำงานของการบดเคี้ยวดีขึ้นอย่างมีนัยสำคัญ และความสัมพันธ์ฟันเขี้ยวและฟันกรามเป็นแบบที่ 1 ทั้งสองข้าง รอยยิ้มและใบหน้าของผู้ป่วยก็ดีขึ้นอย่างเห็นได้ชัดเช่นกัน กรณีนี้แสดงให้เห็นถึงความสำเร็จในการใช้โปรโตคอล Alt-RAMEC สำหรับการปรับเปลี่ยนการเจริญเติบโตในผู้ป่วยโครงสร้างขากรรไกรแบบที่ 3 ที่ได้รับการวินิจฉัยล่าช้า โดยปัจจัยหลักของความสำเร็จในการรักษาคือความร่วมมือของผู้ป่วย

คำสำคัญ: โครงสร้างขากรรไกรแบบที่ 3, ฟันหน้าล่าง
ค่อมฟันหน้าบน, Alt-RAMEC, เครื่องมือกระตุ้นการเจริญ
เติบโตของขากรรไกรบน

Introduction

Skeletal Class III presents a significant challenge in orthodontics, particularly for growing patients. It is characterized by a retrognathic maxilla, a prognathic mandible, or a combination of both.¹ The prevalence of this malocclusion demonstrates considerable heterogeneity across racial and ethnic groups.² While the global distribution ranges from 1% to 20%,³ Southeast Asia presents the highest documented prevalence, with estimates reaching up to 15.80%.⁴ While the etiology of Class III malocclusion can vary, both genetic and environmental factors play significant roles. The treatment approach for such cases necessitates a comprehensive understanding of craniofacial growth and development, as well as proficiency in utilizing orthodontic and surgical interventions to achieve optimal outcomes. Moreover, the management of skeletal Class III malocclusion often extends beyond mere dental alignment to address functional occlusion, facial aesthetics, and long-term stability.

Early identification and initiation of nonsurgical therapy for class III malocclusion have been demonstrated to reduce the severity and complexity of treatment required in the long term, particularly for adolescents progressing toward severe skeletal discrepancies⁵. Early intervention, ideally before 8 years of age, is considered the optimal approach for treatment. Nevertheless, clinical practice often presents cases diagnosed beyond this timeframe.

We present the diagnosis and treatment of a patient with skeletal Class III malocclusion in permanent dentition. A tailored treatment plan was devised based on a detailed examination of the patient's craniofacial morphology, cephalometric analysis, and individual treatment goals. This case report aims to contribute to the existing knowledge on managing skeletal Class III malocclusion in early adolescence by highlighting the diagnostic process, treatment planning strategies, and clinical outcomes. By doing so, it contributes to the existing body of knowledge in orthodontics and dentofacial orthopedics, offering insights into the management of challenging malocclusions in permanent dentition.

Case Report

A 10-year-9-month-old female presented to the orthodontic clinic with a chief complaint of anterior crossbite without familial traits. She had Class III malocclusion in permanent dentition. Her medical history is unremarkable, with no reported facial or jaw trauma or prior orthodontic treatment. She had a symmetrical oval facial form with a concave soft tissue profile and a protruded lower lip. She presented with no signs or symptoms of temporomandibular joint disorder and had a normal range of mandibular motion. Notably, her smile line was at the middle portion of her upper incisors displaying an inconsonant smile arc. (Fig 1A)



Fig 1. Extraoral photograph (A. Pretreatment, B. Posttreatment)

The intraoral examination revealed an anterior crossbite and deep intermaxillary overbite with a negative overjet of -5 mm and a deep overbite of 7 mm. Both the molars and canines showed a Class III relationship on both sides. The upper and lower dental midline coincided with the facial midline. The arch width was normal, and the curve of Spee showed moderate depth. Bolton's analysis showed normal anterior discrepancy; however, the lower arch displayed an overall excess. Additionally, generalized gingivitis was present with adequate attached gingiva. (Fig 2A)



Fig 2. Intraoral photograph

(A. Pretreatment, B. Post interceptive, C. Posttreatment, D. Posttreatment with retainer)

The cephalometric radiograph revealed a Skeletal Class III pattern characterized by a retrognathic maxilla and an orthognathic mandible with normal configuration. Upper incisors were proclined and protruding. While the lower incisors were retroclined but remained within a normal anteroposterior position. Her chin contour was adequate. (Fig 3A and Table 1) The panoramic radiograph showed that the posterior part of the external auditory canal, automatic process, lateral and medial wall of the maxillary sinus, nasal septum are all within normal limits. The condylar head is ovoid in shape and symmetry on both sides. The inferior border of the mandible was smooth. All permanent teeth were presented (Fig 4A). Her puberty development stage was at its peak. (Fig 4B)



