

Early Orthopedic and Comprehensive Orthodontic Treatment of a Growing Patient with an Asymmetric, Low-Angle Skeletal Class III Tendency using a Hybrid Rapid Maxillary Expander and Facemask: A Case Report

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ABSTRACT: This case report presents the early orthopedic and comprehensive orthodontic treatment of a growing male patient whose chief complaint was a retruded maxilla. At the start of treatment (age 12 years 7 months), examination revealed an asymmetric facial appearance, a concave profile, a hypodivergent (low-angle) skeletal growth pattern (Jarabak ratio, 68.8%), a borderline skeletal Class I relationship (ANB, 0.6°) with maxillary retrusion (N-A, -2.1 mm; Wits, -4.2 mm), an asymmetric Class III molar relationship, and a negative overjet (-1.5 mm). Model analysis showed a 6.4-mm maxillary arch-length deficiency, no mandibular crowding, bilateral impaction of the maxillary canines and the maxillary left second premolar, and congenital absence of both mandibular second premolars. Treatment consisted of a hybrid-anchorage rapid maxillary expander combined with a protraction facemask, followed by comprehensive fixed appliance therapy, over 2 years 6 months. At the end of treatment (age 15 years), a stable skeletal Class I relationship was achieved (ANB, 3.5°; SNA increased by 4.9°), together with a bilateral Class I molar and canine relationship, a positive overjet and overbite of 2 mm each. This case illustrates that a hybrid RME/facemask protocol followed by fixed appliance therapy can be an effective approach for growing patients with an asymmetric, low-angle skeletal Class III tendency complicated by multiple dental anomalies.

KEYWORDS: skeletal Class III malocclusion; hybrid rapid maxillary expansion; protraction facemask; early orthodontic treatment; cephalometric analysis; case report

I. INTRODUCTION

Class III malocclusion is one of the most challenging problems encountered in orthodontic practice because of its multifactorial skeletal and dental components and its tendency to worsen during growth [9]. Early orthopedic intervention aims to redirect maxillary growth and control mandibular growth before the pubertal growth spurt is complete, since correction becomes markedly more difficult, and often requires orthognathic surgery, once skeletal maturity is reached [9]. Protraction facemask therapy combined with rapid maxillary expansion (RME) has long been the standard conservative approach for maxillary-deficient Class III patients, and systematic reviews have confirmed its short-term skeletal effectiveness [8]. More recently, hybrid-anchorage expanders combining dental and skeletal (miniscrew) anchorage have been introduced to increase the amount of orthopedic maxillary advancement while limiting the dentoalveolar side effects — such as maxillary molar extrusion and incisor proclination — commonly seen with conventional tooth-borne expanders [6,7]. This report describes the diagnosis and 2.5-year treatment course of a growing patient with an asymmetric, low-angle skeletal Class III tendency and multiple impacted and congenitally missing teeth, treated with a hybrid RME/facemask protocol followed by comprehensive fixed appliance therapy.

II. CASE REPORT

A. Patient History and Chief Complaint

A systemically healthy male patient, 12 years 7 months of age at the start of treatment, presented with the chief complaint of a retruded maxillary appearance. No relevant medical history or previous orthodontic treatment was reported. Written informed consent for orthodontic treatment and for the use of anonymized clinical records for scientific and educational purposes was obtained from the patient's legal guardian(s).

B. Extraoral and Intraoral Examination

Extraoral examination revealed an asymmetric facial appearance and a concave facial profile, with increased maxillary incisor display on smiling, a retrusive upper lip, and a relatively protrusive lower lip. The molar relationship was asymmetric, with an approximately 5-mm Class III relationship on the right side and a Class I relationship on the left side; canine relationships could not

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be reliably assessed at baseline because of bilateral canine impaction. Overbite was 1.5 mm, and overjet was -1.5 mm, indicating an anterior crossbite tendency.

