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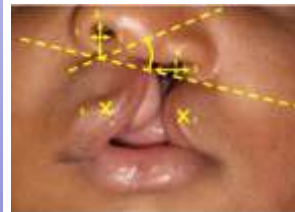
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of malocclusion**



**Orthodontic considerations of
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Peer Assessment Rating (PAR) and Self-reported Improvement of Malocclusion among Patients Treated by Orthodontic Residents in Ibadan

Nkwocha FG^a, Ajibade FA^a, Kosoko JO^a, Lawal OA^a, Jaiyeoba OO^a, Temisanren OT^a

Abstract

Background: Orthodontic treatment brings about an improvement in occlusal features, facial aesthetics, and function. The Peer Assessment Rating (PAR index) quantitatively measures the degree of improvement in the presenting malocclusion following orthodontic treatment as well success of treatment. The aim of this study was to evaluate treatment outcome of patients seen in the orthodontic clinic in U.C.H Ibadan and to compare this with patients' self-reported improvement.

Methods: Study models of the first ten cases treated to the expected standards of an accredited examination body for orthodontic training, by 5 senior registrars were selected. The study models were of patients treated using fixed appliance therapy. Fifty pre and post treatment study models were thus obtained and assessed using the PAR index. Furthermore, the same patients were recalled to assess their self-perceived improvement in their malocclusion using a Likert scale. The data obtained was analyzed using SPSS version 23.0. Variables such as age at start of treatment and treatment duration were also analyzed.

Results: Nineteen (38%) males and 31(62%) females participated in the study. Their ages ranged from 11-26 years with a mean age of 15.7 ± 4.47 . The mean pre-treatment PAR index was 17.96 ± 8.11 and the post treatment PAR index was 4.20 ± 4.43 . The mean percentage reduction in PAR index is 74.87 ± 25.46 . Majority (58%) of the cases showed a PAR reduction of great improvement, while 52% of the patients reported great improvement as the self-perceived outcome of the treatment of their presenting malocclusion.

Conclusion: Patients who had orthodontic treatment as standardized by an accredited examination body for residency training in U.C.H Ibadan showed great improvement in their presenting malocclusion using PAR index, also the patients' self-perception of their treatment outcome was of great improvement.

Keywords: PAR, Self-reported Improvement in Malocclusion Orthodontic residents.

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Introduction

Regular evaluation of treatment outcomes in an orthodontic clinic provides a means for orthodontists to appraise their results, strive to improve treatment outcomes, set clear objectives and encourage high treatment standards in the orthodontic profession.^{1,2} It is a useful guide on policy design and implementation, especially in the training

of orthodontic residents.³

While in training, the orthodontic resident in Nigeria is expected to treat a number of cases of malocclusion, with adequate exposure to the use of fixed and removable orthodontic appliances as well as other orthodontic procedures. The orthodontic resident, presents these cases at the final exam of the accredited examination bodies such as the west Africa college of Surgeons and the National Post Graduate Medical College.

The Peer Assessment Rating (PAR) index introduced by Richmond et al is an occlusal index designed to

measure the change brought about by orthodontic treatment and has been used in various orthodontic clinics⁴.

Using the PAR index involves measurement of patients' pre and post treatment casts and the component of the index includes measurement of: Upper and lower anterior segment-measuring contact point displacement, Left and right buccal occlusion-assessed in antero-posterior, vertical and transverse plane; Overjet assessment including an anterior crossbite; overbite assessment –assessing open bites & overbite depth and centerline assessment. The index scores are weighted according to Richmond et al.⁴

The PAR index however as an occlusal index takes no account of other factors that may be of importance to the total quality of treatment such as side effects such as root resorption, white spot lesions and the patient own assessment of his treatment.⁵ It is very important that the patient is involved in the planning and execution of orthodontic treatment as there has been known to be a discrepancy sometimes between what the specialist aims to achieve and what the patient truly desires. Thus, the objective of this study was to evaluate the treatment outcome of orthodontic patients treated by senior registrars for the fellowship examinations at the Orthodontic Clinic of the University College Hospital and to compare with the patient assessment of their orthodontic treatment.

Materials and methods

A cross sectional study carried out at the orthodontic clinic of the University College Hospital, Ibadan. Pre and Post treatment casts of patients treated by 5 orthodontic residents, which were presented for final post-graduate residency exams in the last 2 years were selected. A total of 50 sets of pre and post treatment casts were obtained, Ten sets from each resident. The selected casts were of good quality and belonged to patients who had full and available orthodontic records including pre and post treatment

pictures and radiograph. These casts represented the patients to be presented by the residents for the final examinations.

The biodata of the patients were obtained from their dental records. Appliance prescription and treatment duration were noted on a data collection sheet. The PAR index was applied on the casts according to Richmond et al.⁴ A pre-treatment weighted score, a post-treatment weighted score as well as a percentage reduction were calculated for each cast and recorded. The same patients were recalled to provide their self-perceived improvement in their treated malocclusion using a self-administered questionnaire with a 5 point Likert scale where 1= Worsened presentation, 2= no improvement; 3 = Little improvement; 4= Moderate improvement and 5 = Great improvement; and their pre and post treatment photographs. The data obtained was analyzed using SPSS version 23.0. The results of the univariate analysis were presented using frequency tables. Means were compared using Student's t- test. The association between age at start of treatment, treatment duration and percentage change in PAR score Pearson correlation. The association between the PAR grade and the patients' self-reported improvement was tested using the Fishers Exact Test as some cells had counts less than 5, and correlation with Pearson's Coefficient. The Level of significance was set at $P \leq 0.05$.

Results

The respondents were mostly females (62%), and their ages ranged from 11 to 30 years, with a mean of 15.98 (SD 4.80) and treated mostly using Roth prescription appliance (88%) Other clinical characteristics of the sample are as shown in Table 1

Table 1: Clinical Characteristics of the Sample

		Number = 50	Percentage %
Gender	Male	19	38
	Female	31	62
Appliance Type	Roth	44	88
	MBT	1	2
	Self-Ligating Appliance	5	10
Treatment Modality	Extraction	16	32
	Non- Extraction	34	64

Mean Age =15.98 ±4.80

Range 11-30 years

The mean pretreatment PAR Index score of the sample was 17.96 (SD 8.12) while the mean PAR Score obtained after treatment was 4.20 (SD 4.43). A total of 78% of the sample had their PAR scores falling into the PAR Category of Improvement. Other PAR Index descriptive for the sample is as seen on table 2 and figure 1. Using the patients' self-assessment, 56% of the sample was assessed as great improvement and 44% as improved. See Figure 2

Table 2: PAR Index Descriptives for the Sample.

	Mean	Standard Deviation
Pre treatment PAR Score	17.96	8.12
Minimum = 1		
Maximum =34		
Post treatment PAR Score	4.20	4.43
Minimum = 0		
Maximum = 19		
PAR Reduction score	13.42	7.40
Minimum = 0.00		
Maximum = 32		
PAR %age Reduction	75.38	25.44
Minimum = 0		
Maximum = 100		

The gender of the respondents, the type of appliance utilized for treatment well as treatment modality (with or without extraction) were noted not to have a statistically significant influence on the treatment outcomes regarding the PAR index. This is shown in Table 3.

There was a negative correlation between the age of patient at the start of treatment and the percentage reduction of the PAR score. Though the relationship was weak (Pearson coefficient = -0.14) and not statistically significant. ($p = 0.92$).

There was also a negative correlation between the total treatment time and the percentage reduction of the PAR score. It was also found to be weak (Pearson coefficient = -0.10, $p = 0.78$).

There was a positive correlation between the patients' self-reported score and the PAR Index though this association was also found to be weak (Pearson's Coefficient = 0.19) and not statistically significant $p = 0.19$. Also only 25% of the cases who had a self-reported score of "great improvement" also had a PAR score for "great improvement" as well. The association between PAR index grades and patients' self-reported improvement is shown in Table 4

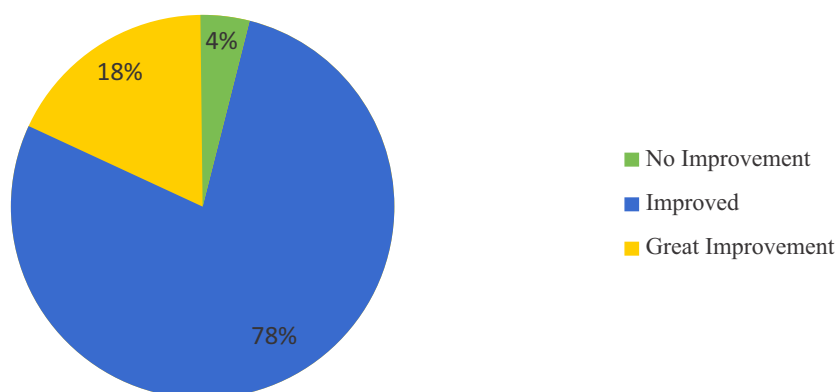
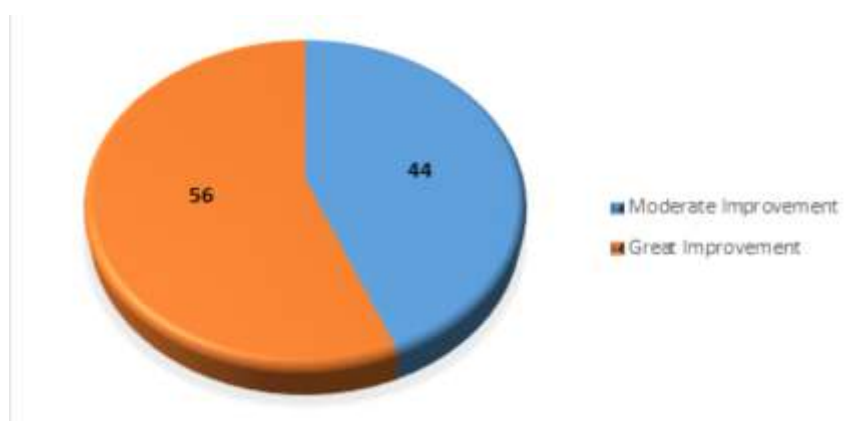
Table 3: Association between categorical variables and PAR Index Scores.

