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Two Phase Orthodontic Treatment of Class II Division 1 Malocclusion Complicated by an Ellis Class IV Fractured Central Incisor - A Case Report

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Abstract

This study reports a case of a 10-year-old boy who presented with a chief complaint of not liking the arrangement of his teeth and the discoloration of an anterior tooth. Mother also complained of a lower lip sucking habit which he performed occasionally and a one year history of trauma to his anterior tooth which was untreated. On assessment, a diagnosis of Angle's class II division 1 malocclusion on skeletal pattern 2 complicated by Ellis class IV fracture of tooth 11, proclined 11 and 21, incompetent lip seal, increased overjet, deep and traumatic overbite, buccal crossbite of 24, moderate spacings in the upper anterior segment, mild crowding in the lower anterior segment, rotated teeth and exaggerated curve of spee in the lower arch was made.

A multidisciplinary treatment plan of Orthodontic and Paedodontic management with a two-phase orthodontic treatment was done. Phase 1 orthodontic treatment was a functional appliance treatment phase using Frankel 2 appliance while Phase 2 was an upper and lower arch fixed orthodontic appliance treatment (non-extraction protocol) after a root canal treatment of tooth 11 had been carried out. Retention was achieved using a combination of upper and lower fixed lingual retainers and an upper Hawleys' retainer.

Conclusion: This study presented a successful orthodontic-endodontic intervention in the management of a 10-year-old boy with Angle's class II division 1 malocclusion on skeletal pattern 2 complicated by a devitalized upper central incisor over a period of 27 months.

Keywords: Functional appliance, multidisciplinary, orthodontic-paedodontic interphase, trauma, Two phase orthodontic treatment.

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Introduction

Class II division 1 malocclusion poses a functional, aesthetic or psychological challenge to individuals with this condition.[1] This form of malocclusion has a prevalence of 1.6% in Benin City,[2] 1.7% in Northern Nigeria,[3] 3.9% in Rivers State[4] and 14% in South-West Nigeria[5]. It has a wide variation in its skeletal and dental presentation amongst which includes proclined maxillary incisors, increased overjet, deep overbite, narrow maxillary arch, mesial positioning of the maxillary molars, short lips, prognathic maxilla and retruded mandible.[1,6,7]

Class II division 1 malocclusion has been found to be a predisposing factor to maxillary incisor trauma.[8] This orofacial trauma results in fractured, discoloured, displaced or avulsed anterior teeth and can have significant negative effect on children.[8, 9] Thus, early orthodontic treatment of Class II division 1 malocclusion to prevent incisor trauma has been recommended.[8,10]

ORIGINAL ARTICLE

This case report presents a multidisciplinary two-phase orthodontic treatment of a 10-year-old boy with class II division 1 malocclusion complicated by an Ellis class IV trauma to the right maxillary central incisor. The Orthodontist utilized a Frankel 2 functional regulator and fixed orthodontic appliance treatment non-extraction protocol while the Paediatric Dentist carried out a root canal treatment on the traumatized tooth. Successful two-phase orthodontic treatment for this complicated condition has been sparingly reported in the south-south region of Nigeria.

Case report

This is the case of a 10-year-old boy who presented to the Paediatric Dental clinic of the University of Benin Teaching Hospital accompanied by his mother. His presenting complaint was "I don't like the way my teeth looks, and I have a discoloured tooth." There was a positive history of digit sucking habit which the mother claimed was discontinued about 6 years prior to presentation. Mother said he then developed a lower lip sucking habit which he performs occasionally. There was also a positive history of trauma to his anterior teeth as a result of a fall one year prior to presentation which was left untreated. Patient claimed the condition did not affect his relationship with friends neither did it affect his speech or mastication. He had no medical history of note, and this was his first dental visit.

On examination, he was in a normal state of health, his face was bilaterally symmetrical, facial profile was convex. He had a class 2 skeletal pattern, lips were complete but incompetent with a Jackson score of 1/0. He was in the mixed dentition stage with teeth 11, 12, 14, 55, 16, 21, 22, 63, 24, 65, 26, 31, 32, 33, 34, 75, 36, 41, 42, 43, 85, 46 present. Teeth 11 and 21 were proclined, 31 and 41 were distolabially rotated and 11 was also discolored. He had an incisal class II division 1 relationship, with an overjet of 15mm on the right and 13mm on the left, overbite was deep and traumatic. There was moderate spacing in the upper anterior segment of 5mm, mild crowding in the lower anterior segment of 3mm with an exaggerated curve of Spee in the lower arch. He also had an Angle's class II molar relationship on the right and left with a buccal crossbite of 24.