Fig 3. Lateral cephalometric radiograph (A. Pretreatment, B. Post interceptive, C. Posttreatment)

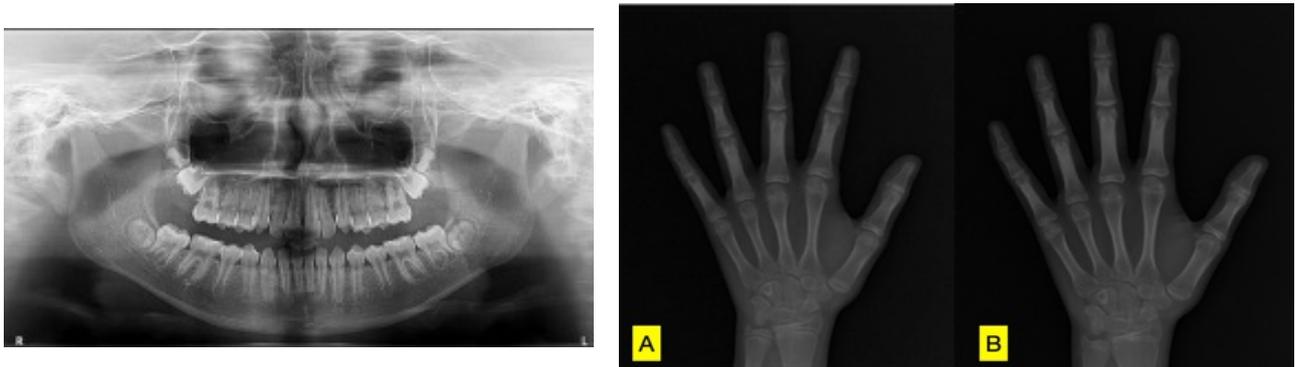


Fig 4. Panoramic radiograph (Pretreatment) (A)
Hand-wrist radiograph (B. Pretreatment, C. Post Inceptive treatment)

Interceptive phase

Interceptive orthodontic treatment was initiated in this case with bonded rapid palatal expansion (RPE) combined with raised-bite acrylics and a facemask (FM) (3M ESPE). To optimize maxillary protraction, the alternating rapid palatal expansion and constriction protocol (Alt-RAMEC) was employed.

The Alt-RAMEC Protocol:6

1. Maxillary expansion (week 1): The RPE appliance was activated to expand the maxilla by 1 mm per day for the first week.
2. Maxillary constriction (week 2): The RPE appliance was then adjusted to constrict the maxilla by 1mm per day for the following week.
3. Repeat cycle (weeks 3-4): This expansion-constriction cycle was repeated for a total of four weeks.

Upon the initial visit of RPE insertion, the Alt-RAMEC protocol was activated. The following month, facemask therapy was initiated. After 11 months of RPE and FM use, the initial anterior crossbite was successfully corrected. Additionally, a 5mm overjet was established, improving the overall alignment and function. (Fig 2B)

Following the successful completion of the first phase of treatment, a hand-wrist radiograph was obtained to assess skeletal maturity. This radiograph revealed the stage of metacarpal phalangeal fusion (MP3U), which helps determine skeletal development and the timing of potential further orthodontic interventions.⁷ (Fig 4C)

Corrective phase

Full fixed orthodontic appliances were bonded to the patient's teeth to initiate the leveling and aligning phase of the treatment. During this phase, we applied gentle forces to align the teeth gradually and smoothly into a symmetrical parabolic arch form. The inclination and position of the anterior teeth, as well as crowding, were all corrected. Following the midline correction, occlusal interferences and marginal ridge discrepancies were resolved.

The total treatment time for the corrective phase was 14 months. Although the patient's oral hygiene was initially fair during orthodontic treatment, oral hygiene instruction was provided regularly during their orthodontic visits. Despite the initial

poor prognosis due to the presence of full permanent dentition^{8,9}, the patient's excellent cooperation and the establishment of a positive overjet that prevented anterior cross-bite recurrence¹⁰ ultimately led to a favorable outcome.