	Pretreatment PAR Mean(SD)	Post treatment PAR Mean (SD)	PAR Reduction Mean (SD)	Percentage Reduction Mean (SD)
Gender				
Male	18.63 (7.30)	4.89 (3.68)	13.74 (6.97)	74.07 (20.41)
Female	17.54(8.66)	3.77 (4.84)	14.00 (7.60)	76.17(28.39)
p value	0.15	0.28	0.43	0.11
Appliance Type				
Roth	17.31 (7.77)	3.86 (4.34)	13.61 (7.36)	75.52(26.39)
Others	22.67 (9.82)	6.67 (4.68)	16.00 (6.99)	74.30(18.84)
p value	0.67	0.91	0.77	0.18
Treatment Modality				
Extraction	20.25 (7.29)	4.69 (5.28)	15.56 (7.22)	77.49 (23.78)
Non Extraction	16.88 (8.36)	3.97 (4.03)	13.11 (7.30)	74.38 (26.48)
p value	0.32	0.39	0.76	0.74

Table 4: Association between PAR Index Grades and Patients' Self-Reported Improvement

Self Reported Improvement	Par Grade N (%)			Total
	No Improvement	Improved	Great Improvement	
Moderate Improvement	1 (4.5)	19 (86.4)	2(9.1)	22(100)
Great Improvement	1(3.6)	20 (71.4)	7(25.0)	28(100)

Fishers Exact Test = 0.40

**Figure 1: Distribution Of Sample According To The Par Improvement Categories****Figure 2: Patients' Self-Reported Improvement**

Discussion

The outcome of orthodontic treatments carried out at various orthodontics clinics and training programmes have been reported.^{1,3} The treatment outcome at the orthodontic clinic, University College Hospital Ibadan has been presented. The mean pretreatment PAR index scores were lower than that observed in other studies⁶⁻⁸, however, the post treatment PAR scores are similar to that from a similar orthodontic training programme in Valencia, Spain⁷ and University of Alabama.⁶ This may mean that cases seen at the orthodontic clinic UCH Ibadan may have been of lower severity compared to the studies above, nonetheless, the treatment outcomes were similar. However, the mean post treatment PAR score in this study was higher when compared with that obtained from another from a graduate orthodontic clinic in the USA⁸. The mean reduction in PAR index in this study was high and similar to that observed in other studies^{6,8,9}. In addition, a large proportion of the patients in the study were in the “improved” and “greatly improved” category with a very small proportion in the “no improvement” category. This means that a high standard of care was achieved in the treatment of patients at the orthodontic clinic of the University College Hospital Ibadan. According to Richmond et al⁴, to produce a high standard of care the mean percentage reduction for a practitioner's case load should be greater than 70%, and the proportion of cases in the no improvement category should be negligible. The mean reduction in a graduate clinic in the USA was reported as 86.2%⁸ and 80.5% in a graduate clinic in Valencia, Spain.⁷

Gender and age at commencement of treatment did not have any significant effect on the treatment outcome in this study. This is similar to observation

from a similar study⁷. The type of appliance used also did not have a significant effect on the success on treatment. This may mean that whatever the appliance prescription utilized for orthodontic treatment, if properly used could bring about improvement even to high standards of treatment. Furthermore, extraction did not affect the treatment success which indicates that good results can be achieved with both extraction and non-extraction treatment especially with careful/proper treatment planning. This is similar to findings from a study⁵ in a graduate orthodontic clinic in Norway.

The patients' perception of their treatment outcome was more of great improvement and moderate improvement. No patient reported “no improvement” nor “little Improvement” in spite of the PAR scores. This shows that patients treated in the orthodontic clinic of the University College Hospital Ibadan are pleased with the outcome of their treatment. Although this was measured subjectively, it has been reported that the lay opinion of malocclusion correlates highly with the orthodontists' opinion of malocclusion.¹⁰ The importance of the patients' input in the process of orthodontic treatment as well as their satisfaction with a treatment regimen cannot be overemphasized. For a treatment regimen to truly be successful, the patient must also be satisfied with its outcome.

The positive correlation between the patients' self-reported improvement and the PAR index scores is expected. This is because patients are likely to become more satisfied and/or impressed as the orthodontic parameters of their occlusion are improved upon. Although this study involved a small sample size, the authors suggest that a study involving a larger sample size be conducted.

Conclusion

At the orthodontic clinic of the University College Hospital Ibadan, orthodontic treatment was carried out to a high standard of care. The patients who received treatment at the clinic reported great improvement in their treated malocclusion.

Based on PAR criteria by Richmond,⁴ it can be concluded that a high standard of treatment is adhered to in managing orthodontic patients at the Lagos

University Teaching Hospital, Nigeria. An overall mean percentage reduction shows the standard maintained in orthodontic treatment at LUTH is high.

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Orthodontic Considerations in the Management of Children with Special Health Care Needs

Aghimien OA

Abstract

Background: Children with special health care needs (CSHCN) include individuals with any form of physical, behavioral, cognitive, emotional impairment and those with specific conditions that are at risk of developing chronic conditions. Due to the peculiarities of this group of individuals, orthodontic treatment should be modified to suit their peculiar needs.

Methods: This review will consider the peculiarities of children with special health care and how it will affect the decisions taken during orthodontic management.

Results: Children with special health care needs are grouped into physical, developmental, behavioral/emotional and those with sensory impairment. They include children with autism, bipolar, Down's syndrome, cerebral palsy, epilepsy and other chronic conditions like asthma and haemophilia. The general presentation of CSHCN like uncoordinated movement and stability, below optimal intellectual performance and poor communication makes management of CSHCN challenging. Also, the increasing prevalence of malocclusion among CSHCN is now making most parents of children with special needs to seek orthodontic care to improve their facial aesthetics and to further enhance social interaction. Modifications of treatment protocol have to be ensured in order to be able to accommodate CSHCN especially with behavioral management, maintenance of oral hygiene and orthodontic biomechanics.

Conclusion: Orthodontic treatment of special need patients should be personalized and simplified as much as possible to meet the patient need. Apart from the motivation to have orthodontic treatment, parents and CSHCN must show enough willingness before they can embark on orthodontic treatment. In the light of this, unbiased orthodontic case selection is critical.

Key words: Orthodontic consideration, Special need

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Introduction

Special health care needs include any physical, developmental, mental, sensory, behavioral, cognitive, or emotional impairment or limiting condition that requires medical management, health care intervention, and/or use of specialized services or programs.¹ For the purpose of prevention, program planning and advocacy for an

inclusive service delivery, the Maternal and Child Health Bureau (MCHB) came up with a broader definition to include those with specific conditions without excluding those at risk of developing this chronic conditions. The MCHB definition states that children with special health care needs are “those who have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally”.² This definition serves as a guide for an organized system of care for both patients and families of CSHCN. It also covers a wide range of individuals including those with developmental disabilities like mental retardation, cerebral palsy,

Down syndrome, attention deficit hyperactivity disorder [ADHD], to those with medical conditions and also people at risk of developing such conditions. CSHCN suffer from wide range of conditions including congenital, genetic, metabolic to severe physical disabilities which often times negatively impact their everyday functionality and their overall health, including dental health. To be able to provide the needed healthcare for this individuals, specialized training is required with additional need for increased awareness and extra accommodative measures beyond what is usually given to the general patient.³ Families and caregivers of CSHCN have considered it arduous and frustrating when attempting to seek dental health care, making oral healthcare one of the most unmet healthcare need for CSHCN.⁴ Lack of training has been highlighted to have contributed to the unwillingness among dentists to provide care for this group of individuals.^{5,6}

Categories and peculiarities of CSHCN

Children with special health care needs (CSHCN) can be grouped into 4 major categories namely; physical, developmental, behavioral or emotional and those with sensory impairment. Children with physical disability include those with muscular dystrophy, epilepsy and cerebral palsy and they usually have problems relating to movement and balance. Sensory impairment include deafness and vision. Emotionally and behaviorally challenged children have difficulty in maintaining interpersonal relationship. They include; attention deficit hyperactive disorder (ADHD). The developmental disabilities include autism, bipolar, Down's syndrome and fragile X syndrome. Other chronic health conditions like; asthma, hemophilia, leukemia, nephritis, rheumatic fever and sickle cell anaemia may also hinder full and effective participation in society on an equal basis with others. The peculiarities of CSHCN involve the affectation of their social interaction, poor verbal and non-verbal communication, poor intellectual performance, uncoordinated movement and stability.