C. Model and Cephalometric Analysis

Hayes-Nance mixed-dentition space analysis [2] showed a maxillary arch-length deficiency of 2.2 mm on the right side and 4.2 mm on the left side (total, 6.4 mm), whereas the mandibular arch showed no length deficiency bilaterally. Bolton tooth-size analysis [1] revealed a mandibular tooth-material excess of 2.2 mm for the anterior (6-tooth) ratio and 2.6 mm for the overall (12-tooth) ratio.

Lateral cephalometric analysis at the start of treatment (Table 1) showed a hypodivergent growth pattern (Jarabak ratio, 68.8%; ideal, 61%) [3] and a Frankfort-mandibular plane angle (FMA) of 27.9° (ideal, 25°). Sagittal jaw positions were close to normal (SNA, 80.5°; SNB, 79.9°) [4], with a borderline skeletal Class I relationship (ANB, 0.6°). However, the N-A linear measurement (-2.1 mm) and the Wits appraisal (-4.2 mm) [5] both indicated maxillary retrusion relative to the mandible, consistent with the patient's concave profile and dental Class III tendency. The maxillary incisors were normally inclined (U1-SN, 103.9°), whereas the mandibular incisors were proclined (IMPA, 97.5°), and the interincisal angle was reduced (124.4°) relative to the ideal (131°).



Fig. 1. Pretreatment (T0) extraoral and intraoral photographs (age 12 years 7 months), showing the asymmetric facial appearance, concave profile, and asymmetric molar relationship.

D. Radiographic Findings

Panoramic radiographic examination showed that the second and third molars (teeth 18, 28, 38, 48) were still in the developing crypt (germ) stage, the maxillary canines (13, 23) and the maxillary left second premolar (25) were impacted, and both mandibular second premolars (35, 45) were congenitally absent. Tooth agenesis has repeatedly been associated with an increased prevalence of maxillary canine displacement and impaction [10], consistent with the pattern of dental anomalies observed in this patient.

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Fig. 2. Pretreatment panoramic radiograph, showing germs of teeth 18, 28, 38, and 48; impaction of teeth 13, 23, and 25; and congenital absence of teeth 35 and 45.

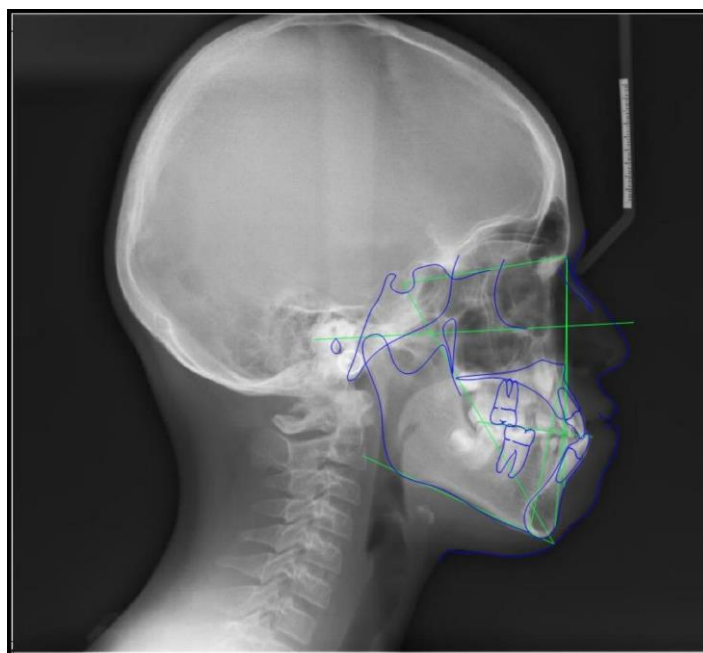


Fig. 3. Pretreatment lateral cephalometric radiograph with tracing (T0).

