MANAGEMENT OF BRITISH STANDARDS INSTITUTE (BSI) CLASS III MALOCCLUSION WITH SINGLE ANTERIOR CROSSBITE, SEVERE CROWDING, AND MIDLINE SHIFTS

Amuasi A. A.[1]*, Sabbah D. K.[1], Ankamah-Lomotey J.[2]

[1] The Department Child Oral Health & Orthodontics, School of Dentistry, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

[2] Komfo Anokye Teaching Hospital, Orthodontics and Pediatric Dentistry Department, Kumasi, Ghana.

Corresponding Author: Dr. (Mrs) Ama Agyeibea Amuasi, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana.
Correspondence: ama.amuasi@gmail.com

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ABSTRACT

BACKGROUND: This case report details the orthodontic management of a 12-year-old male presenting with severe dental crowding and esthetic concerns. Clinical and radiographic evaluation revealed a British Standards Institute (BSI) Class III malocclusion complicated by a single anterior crossbite, an ectopic eruption of the maxillary left canine, and midline deviations, all on a Skeletal Class III base pattern. The case is noteworthy due to the simultaneous presentation of multiple complex malocclusion traits in a growing adolescent, necessitating a comprehensive management approach, and contributes to the growing body of literature by supporting individualized and extraction-based protocols in early adolescent patients with complex occlusal disharmonies.

CASE DESCRIPTION: A comprehensive orthodontic treatment plan was formulated, which included the extraction of all first premolars to create space for alignment, correction of midline discrepancies, and incorporation of ectopic teeth. Space closure and arch coordination were facilitated using fixed appliances with supplementary anchorage devices such as a transpalatal arch and a lingual holding arch. Following 21 months of active treatment, a functional and esthetically satisfactory occlusion was achieved. The post-treatment assessment demonstrated a significant improvement in incisor, canine, and molar relationships, as well as the resolution of midline discrepancies and the alignment of previously ectopic and rotated teeth. Space closure and arch coordination were facilitated using fixed appliances with supplementary anchorage devices such as a transpalatal arch and a lingual holding arch. The Peer Assessment Rating (PAR) score improved from 46 to 7, indicating substantial therapeutic success.

CONCLUSION: This case underscores the efficacy of an extraction-based protocol combined with anchorage reinforcement in managing severe dental crowding with Class III skeletal and dental discrepancies. Timely intervention, individualized biomechanics, and patient compliance contributed to favorable treatment outcomes.

KEYWORDS: BSI Class III malocclusion, Severe dental crowding, Midline shift, Anterior crossbite; Orthodontic extraction therapy

INTRODUCTION

Dental crowding is a prevalent orthodontic condition characterized by a discrepancy between tooth size and available jaw space, resulting in misaligned or overlapping teeth[1]. This malalignment presents both intellectual and technical challenges, as it requires addressing mesiodistal and buccolingual discrepancies to achieve optimal alignment[1,2]. Beyond its aesthetic implications, dental crowding has a significant impact on oral health, contributing to an increased susceptibility to dental caries, periodontal disease, and difficulties in maintaining proper oral hygiene[3]. A frequently associated condition is the buccal (ectopic) eruption of maxillary canines, which can further complicate alignment and treatment planning[3].

Crowding is one of the most common features of Angle Class I malocclusion, and its severity may progress with occlusal maturation[4]. As such, it remains a primary concern for patients seeking orthodontic treatment, both for functional and aesthetic reasons[2]. The appropriate therapeutic approach for managing crowding depends on the severity of the discrepancy, which may be classified as mild, moderate, or severe. Treatment modalities typically involve either tooth reduction (via extractions or interproximal enamel reduction) or arch lengthening (through expansion, proclination, or distalization)[5]. However, determining the most effective intervention poses a challenge for orthodontists, as it necessitates individualized treatment planning based on occlusal and skeletal considerations.

According to several studies, one of the routine treatment approaches for Class I malocclusion, particularly in cases of severe anterior crowding and bimaxillary protrusion, is the extraction of the first premolars. These teeth are often selected due to their strategic location in the dental arch and their compatibility with most types of occlusal discrepancies requiring anterior tooth retraction[6]. Conversely, the extraction of second premolars is generally not indicated in cases with significant discrepancies[6]. In some instances, additional interventions such as interproximal stripping may be necessary to address tooth-size discrepancies within the same case. Given the complexity of crowding and its implications for occlusal function, esthetics, and overall oral health, a thorough diagnostic assessment is essential for selecting the most suitable treatment approach.