Malocclusion and dental characteristics of CSHCN

Studies have shown that there is a high prevalence of malocclusion among children with special health care needs.⁷⁻⁹ Certain conditions like Down syndrome, cerebral palsy, visual and hearing impairment exhibit more of this malocclusion traits than the general population.¹⁰⁻¹² The dental and occlusal traits include; increase overjet, anterior open bite, anterior and posterior cross bite, class II and III relationships. Some of the aetiological factors linked to the development of these malocclusions among children with special health care needs include: delay eruption, oral habits, and abnormal cranio-facial growth pattern.^{13,14}

Orthodontic considerations in the treatment of children with special health care needs

With the increasing prevalence of malocclusion among CSHCN most parents and caregivers of children with special needs now consider improvement of facial attractiveness as a major reason for seeking orthodontic care to further enhance social interaction.^{13,15} It is important to note that the possibility of achieving an ideal treatment outcome may not always be feasible.¹⁶ In spite of the increasing demand for orthodontic care, majority of CSHCN still find it difficult accessing a dental health profession. Lack of training by the dentists, poor patient corporation and additional time required to treat CSHCN are some of the reasons cited by dentists and orthodontists why they may not be willing to take up orthodontic treatment in their practices.^{6,17} Despite all these challenges, being a special need child is not a barrier to having orthodontic treatment. Orthodontic clinician should be able to modify the treatment modalities that are usually delivered to normal patients to suite CSHCN.

This current review is aimed at bringing to fore the various considerations and techniques deployed during the management of the various malocclusion traits commonly seen among CSHCN.

Behavioral management of children with special health care needs.

Most CSHCN approach the orthodontic clinic with a heightened measure of anxiety which is greater than what is expressed by the general population.¹⁵ The orthodontist is therefore faced with onerous task of gaining their trust and building their confidence to follow through with the entire treatment process. Impaired motor control, uncoordinated movement and hyperkinesis in certain conditions like cerebral palsy, Down syndrome and attention deficit disorder make the children cooperate poorly in dental clinics.¹⁸ This attitudinal display is a stark opposite of the ideal orthodontic patient, therefore, making physical examination, investigation (lateral cephalograph, orthopantomogram) and taking clinical records (clinical photograph, and making of impression) difficult. It is usually important to get patient collaboration especially as long procedure like bonding of fixed orthodontic appliance may need to be performed on the dental chair.

Furthermore, parents and caregiver commitment is a major indicator to consider whether or not treatment will be carried out.

Varieties of modalities ranging from behavioral modification, conscious sedation (with benzodiazepine, nitrous oxide) and general anesthesia are available for gaining patients' cooperation, depending on the particular state of the medical conditions,¹⁹ patient's behaviour²⁰ and the nature of the procedure to be carried out. Severely handicapped patients may be able to tolerate the frequent adjustment during fixed orthodontic treatment but may find it difficult to maintain a stable position when bonding.¹⁶

Behavioral modification: The use of Tell-Show-Do with positive reinforcement should be the standard course of action in gaining the special need patient's cooperation. This is because the negative attitudinal display cannot always be controlled using anesthesia throughout the course of treatment.¹⁵

Sedation: It include the conscious and deep sedation

as adjuncts to behavioral technique. The use of conscious sedation is able to place the special need patient in a relaxed and conscious state. This could be achieve using the inhalational route (Nitrous oxide and oxygen), intra-mucosal (midazolam via nasal drops), orally (midazolam) or intravenously. Intravenous deep sedation is an alternative to general anesthesia where long and complex procedures like bonding of the full arch combined with extraction can be performed.²¹

In the light of this, the choice of the technique to employ in gaining the cooperation of the special need patient could be evaluated using the guidelines presented by Chaushu & Becker.²² The guidelines include the combination of the classification of handicapped children,¹⁹ patients behavioral rating,²⁰ gag reflex, drooling rate, uncontrolled movement, inability to keep still and also the need for additional procedure under general anesthesia.

Maintaining good oral hygiene

Maintaining good oral hygiene is a major factor to consider when contemplating treating a CSHCN because it is major problem usually encountered by parents of CSHCN undergoing orthodontic treatment.²³ Poor cognitive ability, poor muscle control (with lack of manual dexterity) and impaired natural cleansing ability by the oral musculature are reasons why majority of some CSHCN may not be able to maintain a good oral hygiene.²⁴ The orthodontist must gain the commitment of the parent/caregiver on oral hygiene maintenance for the treatment to progress.

- A. The child should be taught how to identify plaque accumulation, gingival inflammation and how to perform an efficient and customized-toothbrushing technique.
- B. Parental tooth brushing should be encouraged especially in cases of severe muscular incoordination.
- C. The use of electric tooth brush can be introduced to assist in brushing
- D. The use of mouthwash to reduce plaque accumulation has also be advocated.

If the required standard of oral hygiene maintenance is not met, the clinician can consider declining to treat the patient.¹⁵

Investigation and diagnostic record keeping

Routine radiographic investigations like lateral cephalograph and dental panoramic radiographs usually carried out before commencing orthodontic treatment are challenging for CSHCN due to the difficulty in gaining their cooperation. Therefore, the following alternative methods could be utilized;

Multiple intra-oral peri-apical radiographs

Conventional extra-oral oblique lateral views of the face and jaws.

Computer tomography (CS) scan under sedation.

Impression making: It may be challenging making impression for patient with exaggerated or extreme gag reflex like Down syndrome due to the tongue position and phobia. Therefore, the use of fast-setting and low viscosity impression materials will help to mitigate against such difficulty.¹⁵ In 2010, Topouzelis and his colleagues also described a modified sectional method of making two separate impressions using left and right halves of an impression tray for uncooperative special need child suffering from Lesch-Nyhan Syndrome.²⁵

Choice of orthodontic treatment technique; fixed or removable orthodontic treatment:

Simplified and individualized orthodontic treatment is advocated for special need patients. Several researchers have reported several findings with regard to the choice of orthodontic treatment to be used among CSHCN.^{23,26} According to a survey conducted by Becker et al most parents of special need children (47.0%) complained that fixed appliance was most difficult to cope with by their children when compared to 11.8% who complained about removable appliance. This finding agrees with

the earlier observation made among non-special need patient, that the problems encountered when wearing fixed appliance were generally more severe than those using removable appliance.²⁷ Most parents of CSHCN also reported that maintenance of good oral hygiene was also more challenging with fixed appliance wear.²³ On the contrary, in a case-control study conducted in 2014 by Abeleira and his colleagues, special need patients were reported to have adapted excellently well to fixed appliance than they did to removable appliance.²⁶

Orthodontists consider placement of fixed appliance for CSHCN difficult due to the several challenges they present with. As a result, the use of fixed appliance should be cautiously utilized and simplified as much as possible. Less complex techniques and the use of modern auxiliary that would require less clinic appointment is encouraged.²³ Consequently, it is suggested that where applicable, orthodontic treatment in CSHCN should begin with a simple removable appliance to ascertain patient cooperation, ability to sustain oral hygiene maintenance and follow simple instruction like activation of expansion screws before progressing to incorporating extra-oral forces.^{23,28}

Modifications when using removable appliance

The retentive component of the removable appliance can be modified by including several retentive clasps to prevent the child from removing the appliance easily.²³

Due to excessive stimulation, it is preferable to use less bulky removable appliance among autistic patients.²⁹

Removable appliance with long range of action that will allow for fewer clinic appointments could be helpful for patient with poor muscle control. The en bloc appliance proposed for the Cranio-maxillary orthopedic correction has been effectively used as an adjunct in the orthodontic management of severe class II malocclusion in a cerebral palsy patient.^{15,30}

Modifications during the placement of fixed appliance

Etching technique: self-etching primer is a single step technique that eliminates the need for separate steps of etching and rinsing. It is technique sensitive and can help save time. It is particularly useful in patient with significant drooling like Down syndrome and cerebral palsy.

Bonding: Children with special health care needs may find it difficult to cope with long time duration required for direct bonding. Hence, indirect bonding under sedation will make bonding faster with lesser risk of aspiration.³¹ Care must be taken to protect the airway to prevent aspiration especially among patients with cerebral palsy and muscular dystrophy occasioned by their compromised cough reflex. This can be ensured by making use of rubber dam or the use of oro-pharyngeal airway pack.³²

Bracket. The advantages of self-ligating brackets can be very useful when managing special need patients. Self-ligating brackets reduce chair side time and allow for short clinic appointment. In order to prevent deformation of the arch wire at the early stage of treatment and also to be to commence early space closure, Tip-Edge bracket can be used because it allows for the insertion of heavier archwire gauge.¹⁸

Extraction: Strategic extraction tailored toward simplifying the treatment modalities should be done. This non-routine form of extraction will allow for seamless correction of crowded segmented and ultimately reduces the entire treatment duration. This is particularly important because achieving controlled space closure in CSHCN may be challenging when the standard protocol of extraction is followed.

Archwire: Advanced memory wire like super-elastic nickel-titanium alloy should be used to deliver light

continuous force, thereby reducing the level of discomfort experienced by the patient.

Dealing with relapse: Active retention may be required in some case especially when a conservative approach has been undertaken for a clear surgical case. For cooperative child with special health need and good cognitive ability, removable retainer could be used, otherwise a fixed retainer is advised for a more predictable retention phase. Extended active period of retention will be helpful among CSHCN with skeletal discrepancies like cerebral palsy, myopathy or macroglossia.

Conclusion

It is quite understandable that there is high prevalence of malocclusion and orthodontic treatment need among CSHCN. However, orthodontic treatment is still considered elective for CSHCN due to the plethora of challenges faced by orthodontists and the need to avoid iatrogenic injuries. Nevertheless, some other authors have stated that it is unjustifiable to deny CSHCN that require orthodontic treatment on the basis of the severity of their malocclusion and possibly a doubtful treatment outcome. It is believed that motivation is not enough to go ahead with the treatment, willingness and gaining the cooperation of both the parents and patients are needed for a successful outcome. In the light of this, unbiased case selection is critical. Orthodontic treatment of special need patients should be individualized and simplified as much as possible to meet the patient need. Advancement in technology, innovative and the commitment of orthodontic clinicians have made treatment of CSHCN possible.