III. TREATMENT OBJECTIVES AND TREATMENT PLAN

The treatment objectives were to (1) correct the maxillary skeletal retrusion and the asymmetric Class III molar relationship, (2) gain arch length to resolve the 6.4-mm maxillary space deficiency and permit management of the impacted maxillary teeth, (3) establish a positive overjet and overbite, and (4) manage the mandibular arch, in which the congenital absence of the second premolars was clinically compensated for by the lack of crowding [11]. Given the hypodivergent growth pattern, a degree of clockwise mandibular rotation secondary to maxillary protraction was considered acceptable, and potentially favorable, for correcting the negative overjet. The treatment plan therefore consisted of orthopedic correction with a hybrid rapid maxillary expander and facemask, followed by comprehensive fixed appliance therapy.

IV. TREATMENT PROGRESS

A hybrid-anchorage rapid maxillary expander was used in combination with a protraction facemask to achieve maxillary skeletal advancement and transverse expansion, an approach reported to produce a greater orthopedic effect with fewer dentoalveolar side effects than conventional tooth-borne expanders [6,7]. Following the orthopedic phase, comprehensive treatment with fixed orthodontic appliances was carried out to align the dental arches, manage the impacted and congenitally missing teeth, and finish the occlusion. Total active treatment time was approximately 2 years 6 months, with treatment completed at 15 years of age.

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V. TREATMENT RESULTS

The pretreatment and posttreatment cephalometric values are summarized in Table 1, and the pretreatment and posttreatment occlusal and space-analysis findings are summarized in Table 2.

TABLE 1

Pretreatment and Posttreatment Cephalometric Values

Cephalometric parameter	Ideal value	Pretreatment (T0)	Posttreatment (T1)
Go/Gn-SN	32°	33.4°	33.4°
FMA	25°	27.9°	27.9°
Jarabak ratio	61%	68.8%	68.8%
SNA	80° ± 2	80.5°	85.4°
SNB	78° ± 2	79.9°	81.9°
ANB	2° ± 2	0.6°	3.5°
N-A	0 mm	-2.1 mm	2.0 mm
Wits appraisal	-1 mm	-4.2 mm	4.1 mm
U1-SN	103°	103.9°	115.1°
U1-PP	112°	106.1°	114.3°
IMPA	90°	97.5°	86.7°
Holdaway angle	1°	-0.4°	-2.6°
Interincisal angle	131°	124.4°	128.8°

TABLE 2

Pretreatment and Posttreatment Occlusal and Space-Analysis Findings

Parameter	Pretreatment (T0)	Posttreatment (T1)
Skeletal relationship	Borderline skeletal Class I (ANB 0.6°)	Skeletal Class I (ANB 3.5°)
Molar relationship	Asymmetric (right: Class III, 5 mm; left: Class I)	Class I bilaterally
Canine relationship	Not assessable (bilateral impaction)	Class I bilaterally
Overjet	-1.5 mm	+2 mm
Overbite	1.5 mm	2 mm
Maxillary arch-length discrepancy	-6.4 mm	0 mm
Mandibular arch-length discrepancy	0 mm	0 mm

By the end of treatment, the skeletal Class III tendency had been corrected: SNA increased from 80.5° to 85.4° (+4.9°), SNB increased from 79.9° to 81.9° (+2.0°), and ANB increased from 0.6° to 3.5°, moving the patient from a borderline into a stable skeletal Class I relationship. The N-A measurement improved from -2.1 mm to +2.0 mm, and the Wits appraisal changed from -4.2 mm to +4.1 mm, both reflecting substantial forward repositioning of the maxilla relative to the mandible. The mandibular incisors, initially proclined (IMPA, 97.5°), were uprighted to 86.7°, while the maxillary incisors became more proclined (U1-SN, from 103.9° to 115.1°) as part of decompensation and finishing mechanics; the interincisal angle increased from 124.4° to 128.8°. The Jarabak ratio (68.8%) and FMA (27.9°) remained unchanged, indicating that the hypodivergent growth pattern was preserved and that no undesirable vertical opening occurred during treatment.