Anterior crossbite, on the other hand, can be defined as an abnormal relationship that occurs between one or more upper and lower anterior incisor teeth in which a reverse relation is established between them[7]. Clinically, it is manifested as a reversed overjet. The anterior crossbite is one of the most commonly seen orthodontic problems during development[8,9]. It can be classified into dental, functional, and skeletal categories. Dental anterior crossbites occur due to palatially inclined developing tooth or teeth, which cause ectopic eruption of this tooth or teeth. Dental crossbite is manifested as a dental abnormality, in addition to normal skeletal jaw relationships and a normal functional path of the mandible

during opening and closing. Untreated anterior crossbites can lead to poor esthetics, gingival recession, periodontal diseases, attrition and damage to the teeth, temporomandibular joint dysfunction, restriction of maxillary jaw growth, and/or enhancement of mandibular growth.[10] Anterior crossbite should be intercepted and treated without delay because it is a self-perpetuating condition that, if not treated early, has the potential of growing into skeletal malocclusion and might, at a later stage, require major orthodontic treatment combined with surgical intervention[11]. Removable and fixed orthodontic appliances are used to correct dental anterior crossbites, particularly in the mixed and permanent dentitions.

CASE PRESENTATION

A 12-year-old male presented to the Komfo Anokye Teaching Hospital in Kumasi, Ghana, with the principal complaint of disordered teeth arrangement. There was no relevant medical and dental history and no known allergies or persistent oral habits.

Diagnosis- BSI Class III malocclusion complicated by a single anterior crossbite, ectopic eruption of the maxillary left canine, and midline deviations, all on a Skeletal Class III base pattern.

Clinical Assessment

Extraoral Findings

The patient had a convex facial profile, with a Frankfurt Mandibular Plane Angle that met at the occiput, which suggests normal lower anterior facial height. He had competent, protrusive lips. He also had a non-consonant smile arc, with 90% of the upper central and lateral incisor teeth showing and narrow buccal corridors (see Figure 1).

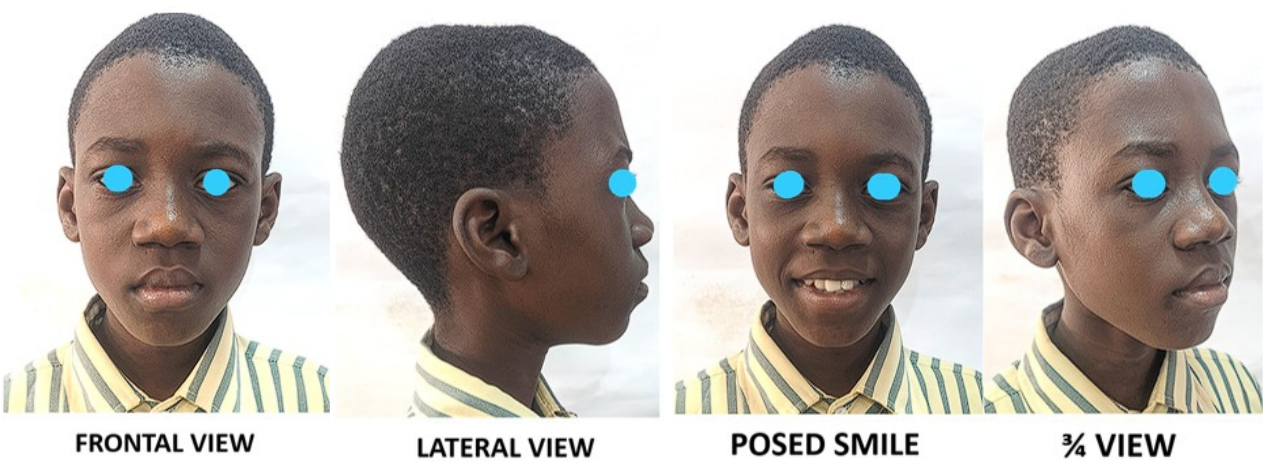

Figure. 1. Pre-treatment Facial Photographs

The patient was in the permanent dentition stage of development, with all but the second and third molars present in the oral cavity. There was McCall festoon adjacent tooth 33, stained buccal pits of teeth numbers 36 and 46, severe crowding (12mm lower anterior contact point displacements; 9mm maxillary arch-perimeter space discrepancy), ectopically placed tooth 23, crowded out tooth 33 and several tooth rotations were observed. Angles Class I molar relation with unclassifiable canine relation (on the left), incisor Class I relation, 4mm overjet between teeth 21 and 31, and 5mm between 21 and 32, and about 40% lower incisor coverage. Both dental midlines relative to the facial midline were non-coincident; the upper dental midline was shifted to the left by 3mm, and the lower dental midline shifted to the right by 1mm (See Figure 2).