In the final stage, we synchronized the arches and fine-tuned the angulation and inclination of the teeth. This treatment successfully achieved Class I canine and molar relationships on both sides. Additionally, it resulted in the upper and lower dental midlines aligning with the facial midline, creating a symmetrical smile and improving overall bite function. (Fig 1B, 2C)

To comprehensively evaluate the results, lateral cephalograms were analyzed after treatment completion. Lateral cephalometric superimposition stability in the cranial base and maxilla. We observed significant condylar growth, indicating a primarily downward and forward mandibular movement with minimal posterior rotation. Maxillary superimpositions revealed proclination of the upper incisors during the early treatment phase, while the lower incisors remained retroclined in both inclination and position. The soft tissue profile showed slight improvement due to a more normal lower lip position. This resulted in a more balanced and aesthetically pleasing lip appearance, along with improved function. (Fig 3B, 3C, 10) (Table 1)

Table 1. Lateral cephalometric analysis

	Area	Measurement	Norm		Pre-tx	Post interceptive	Post tx	Difference		
			Mean	SD						
Skeletal	Maxilla to cranial base	SNA	(degree)	84	3.58	79	82	82	+3	
		SN-PP	(degree)	9	3.03	6	5	5	-1	
	Mandible to cranial base	SNB	(degree)	81	3.59	84	83	84	0	
		SN-MP	(degree)	30	5.61	28	30	29	+1	
		SN-Pg	(degree)	82	3.09	85	83	85	0	
		SN-Gn	(degree)	68	3.29	63	65	63	0	
		ANB	(degree)	3	2.50	-5	-1	-3	+2	
	Maxillo-mandibular	Wits	(mm.)	-2	3.49	-10	-2	-5	+5	
		MP-PP	(degree)	21	5.25	22	25	24	+2	
		FMA	(degree)	24	5.06	23	25	24	+1	
Dental	Maxillary dentition	1 to NA	(degree)	22	5.94	32	36	36	+4	
		1 to NA	(mm.)	5	2.13	6	8	9	+5	
		1 to SN	(degree)	108	6.13	114	120	118	+4	
	Mandibular dentition	$\bar{1}$ to NB	(degree)	30	5.61	17	10	18	+1	
		$\bar{1}$ to NB	(mm.)	7	2.22	6	3	4	-2	
		$\bar{1}$ to MP	(degree)	97	5.97	86	78	85	-1	
	Maxillo-mandibular	1 to $\bar{1}$	(degree)	125	8.03	135	135	130	-5	
	Soft tissue	Soft tissue	E line U. lip	(mm.)	-1	1.76	-0.5	0	0	+0.5
			E line L. lip	(mm.)	2	2.03	7	2.5	4	-3
Naso-labial angle			(degree)	91	7.98	87	90	90	-3	
H-angle			(degree)	14	3.83	7	9	8	+1	

****Additional cephalometric measurement (Appendix A)**

แหล่งที่มาของ Lateral Cephalometric Norm :

1. วรธนา สุชาโต, จิราภรณ์ ชัยวัฒน์ : รายงานการวิจัยต่อสภากาชาดแห่งประเทศไทยเรื่องการประเมินค่าปกติของรูปร่างศีรษะและส่วนต่าง ๆ ของใบหน้า ซึ่งมีความสัมพันธ์กับฟันในคนไทย, 2521
2. สุรชัย เดชคุณากร, จิราภรณ์ ชัยวัฒน์, พรรัชนี แสงวงกิจ, นิวัติ อนุวงศ์นครินทร์ และ นฤมล ทวีเศรษฐ์ ค่าปกติของผู้ใหญ่ไทยในการวิเคราะห์แบบต่าง ๆ จากภาพถ่ายรังสีกะโหลกศีรษะด้านข้าง ว.ทันต. ปีที่ 44 ฉบับ 5-6 ก.ย. - ธ.ค. 2537 หน้า 202 -214

Retention phase

Following appliance removal, the treatment plan transitioned to wraparound retainers in upper arch while lower arch received a modified Hawley retainer. Initially prescribed for full-time wear for a year, the retention regimen was eventually modified to nighttime use only, considering both long-term stability and patient compliance. (Fig 2D)

Discussion

The goal of early orthopedic treatment is to intercept and guide the development of malocclusions toward a more normal, physiological state. In Class III malocclusions specifically, early intervention can lead to improvements in both soft and hard tissues.¹¹ The condition of negative overjet can influence facial growth patterns and potentially lead to more significant skeletal discrepancies in some individuals.¹²

While this patient has permanent teeth, the success rate of maxillary protraction by facemask is generally lower compared to deciduous and early mixed dentition. This patient's individual prognosis may be further impacted by the pre-existing proclined upper and retroclined lower anterior teeth.

Treatment for true skeletal class III malocclusion can be divided into the following categories¹³.

1. Growth modification 2. Dentoalveolar compensation or camouflage treatment 3. Orthognathic surgery.

In growing patients with true skeletal Class III (with retrognathic maxilla), the treatment plan options were 3 options; 1. Removable acrylic plates have been moderately effective for treating anterior forced crossbite in children with Angle Class I and crossbites involving no more than two teeth when treatment began during the period of early mixed dentition, but this patient did not meet the criteria.¹⁴

2. Reverse twin block, the treatment result included a mean upper incisor proclination of 1.8° , lower incisors retroclination of 2.3° , and a mean change in ANB

of 2° . Significantly, despite no increase in maxillary length, indicating that treatment success relies on favorable dentoalveolar changes, the rotational effects of the mandible and found significant maxillary incisor proclination¹⁵. 3. Facemask has a true skeletal effect^{8, 16} and a success rate of 70-80% when used in deciduous, mixed, and early permanent dentitions, but the success rate decreases with age^{8,9}. Facemasks are frequently used in combination with a rapid palatal expander (RPE), which RPE is commonly used before protraction to correct any transverse discrepancies and, theoretically, to enhance anteroposterior correction by releasing the circummaxillary sutures¹⁷.