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Presurgical Infant Orthopaedics: The Lagos University Teaching Hospital Experience

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Abstract

Background: Presurgical infant orthopedics is an important aspect of the orthodontic management of children with cleft lip and palate. The aim of this study was to review the literature on its use and to highlight our experiences in the treatment of infants with different PSIO techniques at the Lagos University Teaching University (LUTH).

Methods: A literature review on PSIOs was conducted, in addition, a review of our experiences in the management of children with clefts at LUTH using different PSIO techniques such as the NAM and DNAM appliances was also done.

Results: A wide variety of PSIO appliances exist and the appropriate use of each technique is dependent on some factors including: the type of cleft, available resources, patient factors and operators' skill. The challenges experienced in LUTH in the use of these appliances include, inadequate record taking, loss of patients to follow-up, financial pressures, lack of patients' compliance, language barrier and irritation of the soft tissues in the children among others.

Conclusion: The article has presented a detailed review of different types of PSIO techniques and their clinical applications. The Lagos University Teaching Hospital experience in the use of PSIOs has been a learning curve, various challenges have been highlighted, and lessons have been learned. These lessons have helped in improvement of our treatment protocol.

Keywords: PSIO, LUTH, Experience

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Introduction

Cleft lip and palate (CLP) are the most common congenital malformation caused as a result of variation in the development of facial structures during gestation.¹ These anomalies affect 1 in every 700-1000 live births worldwide.^{2,3} Butali et al⁴ estimated the prevalence rate as 0.5 per 1000 in Nigeria.

Although causes of orofacial clefts are not completely understood, it has been suggested that it occurs as a

result of interplay between multiple genes and environmental factors which influence the risk of orofacial clefts (OFC) either individually or through their interactions in complex biological pathways⁵

Clefts involving lip, alveolus and palate result in disfigurement, distorted growth and development. Facial features depend on the severity of the cleft, the unilateral cleft deformity is characterized by a wide nostril base, separation of the upper lip on the cleft side, lateral and inferior displacement of the affected lower lateral cartilage, a depressed dome, increased alar rim, oblique columella, an overhanging nostril apex, shift in the base of the nose and deviation of the septum to non-cleft side.^{1,6,7}

The bilateral cleft is characterized by a procumbent or rotated premaxilla, significant increase of the alar base width, widely separated lip segments, the flattened nasal tip is tethered directly to the prolabium by a severely deficient or absent columella, the lower lateral cartilages are flared or concave where they should be convex⁶⁻⁸.

Management of children with cleft lip and palate involves a multidisciplinary team who provides comprehensive diagnosis, planning and treatment. The cleft team includes the orthodontist, maxillofacial surgeon, plastic surgeon, pediatrician, paedodontist, speech therapist, ENT surgeon, prosthodontist, and psychologist.^{2,9} All members of the team are equally important and they all work in tandem with each other to improve the patient's appearance, speech and function. The orthodontist is involved in the management pathway at a number of different stages from birth to adulthood¹⁰ including:

Prenatal stage: To provide counselling and support to parents.

Neonatal and Infancy (Birth to 2 months): Prior to lip repair, an orthodontist is involved in a phase of oral orthopaedics to align the displaced cleft segment. This is known as Presurgical infant Orthopedics treatment.

Deciduous/Primary Dentition (2 years to 6 years) : no/minimal orthodontic intervention is done when there is a functional or psychological challenge.

Mixed dentition stage (7 to 12 years)

Early mixed dentition- fabrication of an upper removable appliance to procline the upper incisors and push them out of anterior crossbite.

Late mixed dentition- expansion of the narrow upper arch form to improve access for surgery prior to alveolar bone graft.

Permanent dentition stage (>12 years)

Early permanent dentition- orthodontic treatment at this stage may be conducted to relieve crowding, facilitate the eruption of canine, attempt correction of a developing skeletal class III relationship, align the dentition, correct dental midline.

Late permanent dentition- most patients will present with moderate to significant class III skeletal relationship, due to maxillary hypoplasia hence the need for orthognathic surgery or distraction osteogenesis.¹⁰

Presurgical Infant Orthopedics

Pre Surgical Infant Orthopaedics (PSIO) has been defined as the use of forces to reposition tissues

secondarily displaced due to a cleft deformity.^{1,11} Treatment is initiated in infants as soon as possible after birth usually within 7 days of life.¹² It engages the use of orthopaedic appliances for correction of Cleft Lip and Palate (CLP) defect using compressive and tensional forces or passively guiding growth and aims at reducing the width of the cleft defect, allowing a favorable alignment in the cleft segments within the first few months of infancy prior to surgical repair of the lip. It ultimately allows ease of surgical repair with minimal tension.¹

Mode of action of PSIO

Matsuo^{1,13-15} carried out a series of research on moulding of neonatal nasal cartilage and nostril using silicone tubes. He recognized that the cartilage in newborn is soft and the high level of estrogen at the time of birth correlates with the increased hyaluronic acid which in turn inhibits the linking of the cartilage intercellular matrix resulting in reduction in the elasticity of the cartilage, ligament and connective tissues.^{6,12} The amount of plasticity in neonatal cartilage is highest after birth and gradually reduces as infant grows, the cartilage subsequently loses its pliability at around 6 weeks. Therefore, Presurgical Nasoalveolar Moulding is most successful within the first 3-4 months of life.¹²

Techniques of PSIO

Lip strapping

Cleft of the lip and alveolus of not more than 5mm can be managed using lip taping. This uses medical adhesive tapes such as Steri-strips or Durapore 3M tape placed across the upper lip, the tape offers outer pressure which approximate the upper cleft lip and alveolar gap segment, decreases the width of the nasal base and exerts a retracting and backward pressure against the protruding premaxilla in bilateral clefts thereby permitting the cleft segments to be anatomically located.^{1,16} This ultimately assist lip repair under less tension so that healing is improved and scarring is minimized.

Dynacleft and Nasal elevators

Dynacleft ® is a prefabricated nasal and alveolar moulding device used to mould the upper lip, alveolus and nose prior to lip repair. Unlike the

traditional surgical tapes that were used in the past, Dynacleft® provides a constant approximation force with an elastic center that allows it to conform to the baby's mouth better because of its ability to contract and expand.¹

The controlled force provided to the prolabium and premaxilla improves surgical result and reduces the need for early lip adhesion surgery. Dynacleft with a nasal elevator has provided results similar to NAM appliance, however unlike the NAM appliance, it does not require adjustments with growth of the infant.¹

Nasoalveolar Moulding

The paradigm shifts in the PSIO treatment came in 1993, when Grayson and Cutting¹⁷ introduced Nasoalveolar molding (NAM) in which presurgical molding of the alveolus, lip and nose is carried out in newborns with Cleft lip and palate.

The older PSIO appliances that were used for most cleft treatment protocol were designed to correct the alveolar cleft only with no recognition and management of the nasal deformity. Most nasal deformities are addressed surgically and the patients usually require quite a number of secondary surgical revisions as they grow up.^{1,18}

Grayson¹⁷ described a new technique to mould the lip, alveolus and nose in infants born with CLP before surgery. The NAM appliance is the only Presurgical orthopedic technique that directly addresses both the cleft nasal and alveolar deformity.^{18,19} It works on Matsuo's principle which described that the nasal cartilage could be moulded due to increased plasticity concurrent to increased level of maternal oestrogen if treatment is initiated within the first six weeks of life.^{1,13,15,20}

The NAM appliance has an intraoral moulding plate and a nasal stent. The intraoral moulding plate gradually approximates the displaced alveolar segments resulting in approximation of the cleft segments as well as the medial and lateral aspects of the nose. The nasal stent reshapes and projects the nasal tip while correcting the corresponding deformity of the lower lateral alar cartilage in unilateral CLP and lengthening of the columella in bilateral CLP.¹⁸

Indications for the use of the nam appliance

Patient selection -

Age - Satisfactory results are better achieved if treatment is commenced within six weeks of life. This is because of high levels of maternal estrogen in the fetal circulation which triggers an increase in hyaluronic acid which in turn increases the plasticity of the neonatal cartilage. The use of NAM appliance takes advantage of the high plasticity of the neonatal cartilage in the early postnatal period.

Cleft type - NAM appliance is indicated in patients with complete unilateral cleft lip and palate with associated nasal deformity.

Also indicated in cases of complete bilateral cleft lip and palate with severe displacement of the premaxillary segment, a wide nasal tip and alar base and a severely deficient columella.

Parental compliance- because of the dependent nature of the infants on the parents /caregiver, the success of NAM appliance depends largely on the parents' positive attitude and commitment. The use of NAM appliance is indicated when parents who are taking care of the babies with cleft do not see the procedure as an additional burden on them but are willing to comply.

Parental availability- Since treatment with NAM requires frequent hospital visits for adjustment of the moulding plate and monitoring of treatment progress, patients' selection should be done based on the availability of the parents/caregiver.

Objectives of the NAM appliance

In unilateral cleft lip and palate, the objectives of NAM appliance are: mainly to reduce the severity of the original cleft deformity by reducing the width of the alveolar cleft segments and aligning the base of the nose and the lip segments.^{1,17}

As the alveolar ridge and maxilla improve in relation to each other, there is a concurrent improvement of the overlying soft tissues.