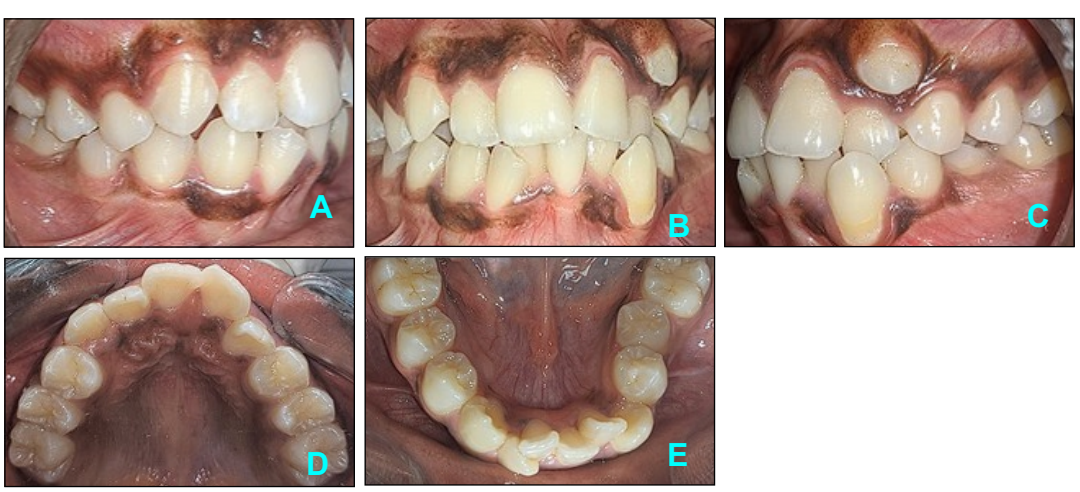

Figure 2. Intraoral Photographs

Radiographic Assessment

Panoramic Findings: This showed the presence of all permanent teeth, with ectopically positioned 23, and the crown of all third molars almost complete—no sign of caries, root resorption, or any periapical lesion (see Figure 3).

Figure 3. Initial Panoramic Radiograph

Cephalometric findings: Lateral cephalometric analysis showed a Skeletal Class III pattern, bimaxillary retrognathism, and increased vertical (skeletal) parameters. The radiographic images and findings are presented in Figure 4 and Table 1 below.

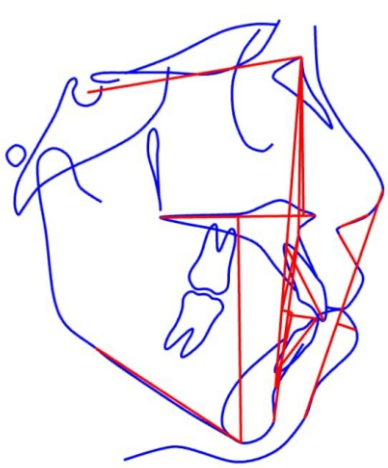

Figure 4. Initial Lateral Cephalogram and Tracing

Table 1. Pre-Treatment & Post-Treatment Cephalometric Values

Parameter			
Skeletal (Sagittal)	**Ghana (*Fadeju et al.*)**	**Pre-treatment**	**Post-treatment**
SNA	88.60° (±4.02°)	**75°**	**75°**
SNB	83.34° (±3.83°)	**74°**	**75°**
ANB	5.37° (±2.24°)	**1°**	**0°**
Dento-alveolar			
UIMxP	102.94° (±7.13°)	**119°**	**128°**
LIMdP	98.74° (±7.98°)	**99°**	**93°**
Dental			
I-IA	112.76° (±10.12°)	**108°**	**108°**
Vertical			
MMPA	27.84° (±5.78°)	**37°**	**31°**

Treatment Objectives

These include improving and reinforcing good oral hygiene through regular scaling and polishing, as well as providing clear instructions on oral hygiene. Additionally, fluoride therapy will be carried out, and a consultation with the Periodontist will be scheduled regarding McCall's festoon. The single anterior crossbite and left lingual crossbite tendencies would be corrected, in addition to creating space in the dental arches through the extractions of all first premolars, to effectively align the crowded canines and correct the dental midline shifts. The remaining spaces would be closed, and occlusion reassessed, after which retaining devices would be provided to preserve the achieved results.