As previously mentioned, face masks are often used alongside RPE. Liou et al. introduced the alternating rapid palatal expansion and constriction protocol (Alt-RAMEC), which involved expanding the maxilla by 1 millimeter per day for the first week, followed by constriction at the same rate in the subsequent week. This cycle was repeated for 7-9 additional weeks to achieve optimal disarticulation of the maxillary sutures without excessive expansion. Studies show that in cleft patients treated with Alt-RAMEC, the maxilla develops further forward compared to those receiving other therapies⁶. In 2015, Liu investigated the effects of ALT-RAMEC on Class III malocclusion in patients aged 7-13. Their study found that the combination of maxillary protraction using a facemask and ALT-RAMEC resulted in greater forward movement of the maxilla compared to using a facemask with RPE alone¹⁸. This treatment protocol proposes itself as a potential therapeutic option for late-diagnosed skeletal Class III malocclusion in growing patients. Its rationale lies in its capacity to induce sufficient distraction of the circummaxillary sutures, thereby facilitating maxillary protraction¹⁹.

This treatment aimed to intercept the developing Class III malocclusion by addressing the

underlying skeletal discrepancy. The first phase focused on promoting maxillary growth, while the subsequent corrective phase aimed to finalize tooth alignment, establish a Class I occlusion with optimal overjet and overbite, and ultimately improve the aesthetics of the patient's facial profile.

Sagittal Changes

The advancement of the upper maxilla controlled mandibular growth direction, and improved the intermaxillary sagittal relationship. Maxillary measurements showed significant improvements of 5 mm and 3 degrees. These effects allowed an improvement in the maxillomandibular skeletal relationships with an ANB that improved by 4° and a Wits appraisal of 8 mm after the initial interceptive treatment phase. However, at post-treatment, the total improvement was 2° and 5 mm for ANB and Wits, respectively. Overjet correction achieved a total improvement of 8 mm, similar to findings from a previous study that reported ANB change from 2° to 5° in patients treated with facemask therapy.⁸ The lower anterior teeth are slightly more retroclined compared to pretreatment due to the use of Class III elastics.

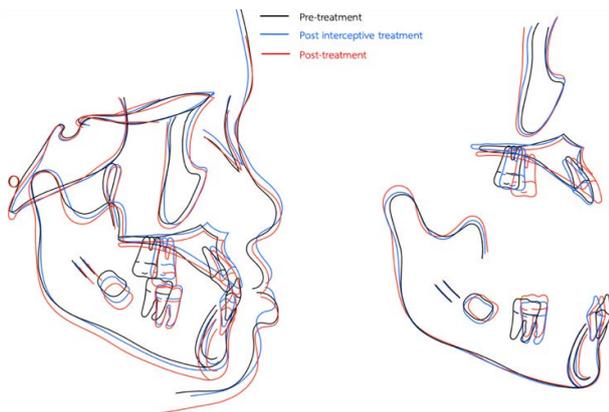


Fig 5. Superimposition

Treatment resulted in the establishment of ideal overjet and overbite, promoting long-term stability. Treatment was completed at 12-year-9-month-old. The patient reported satisfaction with both the final dental alignment and the improvement in her facial profile. Since the patient lacks familial traits of skeletal Class III malocclusion and the initial problem was due to a retrognathic maxilla, wraparound retainer suffices as the sole retention method. Although lifetime retention was recommended, facemask treatment has been shown to induce positive long-term changes in the anteroposterior position of the maxilla, potentially reducing the need for orthognathic surgery and achieving stable treatment results.^{9, 20}

Conclusion

This treatment regimen resulted in significant improvements in the patient's facial profile, complete correction of the crossbite, and establishment of excellent functional occlusion. Achieving this successful outcome was contingent upon the patient's exceptional cooperation. Maxillary protraction in Class III patients using the Hyrax expander with a repetitive weekly ALT-RAMEC protocol and a protraction facemask demonstrates promise as an effective treatment approach, with the stable results over time. Early interceptive treatment can lead to more favorable outcomes. Therefore, the author recommends initiating treatment soon after the eruption of the permanent upper and lower front teeth, as well as the first permanent molars.

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Conflict of Interest

None to declare.

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