The alar rim which was initially stretched over a wide alveolar cleft deformity becomes lax enabling it to be elevated into a symmetrical and convex form.^{1,17-19,21}

In Bilateral cleft lip and palate, objectives are:

To achieve non-surgical elongation of the columella.

To center the premaxilla along the mid sagittal plane.

To retract the premaxilla, to ensure continuity with the posterior alveolar cleft segments.

To reduce the width of the nasal tip and improve nasal tip projection.^{1,17-19,21}

Benefits of NAM

It allows for proper alignment of the lip, nose and alveolus before primary lip and nose repair. This ultimately enables the surgeon to achieve a better and a more predictable outcome with less tension and less scar tissue formation.^{1,6,22,23}

The stable change in nasal shape with less scar tissue, allows for better lip and nasal form.^{6,24}

It reduces the number of surgical revisions for excessive scar tissue, oronasal fistulas, nasal and labial deformities^{1,7}.

It allows for better positioning of the alveolar segments, and increased bone bridges across the clefts, thereby allowing the permanent teeth have a better chance of eruption in a good position with adequate periodontal support.^{1,6,21}

Complications of NAM

Complications associated with NAM therapy can be classified into soft tissue, hard tissue and appliance related.

Soft tissue complications

Mucosal ulceration- may be caused by under relieved areas of the fitted surface of the moulding plate, excessive activation of the internal surface of the appliance resulting in impingement of the mucosa^{21,25}. The area under the prolabium may also get ulcerated if the strapping is too tight¹. Ulcerations can be resolved by lubricating the mucosa interface, smoothening rough surfaces and relieving overcontoured areas²⁵.

Tissue fungal infections- the full-time wear of the NAM appliance and contact with the oral microflora results in a potential reservoir for infectious organisms. If the moulding plate is not removed daily and cleaned regularly, a candida infection may occur^{25,26}.

Fungal infection is treated with Nystatin or Amphotericin ointment.

Skin ulceration - frequent application and removing of the extraoral surgical tape used to approximate the lip segment and secure the appliance may cause irritation of the facial epidermal tissues especially in the zygomatic process area.^{1,25} This can be prevented by using Duoderm® or 3MTegaderm® underneath the strapping. In addition, the overlying retraction and horizontal tape must be removed once a day usually at bath time and hydration cream should be applied to the cheek. Each time the tape is changed, its position on the patient's face should be varied, this allows epidermal tissue to ventilate.

Tape removal solvent or warm water can facilitate the removal of the tape.

Mega-nostril - is the distended nasal aperture created from excessive tension on the flexible lower nasal alar cartilage^{25,27}. This may occur when the stent application is initiated before the size of the cleft gap is adequately reduced, the premature nasal stenting exerts excessive force against the nasal tissue resulting in excessive alar expansion¹. It may also occur due to improper stent positioning, or nasal over contouring which causes the stent activated forces to be concentrated on the alar rim rather than the nasal dome^{25,28}. This is avoided when the nasal stent is applied and activated by a qualified practitioner.

Hard tissue complications

Locked out segment- occurs due to poor and involuntary moulding process, wherein the greater segment moves more rapidly without a change in the position of the lesser segment. As a result, the lesser segment gets locked out behind the greater segment.¹

Premature eruption of the maxillary incisors as a result of pressure exerted by the moulding plate.^{25,29}

Appliance related.

Dislodgement of the acrylic plate- occurs if the arms of the appliance are tapped too horizontally or the appliance is under activated causing obstruction of the airway^{1,6}. A 5mm diameter hole placed in the center of the moulding plate at fabrication allows for

passage of air in the event that the molding plate drops down from the rear and causes obstruction.⁶

Treatment protocol

Following arrival in the outpatient cleft clinic at the Lagos University Teaching Hospital, the parents of the infants with clefts are seen by the cleft team. Those infants who require PSIO are referred to the Cleft Orthodontic clinic.

At the Orthodontic clinic, proper documentation is done:

A detailed history of each child is taken.

Detailed examination (extraoral and intraoral examination) is carried out. This includes detailed measurement of the cleft size.

Parents are counselled, educated and informed on the benefits, proper usage and duration of wear of the NAM appliance.

Informed consents for photographs and PSIO treatment are taken from the parents/guardian.

Records are taken, this includes baseline photographs (extraoral and intraoral views), primary impression for fabrication of study cast and special tray.

Extraoral views taken include Frontal, Right and Left profiles, Basal view while the intraoral view taken is the maxillary arch using the palatal mirror.

Treatment consists of two main parts: a period of alveolar moulding which is ideally initiated within 7 days after birth, this period lasts for about 6-8 weeks or when the cleft is reduced to 5mm or less and a subsequent period of nasal moulding (6-8weeks) after the main correction of the greater alveolar segments have been achieved.

Procedure for fabrication and use of NAM

A heavy bodied poly vinyl siloxane impression material (PVS) is used to take the primary impression as soon as after birth as possible when the cartilage is plastic and moldable for the fabrication of study cast and special tray. The tray is seated until the impression material is observed to just begin to extrude past the tray borders, the head of the infant is inclined forward to keep the tongue in a forward position and to allow fluids to drain out of the oral cavity.

Once the impression material is set, the tray is removed and the mouth is examined for any residual impression material that may be left behind. The impression is poured with dental stone and a study cast is fabricated. A special tray is fabricated on the study cast, and a secondary impression is taken at the patient next visit.

Following this, a secondary impression is taken, a working/master cast is made and NAM (the moulding plate) is fabricated on the working cast. It is made of a clear acrylic and is lined with a thin layer of denture material. The plate is inspected carefully for areas of overextension which may cause soft tissue ulceration if not relieved.

The appliance is secured extraorally to the cheeks bilaterally by surgical tapes which have orthodontic elastic band at each end. The retention arm is positioned at an angle of 40 degrees down from the horizontal to prevent unseating of the appliance from the palate.

Instructions are given to the parents to keep the plate in the baby's mouth full time, to take it out for cleaning at least once in a day, and to change the tape once wet or dirty. The patient visits the clinic weekly to modify the moulding plate to gradually approximate the alveolar segments and reduce the cleft size (the modification is achieved through the selective removal of acrylic from the region where one desires the alveolar bone segment to move while at the same time, soft denture liner is added to the appliance in the region from which one desires the alveolar segment to be reduced) and to monitor treatment progress.

Closure of the alveolar gap brings the lip segments together, reduces the nasal base width and allows for laxity of the alar rim. The nasal stent should not be added before achieving laxity of the alar rim to prevent an increase in the nostril circumference known as mega nostril. When the alveolar segment is reduced to 5mm or less, the nasal stent is incorporated.

The nasal stent is made from 0.036 guage round Stainless-Steel wire with an acrylic bulb. It is attached to the labial flange of the moulding plate

near the base of the retention arm. It extends forward and then curves backward in the form of a swan neck entering 3-4mm past the nostril aperture. As the wire extends to the nostril, it curves back on itself to create a small loop for retention of the intranasal portion of the nasal stent. This hard acrylic portion is shaped into a bilobed form, a layer of soft denture liner is added to the hard acrylic for comfort. The upper lobe enters the nose and gently lifts the dome until a moderate amount of tissue blanching is seen while the lower lobe lifts the nostril apex and defines the top of the columella.

Patients' instructions

The following instructions are given to the parents for the care of the babies and the NAM appliance:

The appliance must be worn by the patients 24 hours a day, 7 days in a week including when they are feeding.

The appliance is secured extraorally to the cheek and bilaterally by surgical tapes which have an orthodontic elastic at each end. The elastics are attached to the retention arm of the appliance.

Surgical tapes are placed to approximate the cleft segments. The tape should be applied at the base of the nose and not low on the lip near the vermilion border, to prevent undesirable horizontal lengthening of the lip overtime.

The tape should be applied to the non-cleft side first and then pulled over and adhered to the cleft side.

The appliance must be cleaned regularly preferably every morning using water and Milton® tablets.

The tape should be replaced every morning or once it is dirty from feeds.

A thin layer of petroleum jelly should be added on the nasal stent at the time of every insertion to prevent irritation of the nasal mucosa.

The patient should be brought to the clinic every 1 to 2 weeks to modify the molding plate to guide the alveolar cleft segments into the desired position.

Assessment of treatment progress

In order to objectively assess treatment progress, certain standardized measurements are done both on the patients and on the casts pre and post treatment using a pair of dividers and a metre rule.

Extraoral measurements carried out as described by Rau et al³⁰

Intersegmental lip distance (ISLD): This is the distance from the right lip (RL) to the left lip (LL) segment or the corresponding premaxilla lip margin.

Nostril height of the cleft (NHc) and non-cleft side (Nhnc): This is the distance from the highest point of the nostril to the alar base (AB) line (connecting line between the right and the left alar base).

Nostril width of the cleft (NWC) and non-cleft side (Nwnc): The distance from the point farthest right to the point farthest left of the nostril.

Columella deviation angle (CDA): angle between the columella axis and the alar base line in unilateral CL/P.

Premaxilla deviation angle (PDA): angle between the premaxilla axis and a vertical line to the vomer in bilateral CLP.

Columella length (CL): distance from the base of the nose to the highest point of the columella in bilateral CLP.