Treatment Progress

Active orthodontic treatment commenced with band cementation on all first permanent molars and bonding of 0.022 x 0.028-inch MBT bracket prescription on teeth. Initial startup 0.012" NiTi Euroform archwires were engaged in both arches.

Two (2) weeks later, all first premolars were extracted under local anaesthesia, and a review done in 2 weeks showed satisfactory healing of the sites. The bite was raised with glass ionomer cement (GIC) on the occlusal surfaces of tooth numbers 36 and 46 to aid in the correction of the single anterior crossbite. Transpalatal arch (TPA) was also delivered. Leveling and alignment continued in both arches with 0.014" NiTi archwires.

A month later, the anterior crossbite had been corrected: occlusal buildups had been removed. The lingual holding arch (LHA) was delivered and activated for expansion of the posterior segment in the third quadrant. Orthodontic traction of 23 was started using the piggyback technique; 0.012" NiTi wire was engaged in the slot, and the main archwire changed to 0.016" Stainless Steel (SS).

Three (3) months later, the 0.016" SS archwires were segmented distal to the canines and cinched back to allow for better intercuspation of the posterior teeth, aided by the use of interarch box elastics (3/16 inch, 5.0oz) for 4 weeks. Archwire coordination began with 0.018x0.025" SS in both arches, where upper and lower wires were swapped to correct buccal excesses. Retraction of tooth 33 into a Class I relation was done with a type II active tieback.

Initial space closure began with a short power chain engaged from 16 to 26 and 36 to 46, thirteen months into active orthodontic treatment. TPA and LHA were also retired due to reduced anchorage demands. All bands were changed to bonded molar tubes of similar prescription. Closure of all residual spaces was achieved with a continuous power chain spanning from tooth

numbers 16 to 26 and 36 to 46, as before. Dental midlines had centred after complete leveling, alignment, and space closure.

Five months after finishing, detailing and settling of the occlusion were commenced. Aesthetic gingival procedures (gingivoplasty) were performed on teeth numbers 11, 13, 21, 41, and 43. Light 3.5oz, 3/16-inch vertical (triangular) elastics were added to foster the settling.

After twenty-one (21) months of treatment, all brackets and attachments were debonded. Enamel smoothening and polishing of all surfaces of the teeth was carried out, and a fixed bonded retainer on palatal surfaces of 15 to 25 and lingual surfaces of 35 to 45 was incorporated. Fluoride therapy was done. A simple, removable Hawley's appliance was delivered, along with instructions for its use, hygiene, and maintenance. The occlusion was checked, and oral hygiene instructions were reinforced.