Periapical radiograph of tooth 11 revealed signs of pulp chamber calcification and external root resorption, while the dental panoramic radiograph revealed the presence of the complete complement of the permanent dentition in the bone. Lateral cephalometric radiograph revealed an SNA of 84^{o} ($85.5^{0} \pm 3.5$) which was normal, SNB of 77^{0} ($82.7^{0} \pm 3.0$) which implied a mandibular retrognathism, ANB of 7^{0} ($2^{0} – 4^{0}$) which implied a class 2 skeletal pattern, upper incisor to Frankfurt plane of 132^{0} ($119^{0} – 127^{0}$) which implied a maxillary incisor proclination, lower incisor to mandibular plane of 97^{0} ($96^{0} – 104^{0}$) which was within normal range, interincisal angle of 100^{0} ($108^{0} – 116^{0}$) which implied a bimaxillary proclination, Frankfurt mandibular plane angle of 29^{0} ($20.8^{0} \pm 3.1^{0}$) which implied a high angle, lower facial height proportion of 60.2% (50-60%) which implied a slightly increased lower face and a cervical vertebrae maturation stage 3.

A multidisciplinary assessment by the Orthodontists and Paedodontist made a diagnosis of Angle's class II division 1 malocclusion on skeletal pattern 2 complicated by Ellis class IV fracture of tooth 11, proclined 11 and 21, incompetent lip seal, increased overjet, deep and traumatic overbite, buccal crossbite of 24, moderate spacing in the upper anterior segment, mild crowding in the lower anterior segment, rotated teeth, exaggerated curve of spee in the lower arch was made.