Occlusally, the previously asymmetric molar relationship was corrected to a bilateral Class I molar and canine relationship, the maxillary arch-length deficiency was resolved with no residual crowding in either arch, overbite and overjet were normalized to 2 mm each.

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Fig. 4. Posttreatment (T1) extraoral and intraoral photographs (age 15 years), showing the corrected facial symmetry and profile and the bilateral Class I occlusal relationship.

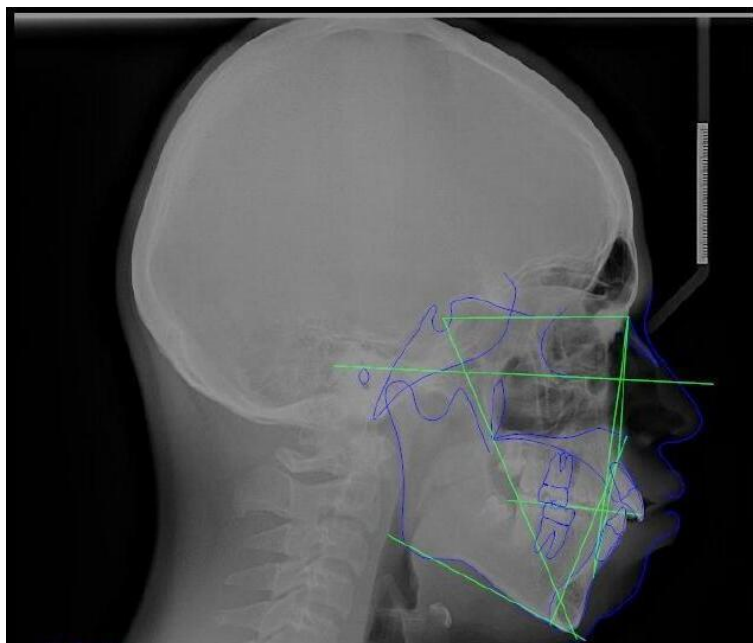


Fig. 5. Posttreatment lateral cephalometric radiograph with tracing (T1), showing the advanced maxillary position relative to Fig. 3.

VI. DISCUSSION

This case demonstrates that a growing patient with an asymmetric, low-angle skeletal Class III tendency, complicated by multiple impacted and congenitally missing teeth, can be successfully managed with a hybrid RME/facemask protocol followed by comprehensive fixed appliance therapy. The 4.9° increase in SNA achieved in this patient is consistent with reports that hybrid or skeletally anchored expansion protocols can produce a greater degree of maxillary skeletal advancement than conventional tooth-borne RME/facemask therapy while limiting maxillary molar extrusion and incisor proclination [6,7]. Systematic reviews have similarly confirmed that facemask therapy produces a favorable short-term skeletal effect on the ANB angle and on

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maxillomandibular sagittal relationships in growing Class III patients [8], and that early treatment may reduce the likelihood of later orthognathic surgery, although long-term stability continues to depend on subsequent mandibular growth [9].

The patient's hypodivergent growth pattern was a favorable factor for this treatment approach. The mild clockwise mandibular rotation associated with facemask protraction is generally well tolerated, and can even be advantageous, in hypodivergent Class III patients, whereas the same rotation would be more likely to compromise vertical facial proportions in a hyperdivergent patient. This is consistent with long-term follow-up data on hybrid RME/facemask protocols, which describe overall maintenance of the achieved sagittal correction despite a degree of relapse attributable to residual mandibular growth [7].

The combination of bilateral maxillary canine impaction, impaction of the maxillary left second premolar, and bilateral congenital absence of the mandibular second premolars observed in this patient is in line with reports that tooth agenesis is associated with an increased prevalence of maxillary canine displacement and impaction, likely reflecting a shared developmental or genetic background for these dental anomalies [10]. The absence of the mandibular second premolars was clinically favorable in this case, since it coincided with the absence of mandibular crowding and simplified management of the mandibular arch; when the deciduous second molars can be maintained in good condition, or the space closed under sound anchorage control, congenitally missing second premolars can often be managed without the need for future prosthetic replacement [11].