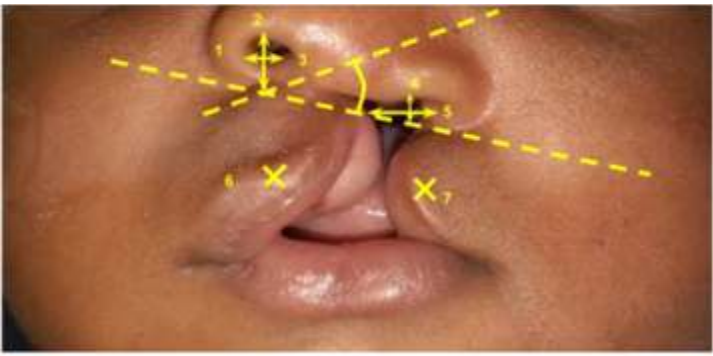


Figure 1: Landmarks on Unilateral Cleft Lip and Palate

- 1. - Nasal width on the non-cleft side
- 2. - Nasal height on the non-cleft side
- 3. - Columellar Deviation Angle
- 4. - Nasal height on the cleft side
- 5. - Nasal width on the cleft side
- 6. - Right Lip
- 7. - Left Lip



Figure 2: Landmarks on Bilateral Cleft Lip and Palate

- 1. - Right Lip
- 2. - Right Premaxillary Lip
- 3. - Left Premaxillary Lip
- 4. - Left Lip
- 5. - Columellar Length

Table 1: Measurement on the patient

Measurements	Explanantion
Bialar Width	Measurements between right and left ala of the nose
Columellar Width	Width of columella at base
Columellar Length	Distance from the base of the columella to the most anterior and inferior point of the nasal tip
Nostril Height	Maximum vertical Length from the floor to the inner aspect of the ala of the nose
Nostril Width	Maximum horizontal length at alar base
Columellar angle on cleft side	Angle formed by joining a line from nasal tip to intercolumnar line and calculated from the cleft side.



Figure 3: ICW - Intraoral Cleft Width, IAW - Intraoral Arch Width

Table 2: Measurement on the cast

Measurements	Explanation
Intraoral cleft width	Distance from the right alveolar crest to the left alveolar crest
Intraoral arch width	Maximum horizontal measurement at crest of alveolar ridge

Lagos University Teaching Hospital Experience: Challenges Encountered and Lessons Learned

Challenges:

Operational Factors

Availability of Equipment and Instruments - Lack of scanning machine which can be used in making extraoral and intraoral scans needed for making study models and the NAM appliance.

Doctor Factors

Deficient Views of Photographs

Initially, not all the required profiles of extraoral photographs were taken, so we had incomplete records of patients extraoral photographs.

Intraoral photographs (maxillary arch views) were taken without palatal mirrors.

Unstandardized Measurements

Standardized measurements were not taken pre and post treatment to assess treatment progress, we simply eyeballed and compared final result with previous photos that were taken before the initiation of treatment. This method is subjective and forestalled objective assessment of treatment progress.

Patient Factors

Loss Of Patients to Follow Up - few patients came into the clinic, intraoral impressions were taken for fabrication of special tray and NAM but they did not come back to complete these procedures while others were lost after the appliance was fitted.

Some of the patients are living a far distance from the hospital and had to travel a long distance before arrival at the clinic

Finances available for transport also affected some parents' compliance

Language Barrier- we had parents that do not speak and understand English language, so we had difficulties communicating effectively with these parents. This in turn affected our treatment.

Few parents also attempted to boycott PSIO treatment and presented themselves to the Oral and maxillofacial Surgery clinic for cheiloraphy while they were still on PSIO treatment without being certified ready for surgery by the orthodontist.

Some patients could not tolerate the NAM appliance when fitted, the appliance irritated the soft palate, she kept retching and so there was a need to modify the appliance.

Lessons learnt

We learned to take the complete profiles of extraoral radiographs. This includes frontal, right profile, left profile, basal views.

We now have suitably sized palatal mirrors for newborns, allowing for standard maxillary arch view. Standardized measurements are now taken pre and post treatments using a pair of divider and meter rule in order to allow for objective assessment of treatment progress.

Enquires must be made about parents' availability and financial ability to be able to bring the babies to

the clinic for treatment and financial help should be provided for those that lack finances for transportation.

Speak the language they understand for effective communication and a good treatment outcome.

Constant communication with patients through phone calls, whatsapp videos, photos sent by parents encourage parents and help to show parents we are in this together as this is often a traumatic period for them.

There is a need to work as a team, the full cooperation of the oral and maxillofacial surgeon with the orthodontists is required. The Orthodontist must confirm a patient eligibility for surgery having completed the PSIO treatment before the surgeon carries out the lip repair.

Treatment should be individualized, there may be a need to modify or change the appliance type in some cases.



Pretreatment



Naso-alveolar
moulding Appliance



Appliance in
patient's mouth



Post Treatment



Pretreatment



Aligner Appliance



Appliance in
patient's mouth



Post Treatment

Conclusion

This article has presented a detailed review of the different types of PSIOs and their clinical applications in the orthodontic preparation of children born with clefts for surgical repair. We have also highlighted our experience at the Lagos University teaching hospital in the use of PSIOs,

citing the challenges experienced and the lessons learnt so far.

Authors' contribution - Contributions equally made by all the authors

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Case report: Management of Angles Class I Malocclusion with Bimaxillary Dentoalveolar Proclination

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Abstract

A 31-year-old Ghanaian lady presented with a chief complaint of diastemata. The clinical examination showed a flat profile, with proclia of the upper lip using the rickets aesthetic E line, a class I malocclusion with bi-maxillary Dento-alveolar proclination, retained deciduous tooth, ectopic premolar and multiple spacing.

Extraction of the deciduous tooth with auto-transplantation into a prepared socket of the deciduous tooth, with subsequent space closure. The active treatment was Eighteen (18) months.

Keywords: Angles Class I malocclusion, Bimaxillary proclination,

anterior alveoli.

In 1897 the term bimaxillary protrusion was coined by Calvin Case, describing "a condition in which the entire dentures of both jaws are protruded in relation to the mandible and other bones of the skull", and that "a receding chin always aggravates this deformity".

Another definition describes bimaxillary protrusion as "a condition characterised by protrusive and proclined upper and lower incisors and an increased procumbency of the lips

A primary tooth is retained beyond the time of normal exfoliation in some cases. This results in an extended life for that tooth which usually has a good crown, roots, and supporting alveolar bone, and can offer an adult patient many years of service. However, persistent teeth can lead to some clinical problems, including periodontitis, profound caries, and

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Introduction

Bimaxillary dentoalveolar proclination is the condition where the upper and lower dental arches are proclined, thus increase lip fullness.

Patients with bimaxillary proclination may demonstrate increased incisor proclination and protrusion, a vertical facial pattern, increased procumbency of the lips, a decreased nasolabial angle, and thin and elongated upper and lower

ankylosis, and in most cases, tend to push the permanent teeth out of the arch perimeter, making them ectopic.

Diastemata are gaps found in between teeth. In adults, the aetiology is varied - arranging from the size of the teeth in relation to the jaw, missing or microdontic teeth, oversized labial frenulum, habits, and many more. Treatment is usually not necessary

for medical reasons, but most times, for purely cosmetic or aesthetic considerations. The presence of these various conditions may lead to malocclusion, which may require orthodontic treatment.

Presenting Complaint

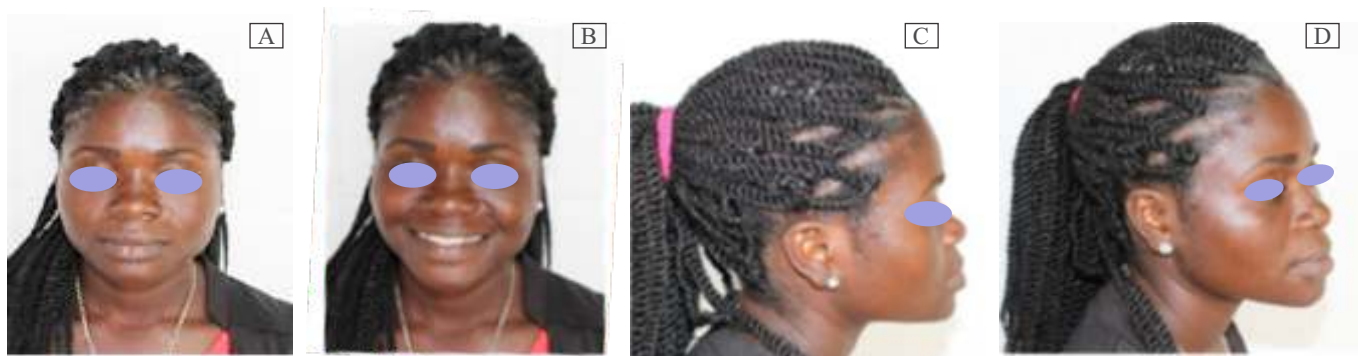
A 31-year-old Ghanaian female patient presenting at the Komfo Anokye Teaching Hospital in Kumasi,