Figure 1: Pretreatment Extraoral Photographs

Figure 2: Pretreatment intraoral photographs

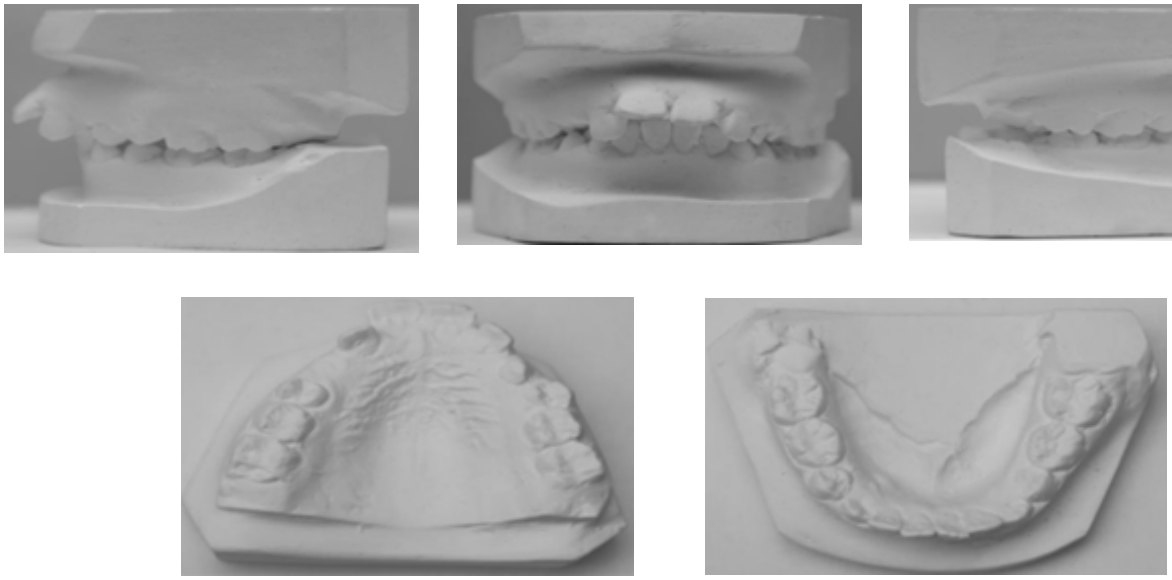

Figure 3: Pretreatment study model

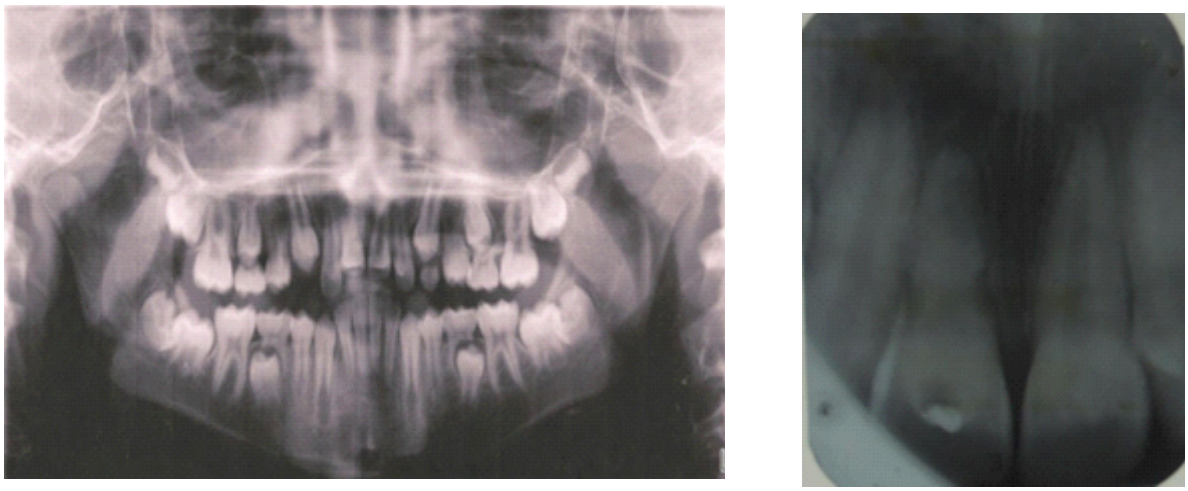

Figure 4: Pretreatment dental panoramic and periapical radiograph

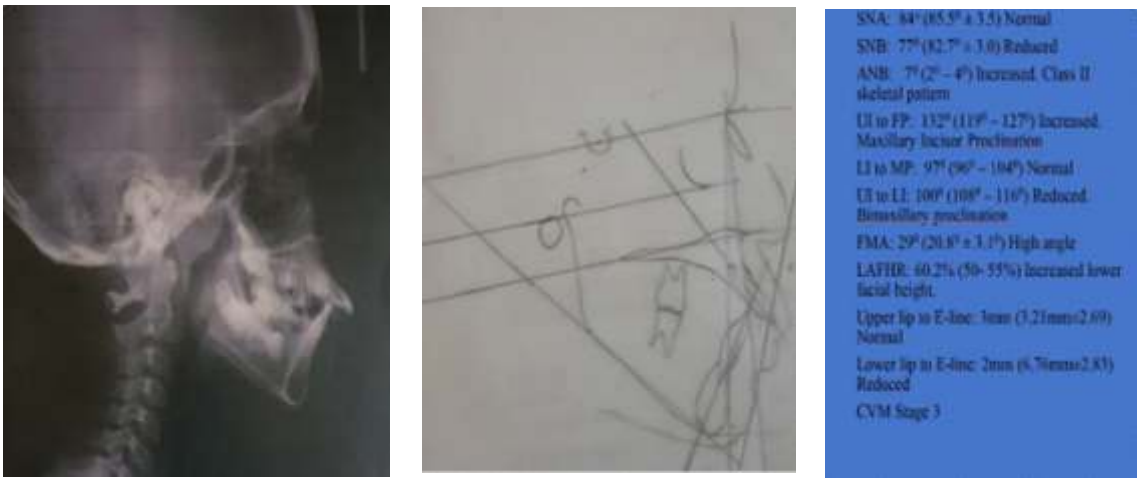

Figure 5: Pretreatment lateral cephalometric radiograph

Treatment objectives

The treatment objectives were to: a) treat pulpally necrosed tooth, b) correct skeletal discrepancy, c) achieve lip competence, d) align malaligned teeth in the upper and lower arches, e) achieve normal overbite, f) achieve normal overjet, g) close spaces in the upper anterior segment, h) achieve class I molar relationship and i) achieve a stable occlusion.

Treatment options/alternatives

The following were treatment alternatives available for the patient

1. Orthodontic-Paedodontic multidisciplinary management: Two phase orthodontic treatment: Phase 1- Functional appliance treatment: Phase 2 - Upper and lower arch fixed orthodontic appliance treatment (non-extraction) with root canal treatment of tooth 11
2. Orthodontic-Paedodontic multidisciplinary management: Full upper and lower arch fixed orthodontic appliance treatment with extraction of teeth 14 and 24 when patient is in the permanent dentition stage with root canal treatment of tooth 11.
3. Orthodontic-Paedodontic multidisciplinary management: Clear aligner therapy with extraction of teeth 14 and 24 when patient is in the permanent dentition stage with root canal treatment of tooth 11.

Due to a favourable cervical vertebrae maturation stage 3 (circumpubertal growth spurt), mixed dentition stage, lower lip sucking habit and motivation of the patient, treatment option 1 was selected.

Treatment Progress (Phase 1)

Patient's root canal treatment was carried out at the Paediatric dentistry clinic and then referred to the Orthodontic clinic where a Frankel 2 appliance was fabricated after making an alginate impression and taking a bite registration. Patient was instructed to wear the appliance for at least 18 hours a day and other post insertion instructions were given. After 5 months on the Frankel 2 appliance, the overjet was reduced from 15mm on the right and 13mm on the left to 9mm on the right and left. Another Frankel 2 appliance was then fabricated. After another 4 months of the Frankel 2 appliance wear, overjet was reduced from 9mm to 6mm. Functional appliance treatment was then discontinued and upper and lower arch fixed orthodontic appliance treatment commenced. Total treatment time for functional appliance treatment with Frankel 2 was 9 months.