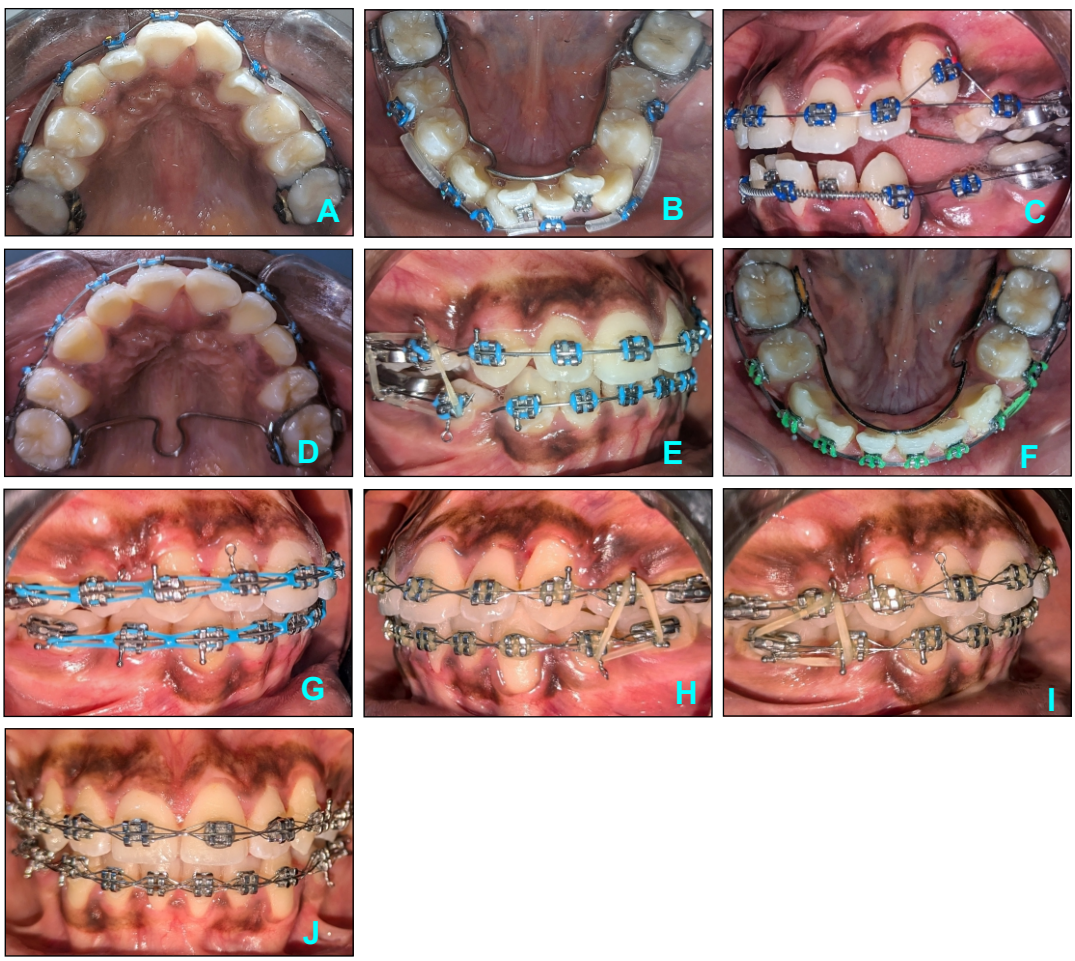

Figure 5- Treatment Progress: A, B- Initial bonding; C- Post-extraction & Piggyback D, E- TPA in-situ and Box Elastics; F, G- Active tieback on tooth 33 and residual space closure; H, I, J- Finishing, Detailing & Settling with light triangular elastics

At the completion of treatment, all teeth in both arches were well aligned, with post-treatment radiographs confirming Class I incisor, canine, and molar relationships, along with a normal overbite and overjet. Both dental midlines were coincident with the midfacial axis (Figure 8). Post-treatment assessments, including cephalometric analysis, panoramic radiographs, and superimpositions, demonstrated notable skeletal and dental changes. These investigations indicated growth of both the maxilla and mandible during the treatment period. Additionally, mild root resorption was observed; however, it remained within acceptable limits, consistent with the extent of orthodontic tooth movement (Figure 9). A significant improvement in occlusion was observed, as reflected in the Peer Assessment Rating (PAR) score, which decreased from an initial value of 46 to 7 at the end of treatment (Figure 7), signifying a substantial enhancement in dental alignment and occlusal function. Pre- and post-treatment frontal views further illustrate these improvements (Figure 10).

PAR SCORING SHEET

Name: Thomas Adom-Opoku Owusu (12 yrs.)

CASE NUMBER	KU-A01-AAXABB 2226	Pre-Treatment									Date	14/12/2022		
PAR COMPONENTS	RIGHT									LEFT		UN-WEIGHTED TOTAL		WEIGHTED TOTAL
Upper anterior segments	3-2	1	2-1	2	1-1	1	1-2	2	2-3	3		9	X1	9
Lower anterior segments	3-2	1	2-1	3	1-1	1	1-2	2	2-3	1		8	X1	8
Buccal occlusion	Antero-posterior				Right	0			Left	0		0	X1	0
	Transverse				Right	0			Left	1		1	X1	1
	Vertical				Right	0			Left	0		0	X1	0
Overjet	Positive		1		Negative			2				3	X6	18
Overbite	Overbite		1		Openbite			0				1	X2	2
Centre line						2						0	X4	8
											TOTAL	22		46