Limitations of this report include the absence of long-term post-treatment follow-up to confirm the stability of the skeletal and dental correction, particularly given the known potential for some relapse of the sagittal correction as residual mandibular growth continues after facemask therapy [7]. Long-term clinical and cephalometric follow-up, together with three-dimensional (CBCT) evaluation of the previously impacted teeth, would further strengthen the evidence base for this treatment approach in similarly complex growing Class III patients.

VII. CONCLUSION

In a growing patient with an asymmetric, low-angle skeletal Class III tendency complicated by impacted and congenitally missing teeth, a hybrid rapid maxillary expander combined with a protraction facemask, followed by comprehensive fixed appliance treatment, achieved a stable skeletal Class I relationship, a bilateral Class I occlusion, and a normalized overjet and overbite over a 2.5-year treatment period. This combined approach may represent a favorable option for similarly complex growing Class III patients, particularly those with a hypodivergent growth pattern.

ETHICAL STATEMENT

Written informed consent for orthodontic treatment and for the use and publication of anonymized clinical records was obtained from the patient's legal guardian(s). The patient's identity has been withheld throughout this report in accordance with patient confidentiality principles.

CONFLICT OF INTEREST

The authors declare no conflict of interest related to this case report.

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To be completed by the authors, if applicable.

REFERENCES

- 1) Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. *Angle Orthod.* 1958;28(3):113-130.
- 2) Nance HN. The limitations of orthodontic treatment. I. Mixed dentition diagnosis and treatment. *Am J Orthod Oral Surg.* 1947;33(4):177-223.
- 3) Jarabak JR, Fizzell JA. *Technique and Treatment with Light-Wire Edgewise Appliances*. 2nd ed. St. Louis: C.V. Mosby; 1972.
- 4) Steiner CC. Cephalometrics for you and me. *Am J Orthod.* 1953;39(10):729-755.
- 5) Jacobson A. The Wits appraisal of jaw disharmony. *Am J Orthod.* 1975;67(2):125-138.
- 6) Maino G, Turci Y, Arreghini A, Paoletto E, Siciliani G, Lombardo L. Skeletal and dentoalveolar effects of hybrid rapid palatal expansion and facemask treatment in growing skeletal Class III patients. *Am J Orthod Dentofacial Orthop.* 2018;153(2):262-268.
- 7) Maino GB, Cremonini F, Maino G, Paoletto E, De Maio M, Spedicato GA, Palone M, Lombardo L. Long-term skeletal and dentoalveolar effects of hybrid rapid maxillary expansion and facemask treatment in growing skeletal Class III patients: a retrospective follow-up study. *Prog Orthod.* 2022;23:33.
- 8) Cordasco G, Matarese G, Rustico L, Fastuca S, Caprioglio A, Lindauer S, Nucera R. Efficacy of orthopedic treatment with protraction facemask on skeletal Class III malocclusion: a systematic review and meta-analysis. *Orthod Craniofac Res.* 2014;17(3):133-143.

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- 9) Woon SC, Thiruvengkatahari B. Early orthodontic treatment for Class III malocclusion: a systematic review and meta-analysis. *Am J Orthod Dentofacial Orthop.* 2017;151(1):28-52.
- 10) Laganà G, Venza N, Lione R, Chiaramonte C, Danesi C, Cozza P. Associations between tooth agenesis and displaced maxillary canines: a cross-sectional radiographic study. *Prog Orthod.* 2018;19:26.
- 11) Williams R, Park JH, Chae JM, Vaden JL. The congenitally missing second premolar: Space closure. A viable option. *Am J Orthod Dentofacial Orthop.* 2020;157(4):571-583.