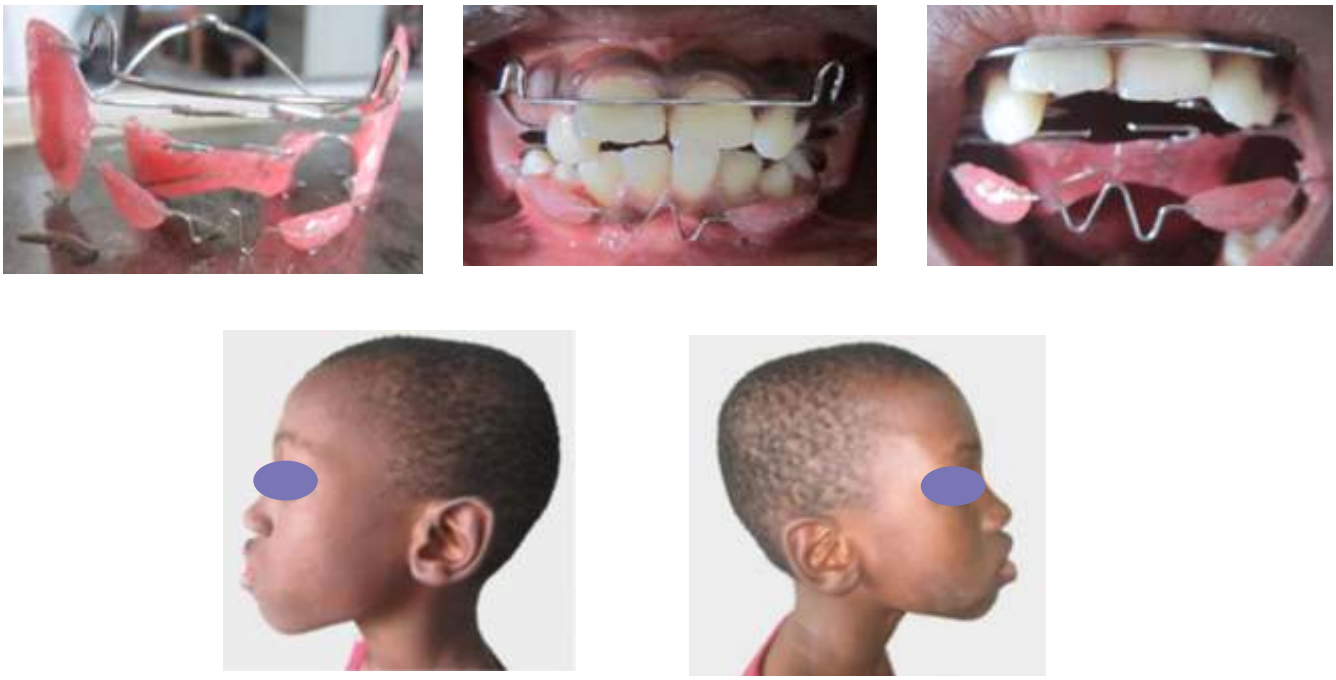

Figure 6: Treatment progress Photographs

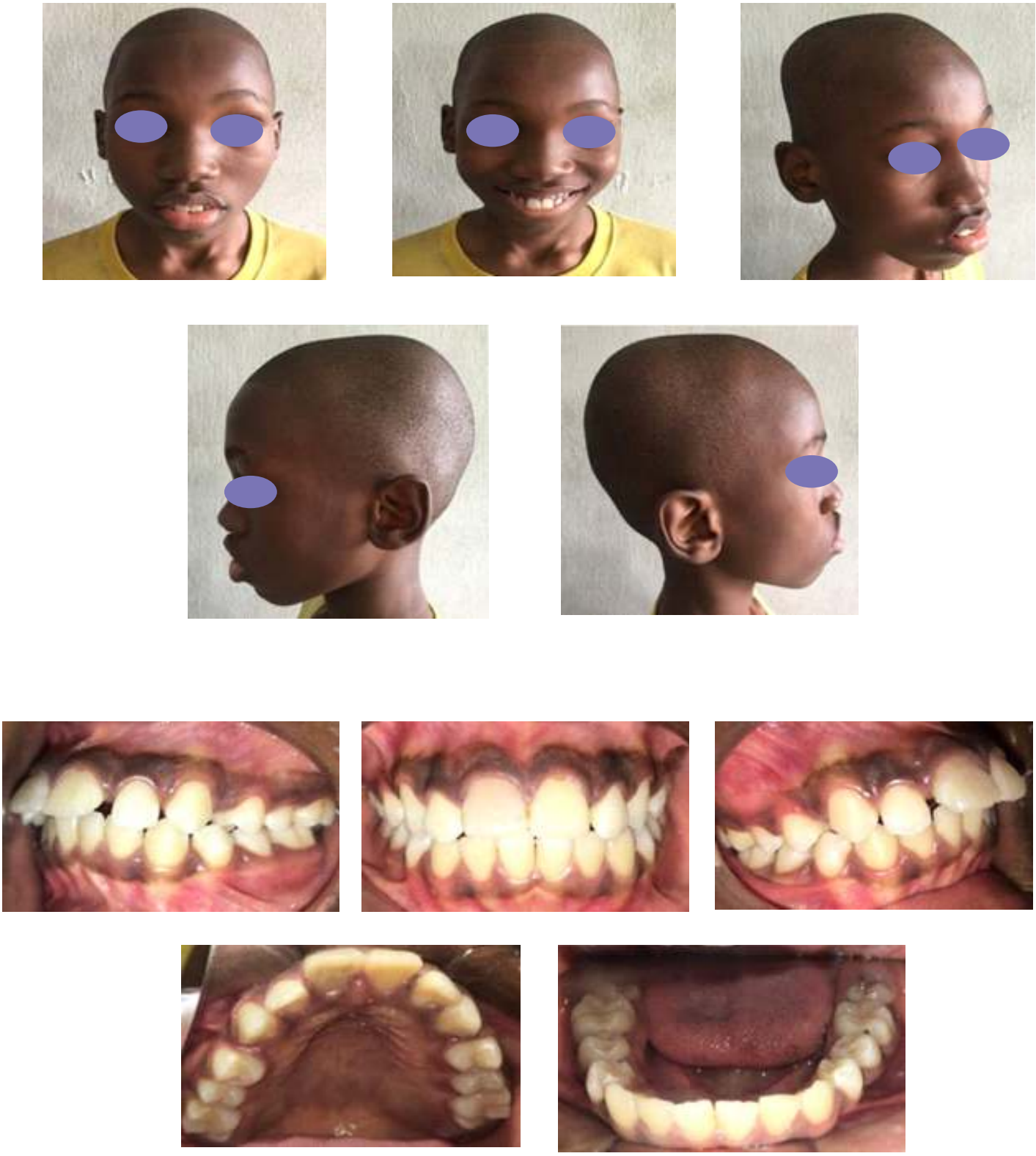

Figure 7: Post functional appliance treatment photographs

Figure 8: Post functional appliance treatment models

Figure 9: Post functional appliance treatment lateral cephalometric radiograph

Figure 10: Post functional appliance treatment dental panoramic radiograph

At the conclusion of phase 1 treatment (functional appliance treatment), patient had an Angle's class I malocclusion on skeletal pattern 1 complicated by: bimaxillary proclination, incompetent lip seal, increased overjet, incomplete overbite, mild crowding in the lower anterior segment, mild spacings in the upper anterior segment and distolabially rotated 31 and 41. The treatment objectives of the upper and lower arch fixed orthodontic appliance treatment were to: Align mal-aligned teeth, achieve normal overbite, achieve normal overjet, achieve competent lip seal and achieve a stable occlusion.

Full upper and lower arch set up was done using the Preadjusted edgewise technique Roth 022X 030 prescription. The starting arch wire was 0.014 Nitinol (Niti) on the upper and lower arches. The arch wire sequence followed was 0.014Niti, 0.016Niti, 0.018Niti, 0.018Niti reverse curve, 0.020 stainless steel, 0.017X0.025 Stainless steel and 0.019X0.025 stainless steel arch wire. Elastic chain was placed on the upper arch from upper right 1st permanent molar to upper left 1st permanent molar. Vertical elastics were prescribed on the posterior segment for proper interdigitation. At 18months 1 week, treatment objectives were achieved as patient and parents were satisfied with treatment outcome. Upper and lower arches were debonded and debanded.

Retention was achieved using a combination of fixed lingual retainers in the upper and lower arches with an upper Hawley's retainer.