CASE NUMBER	KU-A01-AAXABB 2226	Post-Treatment									Date	16/08/2024		
PAR COMPONENTS	RIGHT									LEFT		UN-WEIGHTED TOTAL		WEIGHTED TOTAL
Upper anterior segments	3-2	0	2-1	0	1-1	0	1-2	0	2-3	0		0	X1	0
Lower anterior segments	3-2	0	2-1	0	1-1	0	1-2	0	2-3	0		0	X1	0
Buccal occlusion	Antero-posterior				Right	0			Left	0		0	X1	0
	Transverse				Right	1			Left	0		1	X1	1
	Vertical				Right	0			Left	0		0	X1	0
Overjet	Positive		1		Negative			0				1	X6	6
Overbite	Overbite		0		Openbite			0				0	X2	0
Centre line						0						0	X4	0
											TOTAL	2		7

ASSESSMENT OF OUTCOME

PAR SCORE		IMPROVEMENT	
Change in PAR score	39	Greatly improved	✓
% change in PAR score	85%	Improved	
		Worse or no different	

ASSESSMENT OF TREATMENT OUTCOME USING P.A.R.

- Pre-treatment PAR score: 46
- Post-treatment PAR score: 7

- Change in PAR score (points)
  - **39 points**

This signifies a greatly improved case

- Percentage change in PAR score

$$= \frac{change\ in\ PAR\ score}{pretreatment\ PAR\ score} \times 100$$

$$= \frac{39}{46} \times 100 = 84.8$$

= 85%

This signifies a greatly improved case

74

Figure 7. Peer Assessment Rating (PAR) score sheet results

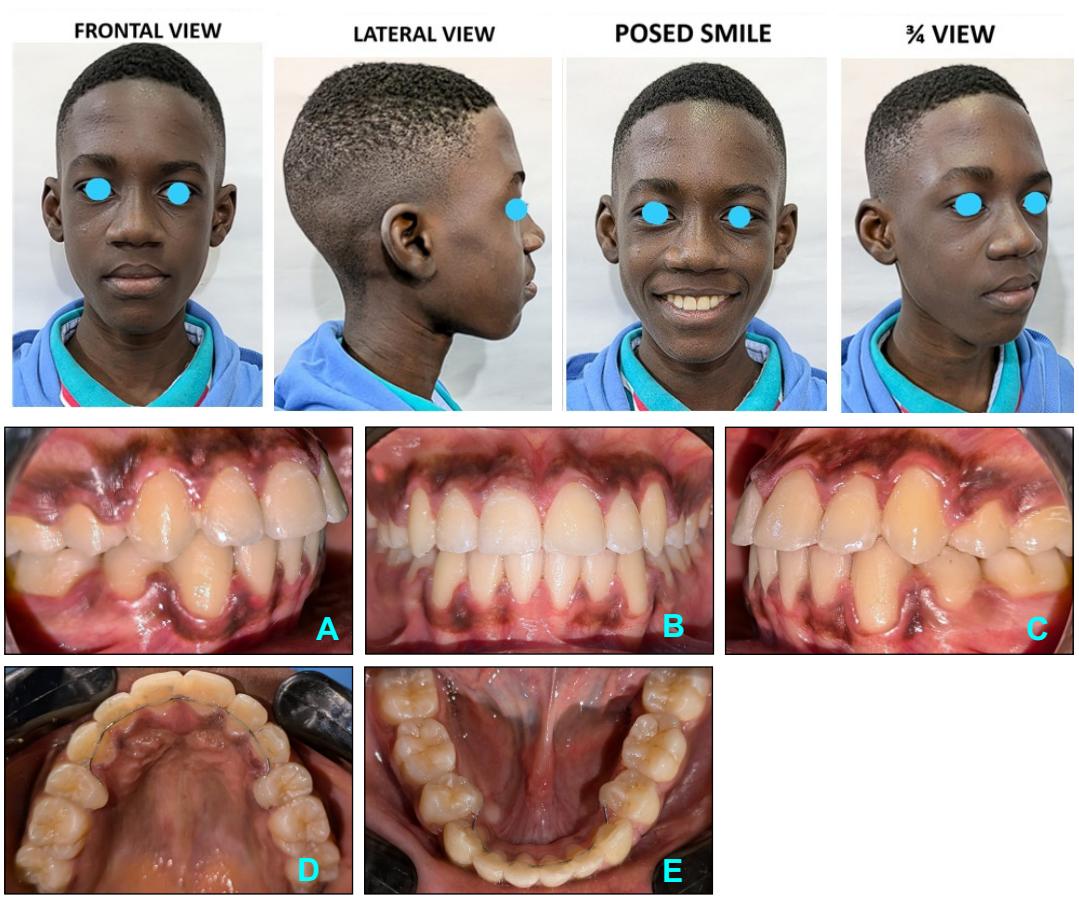

Figure 8- Post-Treatment Facial & Intraoral Photographs

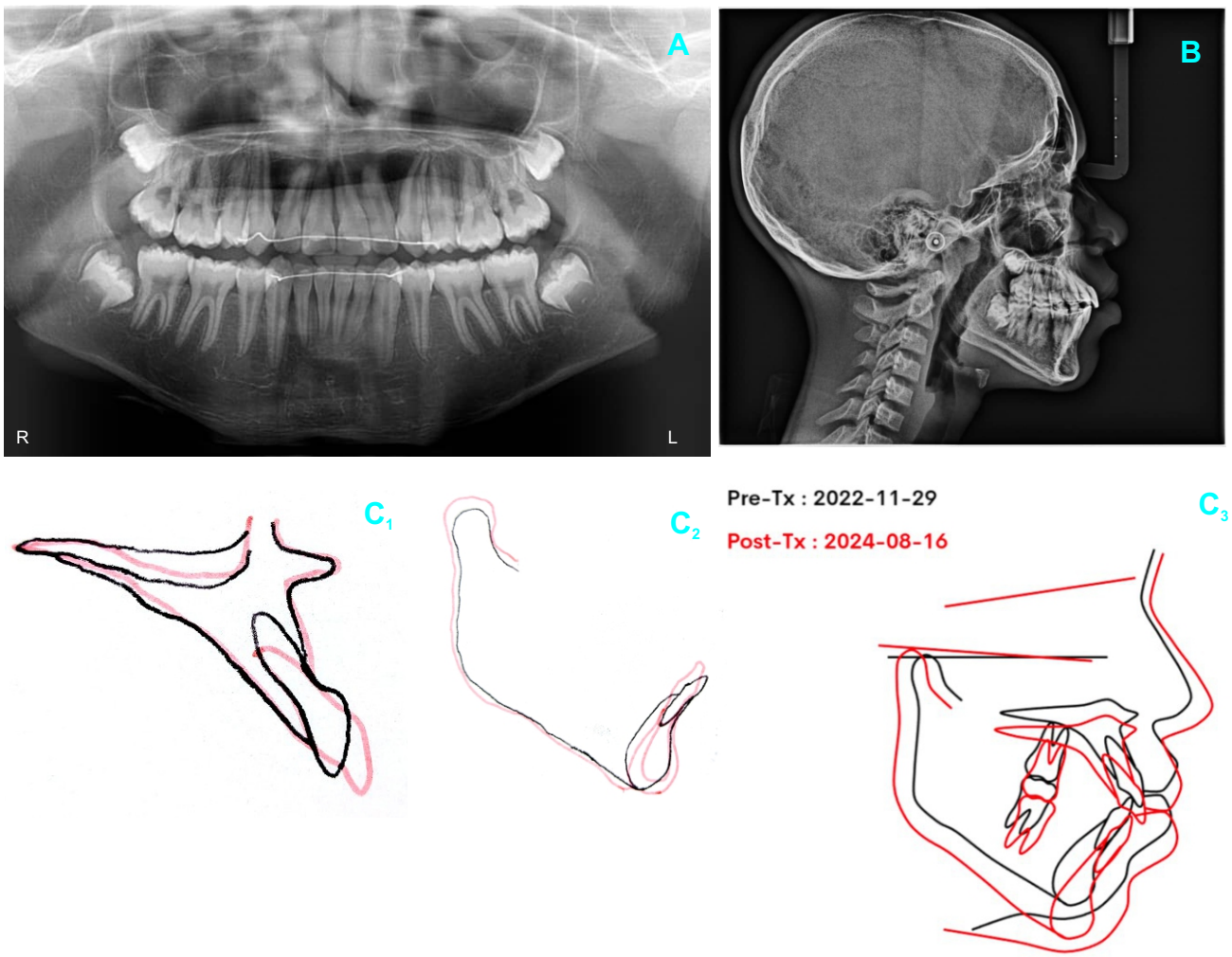

Fig. 9- A) Post-Treatment Panoramic Radiograph; (B) Cephalogram; and (C) Superimposition (maxilla, mandible, S-N plane)