Figure 1

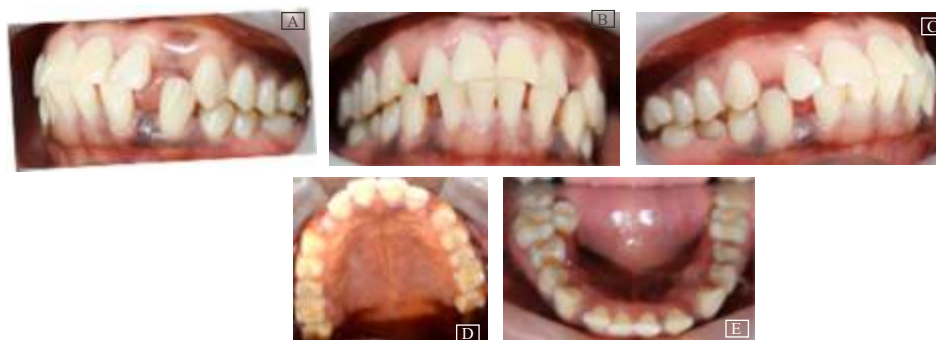


Figs. A and B show ectopic premolar and deciduous second molar, C shows the root-treated transplanted second premolar

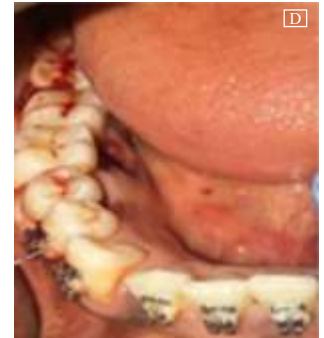
Figure 2: Pre-treatment facial and intraoral photographs



A-Frontal view, B- lateral view, C posed smile, D- ¾ view



A-maxillary occlusal view, B-left lateral view, C- right lateral view D- frontal view, E- mandibular occlusal view



A - Sockets of extracted deciduous tooth and ectopic tooth,

B - extracted teeth in normal saline in a kidney dish,

C - transplanted premolar slanted to 44 and 46, with 0.4mm stainless steel wire

D - post-op day 7, after wire splint removal

with the chief complaint of multiple spaces in the anterior maxillary and mandibular region

Medical and Dental History

There was no significant medical history, but past dental history revealed an episode of gingival swelling around the right mandibular first 1st molar region.

Diagnosis

Clinical Assessment

Extra oral findings: examination showed a flat profile with proclia of the upper lip, facial symmetry and a mesocephalic. Lips were competent with equal facial proportions (figure 2)

Intraoral findings

Examination showed full complement of adult dentition with a retained deciduous second molar in the right mandible, and a lingually placed second premolar spacing in the maxillary and mandibular anterior regions, distal to the laterals. There was an edge-to-edge bite and enamel wear from attrition (figure 2)

The clinical examination suggested Canine guidance with no temporomandibular joint symptoms.

Radiographic Assessment

Panoramic findings - this revealed all teeth in

permanent dentition with a retrained deciduous tooth. Periapical findings revealed no root resorption, Caries or periapical lesions(figure 1)

Cephalometric findings (figure 4 and table 1)

Bimaxillary Protrusion

Bimaxillary Dentoalveolar Proclination

Skeletal class III base

Normal vertical proportions

Treatment Objectives

Address deciduous 85 and ectopic 45

Correct rotations of teeth

Normalize overbite and overjet

Level and align arches and close spaces

Address maxillary and mandibular incisal attrition

Reassess and Retain corrected results

Treatment alternatives

Two alternatives were presented to the patient

1. Combined orthodontic and restorative treatment with the extraction of both deciduous tooth and ectopic premolar, with subsequent replacement of extraction space with a prosthesis.
2. Or orthodontic treatment with transplantation of ectopic premolar into the extraction space of the deciduous tooth.

After a review of the risks, benefits, and financial implications, the patient chose the second

alternative because she wanted to have her full set of teeth, for religious beliefs and because the cost of the prosthesis was not affordable to her.

Aetiology of the Malocclusion

Primary – 1. Skeletal

Secondary - 2. Dento-alveolar and
3. Dental

Clinical Diagnosis

Plaque-induced gingivitis

Retained deciduous 85

Ectopic 45

Maxillary and mandibular labial segment diastemata

Bimaxillary Dento-alveolar Proclination

Bimaxillary Protrusion

Treatment progress

Orthodontic treatment began on the 4th of February 2019, with preadjusted 0.022-inch brackets with MBT prescription were bonded, engaged with 0.014-inch nickel-titanium archwire ligated to all maxillary and mandibular teeth, except the deciduous and ectopic teeth. Both arches were levelled and aligned, beginning with 0.014-inch nickel-titanium arches, and progressing up to 0.019x0.025-inch stainless steel archwires (Table 2).

The deciduous tooth and ectopic premolar were extracted by deepening the extraction socket of the deciduous tooth to accommodate the roots of the premolar. The implanted tooth was splinted with a 0.4mm stainless wire, while the composite lingual and root canal was commenced on the 7th Day (Figure 3).

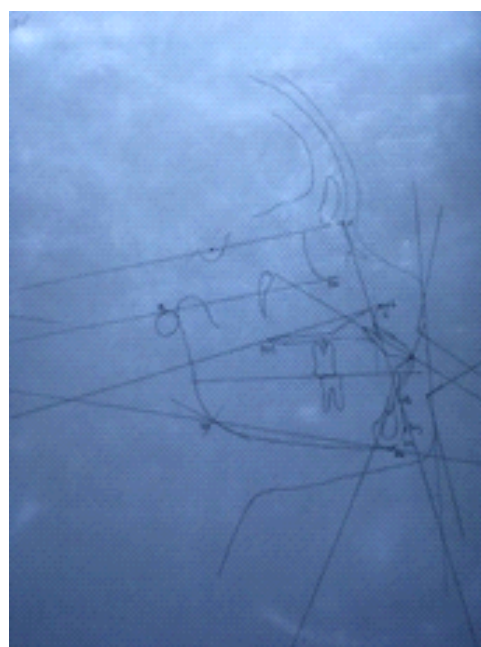


Figure 4. Lateral Cephalogram and Cephalometric Tracing

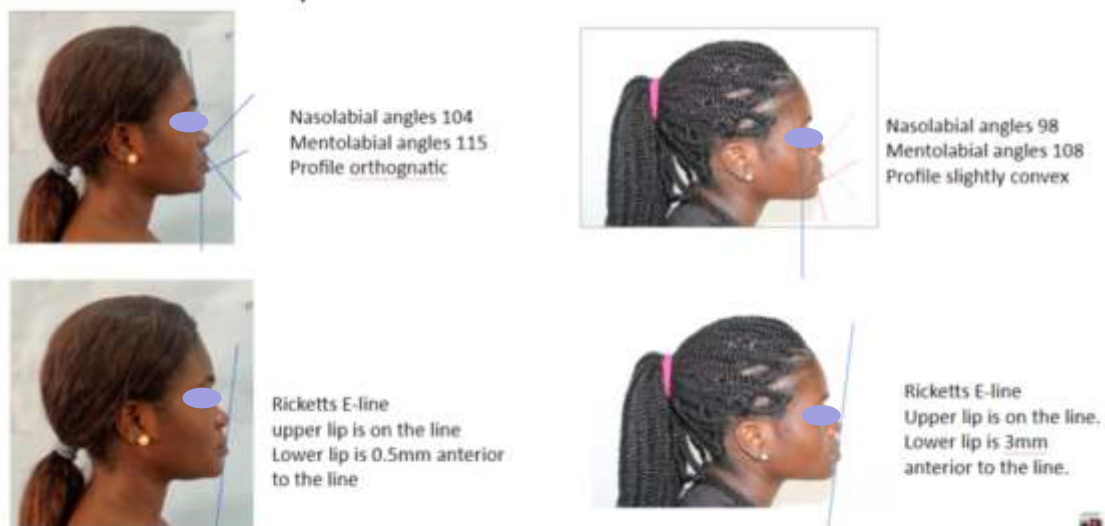
Table 1. Pre Treatment Cephalometric Values

Parameter	Patients Values	Ghana (Fadeju et al, Dec 2012)
Skeletal (Sagittal)		
SNA	94°	88.60° ± 4.02°
SNB	94°	83.34° ± 3.38°
ANB	0°	5.37° ± 2.24°
Wits Analysis	7mm	3.58° ± 2.55 mm
Dento-Alveolar		
UI-MxPl	130°	120.94° ± 7.13°
LI-MnPl	108°	98.74° ± 7.98°
UI-LI Angle	98°	112.76° ± 10.12°
Vertical		
MxP-MnP Angle	26°	27.84° ± 5.78°
SN-MnP Angle	31°	33.76° ± 5.77°
SN-MxP Angle	5	
Facial proportions	58.82	56.52% ± 2.3%

Table 2 - Archwire Sequencing Used In Treatment

Dates/visit	Upper Arch	Lower Arch
1 ST - 3 RD Visit	0.014 NiTi	0.014 NiTi
4 TH -7 TH Visit	0.016 NiTi	0.016 NiTi
8 TH -10 TH Visit	0.020 SS	0.020 SS
11 TH -20 TH Visit	0.019 x 0.025 SS	0.019 x 0.025 SS

**Figure 5**

Extra Oral Profile Comparisons**Extra Oral Profile Comparisons****Figure 6****Soft tissue Comparisons****Figure 7****Root canal after Autotransplantation****12 month Post Autotransplantation****figure 8**

Discussion

Space closure and its retention in an adult can be a difficult treatment to carry out when the occlusion seems stable. The desire for an aesthetic-looking smile has been the determining factor for most patients who seek orthodontic treatment for space closure.

The aetiology is varied, ranging from skeletal - where the maxilla or mandible may be large in relation to the teeth; dento-alveolar or dental - where the teeth sizes may be smaller in relation to the dental arches. Closing of spaces in an adult's teeth is therefore challenging and has a high occurrence of relapse.