Figure 11: Treatment progress photographs

Figure 12a: Treatment outcome photographs

Figure 12b: Treatment outcome photographs

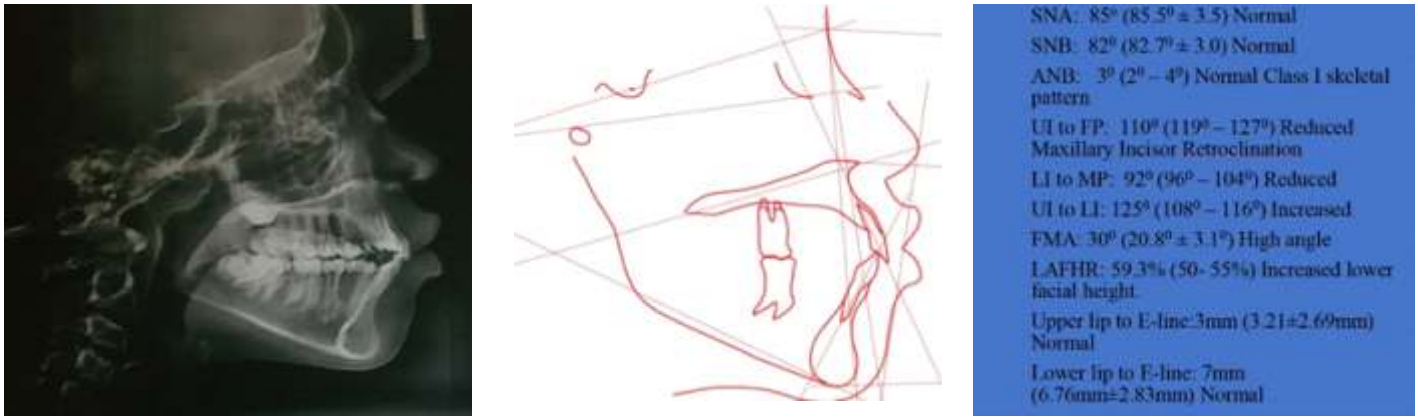

Figure 13: Post treatment lateral cephalogram

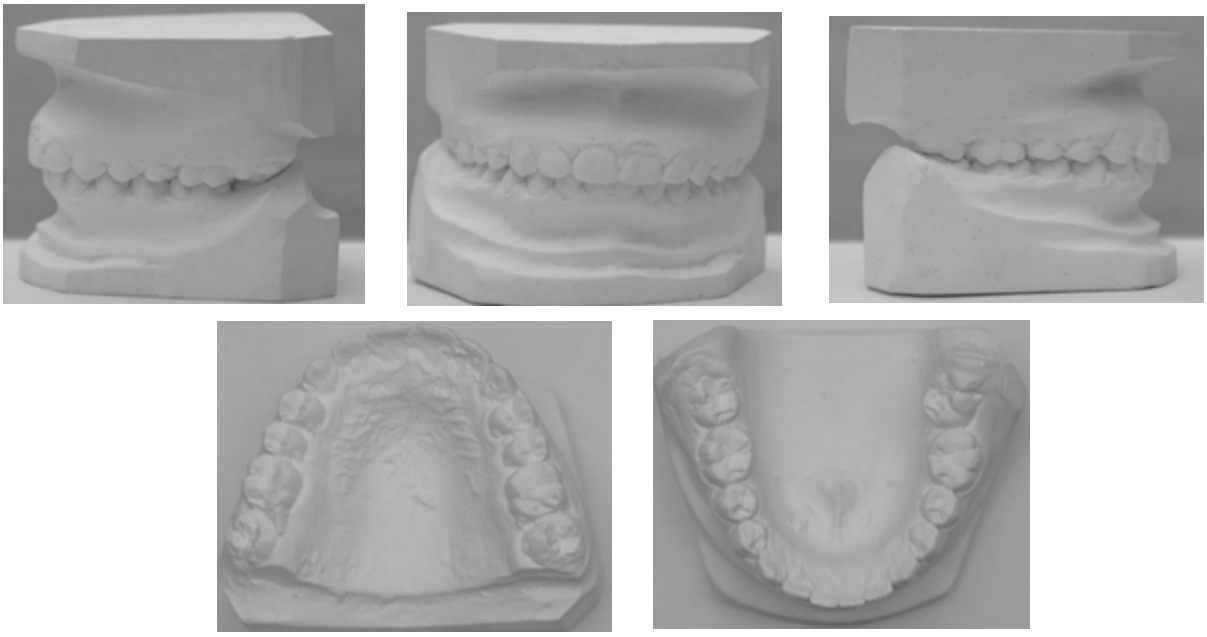

Figure 14: Post treatment models

Figure 15: Retention photographs

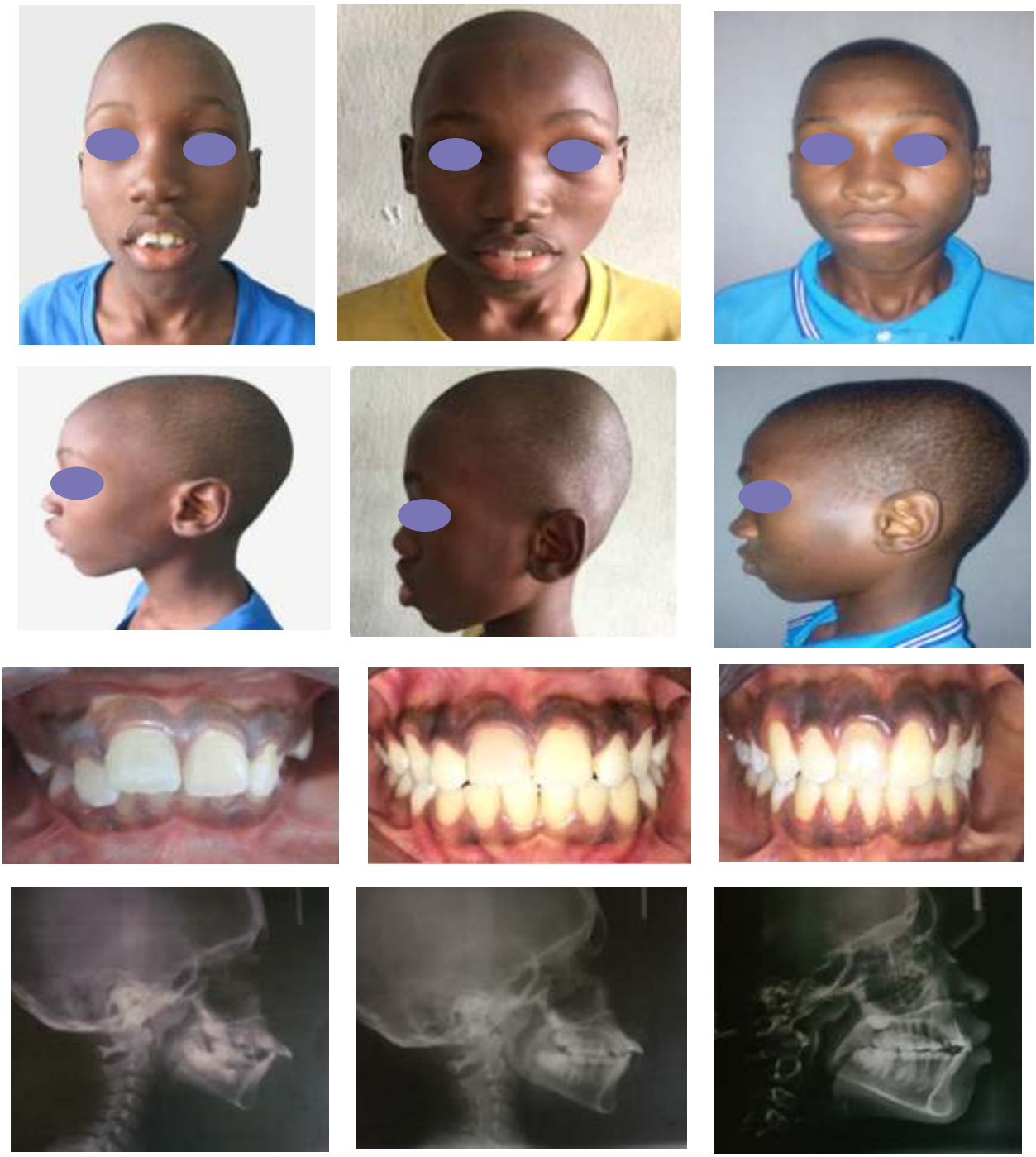

Figure 16: Treatment outcome comparison

Discussion

There are mainly two treatment modalities for class II division 1 malocclusion which are: one phase upper and lower fixed orthodontic appliance treatment and two-phase orthodontic treatment comprising functional appliance treatment followed by an upper and lower arch fixed orthodontic appliance treatment.[11] The one phase orthodontic treatment which is also referred to as a camouflage therapy is usually performed in patients with little or no growth potentials.[11, 12] It may require tooth extractions and treatment outcome may be associated with unpleasant retroclination of the maxillary incisors and proclination of the mandibular incisors.[11] The two-phase orthodontic treatment however aims at reducing or eliminating the skeletal basal bone discrepancy associated with class II division 1 malocclusion.[12] This is usually carried out in patients with growth potentials.[12] This could reduce or eliminate the need for tooth extractions for correction of the malocclusion.[11,12]

Among contemporary functional appliances, Frankel 2 is one of the most popular.[13] It is the most commonly used tissue borne appliance which is named after the inventor Rolf Frankel.[13,14] It utilizes the philosophy of elimination and redirection of orofacial musculature to bring about the advancement of the mandible thereby correcting the malocclusion.[14] Although a minimum wear time for functional appliances to achieve an orthopaedic effect has not been precisely determined, a wear time of 8 to 15 hours per day is recommended.[15-17] This therefore requires a level of compliance and motivation. This patient was encouraged to wear the appliance for at least 18 hours a day which probably resulted in a favourable phase 1 treatment time. This patient was in the circumpubertal growth spurt and was motivated for treatment which probably resulted in the translation of the SNB and ANB from 77 degrees and 7 degrees respectively to 81 degrees and 4 degrees respectively after the functional appliance treatment phase. The above patient also did not require extraction treatment protocol to correct the malocclusion.