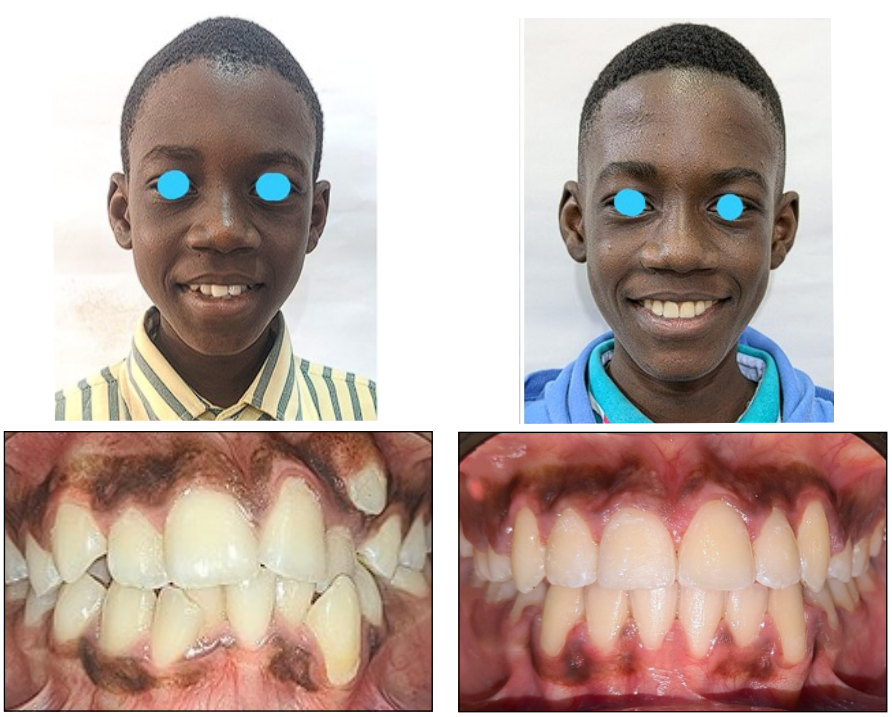

Figure 10. Before and After Treatment

DISCUSSION

The severe crowding in the anterior region of both dental arches primarily dictated the treatment approach for this case. To effectively unravel the malocclusion and facilitate the correct positioning of the ectopic canines, the extraction of the four first premolars was performed. This intervention not only created the necessary space for orthodontic traction but also contributed to the correction of both dental midlines by effectively utilizing the extraction spaces. Midline discrepancies are a common challenge in clinical orthodontics and may arise from skeletal, dental, or functional factors[3]. In some cases, a functional shift of the mandible can exacerbate midline discrepancies, requiring careful diagnostic evaluation to ensure appropriate treatment planning. In this case, the extraction spaces allowed for significant midline correction, aligning both dental midlines with the midfacial axis, as confirmed in post-treatment assessments.

The single anterior crossbite was corrected early in treatment with the aid of the aligning nickel-titanium archwires and the occlusal bite ramps. An adequate overbite was achieved, which is vital for post-treatment retention and stability.[10]

Anchorage control played a crucial role in achieving the desired occlusal and skeletal outcomes. Given the severity of crowding and the presence of ectopic canines, a moderate anchorage strategy was implemented for the upper arch, incorporating a trans-palatal arch to provide the necessary stability. For the lower arch, minimum anchorage was used during leveling and alignment, followed by moderate anchorage utilizing a lingual holding arch to control the retraction of the canines and ensure stability of results. Post-treatment records, including cephalometric superimpositions, panoramic radiographs, and occlusal assessments, confirmed that the treatment objectives were successfully achieved. The final occlusion exhibited well-aligned teeth in both arches, with Class I incisor, canine, and molar relationships, as well as a normal overbite and overjet. Furthermore, the Peer Assessment Rating (PAR) score showed a significant reduction from 46 to 7, indicating a substantial improvement in occlusion and function.

Overall, this case highlights the effectiveness of extraction-based treatment protocols in managing severe anterior crowding and ectopic canines, particularly when combined with precise anchorage control and individualized biomechanical strategies. The successful alignment of teeth, correction of midline discrepancies, and enhancement of overall occlusion emphasize the importance of a well-structured, evidence-based approach in orthodontic management.

CONCLUSION

The unravelling of severe crowding in this case of BSI Class III malocclusion, with a single anterior tooth crossbite, ectopically placed canine, and midline shift in both dental arches on a Class III Skeletal base was successful after the extraction of the four first premolars. There was marked improvement in dental and gingival margin aesthetics, which produced a balanced occlusion and consonant smile after active orthodontic treatment.

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