Class II division 1 malocclusion which is a predisposing factor to maxillary incisor trauma has been reported to be more common in boys than girls.[6,18,19] Tooth devitalized by trauma has also been found to be more prevalent than avulsed tooth in class II division 1 malocclusion cases.[6] This is in consonance with the findings in this case report. The patient presented was a 10-year-old boy and his right central incisor was devitalized due to trauma. Therefore, it is beneficial to have early screening of malocclusion and provision of preventive measures against orofacial trauma.

Retention in orthodontics entails that teeth are maintained in optimal aesthetic and functional position after treatment.[20, 21] Retention phase therefore is crucial for stability of treatment results.[20] Fixed retainers are commonly used in the retention phase due to their advantage of better aesthetics, less need for patient cooperation and effectiveness for long term retention.[22] They are also indicated in cases with spaces in the anterior segment [23] and cases in which lower inter-canine width is changed.[24] Due to the long term desire for retention and the spaces closed during treatment, upper and lower fixed lingual retainers were given for retention. Hawley's retainer which is composed of an acrylic component with a labial bow and two Adams clasp attached has an advantage of controlling incisor root torque.[25] This characteristic engendered us to make use of the Hawley's retainer for retention in this patient.

Conclusion

This case report presents a successful multidisciplinary intervention involving orthodontic-endodontic treatment in the management of a 10-year-old boy with Angle's class II division 1 malocclusion on skeletal pattern 2 complicated by a devitalized upper central incisor. Endodontic treatment was used for the pulpally involved tooth, while functional appliance was used to correct the skeletal discrepancy, and fixed orthodontic appliance was then used to correct the occlusal anomalies. Retention was a combination of upper and lower fixed lingual retainers with an upper Hawley's retainer. Total treatment time was 27 months 1 week.

Authors' Contribution: All the authors contributed to the manuscript

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Conflict of Interest: The authors declare no conflicts of interest.

References

1. Sidlauskas A, Svalkauskiene V, Sidlauskas M. Assessment of skeletal and dental pattern of Class II division 1 malocclusion with relevance to clinical practice. Stomatologija. 2006;8(1):3-8.
2. Ajayi E.O. Prevalence of malocclusion among school children in Benin city, Nigeria. JMBR. 2008;7(1&2):58-65.
3. Da Costa O. O. The prevalence of malocclusion among a population of northern Nigeria school children. West Afr J Med 1999; 18: 91-6.
4. Aikins EA, Onyeaso CO. Prevalence of malocclusion and occlusal traits among adolescents and young adults in Rivers State, Nigeria. Odontostomatol Trop. 2014;37(145):5-12.
5. Sanu O.O. The Epidemiology of malocclusion in Nigerians of Yoruba ethnic group. F.W.A.C.S. Thesis, Lagos University Teaching Hospital, 1994
6. Isiekwe MC. Malocclusion in Lagos, Nigeria. Community Dent Oral Epidemiol. 1983;11(1):59-62.
7. Tlig A, Dallel I, Tobji S, Benamor A. Mechanical Treatment of Class II Division 1: A Case Report". Acta Scientific Dent Sci. 2022;6(2):68-73.
8. Punati N, Adrij D, Kiran Kumar HC, Sadashiva S, Sapna B. Prevalence of incisal trauma in class II division 1 malocclusion compared to class I control group – a retrospective study. Int J Contemp Med Res 2020;7(12):12-16.
9. Cortes M.I. Marcenes W, Sheiham A. Impact of traumatic injuries to their permanent teeth on the oral health related quality of life in 12-14-year-old children. Community Dent Oral Epidemiol 2002;30(3):193-198.
10. Thiruvenkatachari B, Harrison J, Worthington H, O'Brien K. Early orthodontic treatment for Class II malocclusion reduces the chance of incisal trauma: Results of a Cochrane systematic review. Am J Orthod Dentofac Orthop. 2015; 148(1):47-59.
11. Aristeu Correa D.B, Armando Y.S, Ariel Adriano R.P, Orlando T. Therapeutic approach to Class II, Division 1 malocclusion with maxillary functional orthopedics. Dental Press J Orthod. 2015; 20(4): 99-125.
12. Hsieh WH, Chen HI, Chan CH. Two-Phase Orthodontic Treatment in Class II Division 1 Malocclusion. Taiwanese J Orthod. 2018;30(1): 18-30.
13. Frankel R. The theoretical concept underlying the treatment with functional correctors. Rep Congr Eur Orthod Soc. 1966;42:233–254.

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14. A, José Fernando C H, Renato R A, Weber U. Treatment Effects Produced by Frankel Appliance in Patients with Class II, Division 1 Malocclusion. Angle Orthod. 2002;72(5):418–425.
15. Kutay C, Kilicoglu H, Sayar G. Comparison of objective wear time between monoblock and twin-block appliances measured by microsensor. Angle Orthod. 2021;91(6):749-755.
16. Schott TC, Ludwig B. Quantification of wear-time adherence of removable appliances in young orthodontic patients in relation to their BMI: a preliminary study. Patient Prefer Adherence. 2014;8:1587–1595.
17. Tsomos G, Ludwig B, Grossen J, Pazera P, Gkantidis N. Objective assessment of patient compliance with removable orthodontic appliances: a cross-sectional cohort study. Angle Orthod. 2014;84(1):56–61.
18. Marcenes W, Beiruti NA, Tayfour D, Issa S. Epidemiology of traumatic injuries to the permanent incisors of 9–12 year old school children in Damascus, Syria. Endod Dent Traumatol. 1999;15(3):117-123.
19. Atabek D, Alacam A, Aydintug I, Konakoglu G. A retrospective study of traumatic dental injuries. Dent traumatol. 2014;30(2):154-161.
20. Kartal Y, Kaya B. Fixed Orthodontic Retainers: A Review. Turk J Orthod. 2019; 32(2):110-114.
21. Bearn DR. Bonded orthodontic retainers: a review. Am J Orthod Dentofac Orthop. 1995;108(2):207–213.
22. Chinvipas N, Hasegawa Y, Terada K. Repeated bonding of fixed retainer increases the risk of

enamel fracture. Odontology. 2014;102(1):89–97.
23. Zachrisson BU. The bonded lingual retainer and multiple spacing of anterior teeth. Swed Dent J Suppl. 1982;15:247–55.
24. Lee RT. The lower incisor bonded retainer in clinical practice: a three year study. Br J Orthod. 1981;8(1):15–28.
25. Ramazanzadeh B, Ahrari F, Hosseini ZS. The retention characteristics of Hawley and vacuum-formed retainers with different retention protocols. J Clin Exp Dent. 2018;10(3):224-231.