Auto-transplantation is the surgical repositioning of a tooth within the same patient. It can be thought of as controlled avulsion and re-implantation of a tooth in a new, surgically-prepared socket. Auto-transplantation can be classified into three groups: (1) conventional transplantation, (2) intra-alveolar transplantation, and (3) intentional replantation.

Conventional transplantation (Figure 3) involves moving the teeth surgically from one site to another in the same individual. Auto-transplantation is the term usually used to describe the procedure. This procedure is indicated when there is a case of missing teeth with a hopeless prognosis, in a mouth where an appropriate donor tooth can be used without any negative effects from the loss of its position in the arch. Good candidate donor teeth are those with simple root form, at the optimal stage of root development, easy extraction, and in matching sizes for recipient sites.

Most documented auto-transplanted cases have been in children and adolescents, where there has been successful regeneration of the periodontal ligaments and the teeth had about one-third or half of their root length formed. The problems usually associated with auto-transplanted teeth are root resorption and ankylosis, particularly in adult patients, where the roots are completely formed.

However, in an adult patient, the occlusal forces from mastication and other forms of injuries, over time, lead to the obliteration of root canals, by laying down the reparative and secondary dentine. Ankylosis may not be seen as a deterrent to auto-plantation but the

main concern will be the resorption of the roots. Ankylosis in this particular case study may be an advantage to anchorage control, to retract the anterior segment and close the spaces.

The treatment was performed with the straight wire technique MBT prescription (0.022x0.028)

Leveling and alignment were carried out with a sequence of NiTi round wires. Stainless steel round wires with loops and rectangular posted archwires 0.019x 0.025 (Table 2) were used in the active treatment phase. Retraction of the anterior segment was done with closed coil NiTi springs and the residual spaces were closed with a continuous elastic power chain.

There was improved aesthetics, intraorally and extra-orally (Figures 5, 6, & 7), and 12 months post-auto-transplantation did not reveal any pathological loss of bone.

Conclusion

Space closure in the teeth of an adult patient can be challenging because of the high relapse rate. Dento alveolar proclination is a common occurrence in the afro-Caribbean population and is seen as a stable occlusion if not complicated by any other dental or skeletal aetiology.

Auto-transplantation is a viable treatment option in the management of compromised teeth among patients, once biological principles are adhered to. Treatment success is dependent on a good knowledge of the aetiology of the malocclusion, and the maintenance of a lifelong retention protocol.

Tooth auto-transplantation is a demanding surgical procedure. The possibility of complications and the success rate can be achieved by applying a methodology based on modern guidelines about tooth auto-transplantation. This will ensure that the transplanted teeth will remain functional for a significant period of time, offering another possible treatment plan with various advantages for the patient's oral health.

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Case Report: Management of Angles Class I Malocclusion with Severe Crowding and Midline Shift

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Abstract

A 12-year-old male who reported to the dental unit with his mother complained of teeth not well aligned and requested expert management. Clinical examination showed he had Angles class I malocclusion, ectopic 23, severe crowding in the upper and lower anterior segment, minor rotations in the upper and lower arch, an upper midline shift to the left by 3mm and a lower midline shift to the right by about 3mm, an increased overjet of about 5mm, and a 3mm overbite.

Treatment involved the extraction of maxillary and mandibular first premolars to help relieve crowding and align ectopic canines, and to correct upper and lower midline shifts.

Treatment was workable and simple within an active period of 24 months. The patient was very compliant and received a satisfactory occlusion and an attractive smile.

Keywords: Angles Class I malocclusion, Severe crowding

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Introduction

Tooth crowding occurs when there is disharmony in the tooth-jaw size relationship or when the teeth are larger than the available space.

Tooth crowding can pose an intellectual and technical challenge since the mesiodistal and buccolingual discrepancies must be addressed. A thorough evaluation of the patient will establish the basis for potential treatment options. Crowding leads to dental caries, periodontal diseases, improper cleaning of all surfaces of the teeth, and above all, it is aesthetically unsatisfactory.

Ectopic buccally erupted maxillary canines are one of the frequently encountered conditions in orthodontic

practice.

Orthodontic management involves the creation of space in the arch, for the alignment of teeth into their respective positions. The spaces created could be a result of the expansion or extraction of teeth.

Presenting complaints

A 12-year-old male presented to the Komfo Anokye Teaching Hospital in Kumasi, Ghana, with the chief complaint of teeth not being well arranged.

Medical and dental history

There was no significant medical and dental history, and no known allergies or oral habits.

Diagnosis

Clinical assessment

Extraoral findings

The patient had a convex facial profile, with a Frankfort mandibular plane angle formed anterior to the occiput, which is suggestive of an increased lower anterior facial height. He had protrusive upper and lower lips. He also had a non-consonant smile arch

with 100% of the upper central and lateral incisors teeth showing and about 25% of the ectopic left upper canine.

Intraoral findings

Patient was in the permanent dentition stage of development with all teeth present, except the third molar in all quadrants, as well as partially-erupted second molars. There was severe crowding in the lower and upper anterior segment, stains in fissures of all first molars, and hypoplastic enamel of 15, 23, and 25. Ectopically placed 23, crowded out 33 and 43, and rotation of teeth was observed.

Angles class I molar relationship with unclassifiable canine relationship and an incisor class I relationship 5mm overjet between 21 and 31, 32

3mm overbite between 11 and 41, 42 with about 50% lower incisor coverage.

Upper relative to the facial midline non-coincident with upper centerline shifted to the left by 3mm and lower centerline shifted to the right by 3mm.

Radiographic assessment

Panoramic findings: This revealed the presence of all teeth with ectopically positioned 23 and the crown of all third molars almost complete. No sign of caries, root resorption, or any periapical lesion.

Cephalometric findings: Lateral cephalometric analysis showed a skeletal class II pattern, maxillary skeletal prognathism, maxillary dentoalveolar proclination, and an increased lower anterior facial height. The radiographic images and findings are shown below (Figure 2)

Treatment objectives

The following treatment objectives were adopted:

Improve and reinforce oral hygiene by scaling and polishing, and oral hygiene instructions

Fluoride therapy and fissure sealants of all first molars

Correct rotations of all de-rotated teeth

Extraction of maxillary and mandibular first premolars to align the crowded out lower canines and ectopic upper canines, and to correct the upper and lower midline shifts.

Levelling and aligning the arches

Closure of the remaining spaces

Reassessment of occlusion and retaining corrected results

Treatment progress

Orthodontic treatment began on 20th August 2019, with band cementation on all first molars and bonding of 0.022"x 0.028" inch MBT bracket prescription on teeth. This was done with an initial startup 0.014 NiTi Euroform Archwire for the upper arch and 0.012 NiTi Euroform archwire for the lower arch. Bendbacks were then incorporated to control anterior-posterior movements.

Four weeks after, the transpalatal arch was fixed and the forceps of all first premolars were extracted under local anaesthesia. Retraction of 23 started with a NiTi coil spring with open coils between 22 and 25, and canine laceback commenced in other quadrants after 5 weeks. By 19th May 2020, the correction of the midline had started with the distalisation of 11 and 12, as well as the mesialisation of 21 and 22. By October 2020, an elastomeric chain was used to close the spaces in both arches, and Class II intermaxillary elastics were used for better interdigitation of occlusion.

Settling of teeth started with metallic ligature wire undertie on 0.014" SS wire for both upper and lower arches, it continued with metallic ligature overtire after 6 weeks, with archwires maintained in both arches.

On 24th August 2021, debonding of all brackets was done with all residual composites removed. Enamel smoothing and polishing of all surfaces of the teeth was done and a fixed bonded retainer on palatal surfaces of 15 to 25 and lingual surfaces of 35 to 45 was incorporated. Fissure sealants were applied on occlusal and buccal pits and fissures of 1st and 2nd

permanent molars and fluoride therapy was done. Simple removable Hawley's appliance was delivered and instructions for its use and maintenance were given. The occlusion was checked and oral hygiene instructions were also reinforced.

Treatment results

At the end of the treatment, all teeth in both arches were well aligned with post-treatment radiographs depicting a Class I incisor, canine, and molar relationship with normal overbite and overjet. The

upper centerline was coincident with the midfacial axis and the lower midline of about 0.5mm shift to the right.

The post-treatment cephalogram, panoramic radiograph, cephalometric analysis and superimpositions are shown below. These investigations show a massive growth of the maxilla and mandible during the period of treatment and evidence of mild root resorption within the acceptable parameters compatible with the extent of movement. The one-year follow-up is yet to be done on the patient.

Table 1. PRE TREATMENT CEPHALOMETRIC VALUES

Parameter			
Skeletal (Sagittal)			
SNA	88.6($\pm$ 4.02)	94	90
SNB	83.34 ($\pm$ 3.83)	84	83
ANB	5.37 ($\pm$ 2.24)	10	7
Dento-Alveolar			
UIMxP	102.94($\pm$ 7.13)	112	100
LIMdP	98.74($\pm$ 7.98)	95	86
Dental			
I-IA	112.76($\pm$ 10.12)	115	105
Vertical			
MMPA	27.84($\pm$ 5.78)	40	32



Fig. 1. Pretreatment facial and intraoral photographs.



FIGURE 2 - A) Initial panoramic radiograph, (B) Initial lateral cephalometric radiograph, and (C) tracing.



FIGURE 2A



FIGURE 2B



FIGURE 2C



FIGURE 3- Treatment progress: A, B- Initial bonding; C), D)-post-extraction and TPA insertion; E), F- Canine retraction; G), H- Midline correction; J) Remaining Space closure; K) Lateral open bite closure with elastics; I) Settling

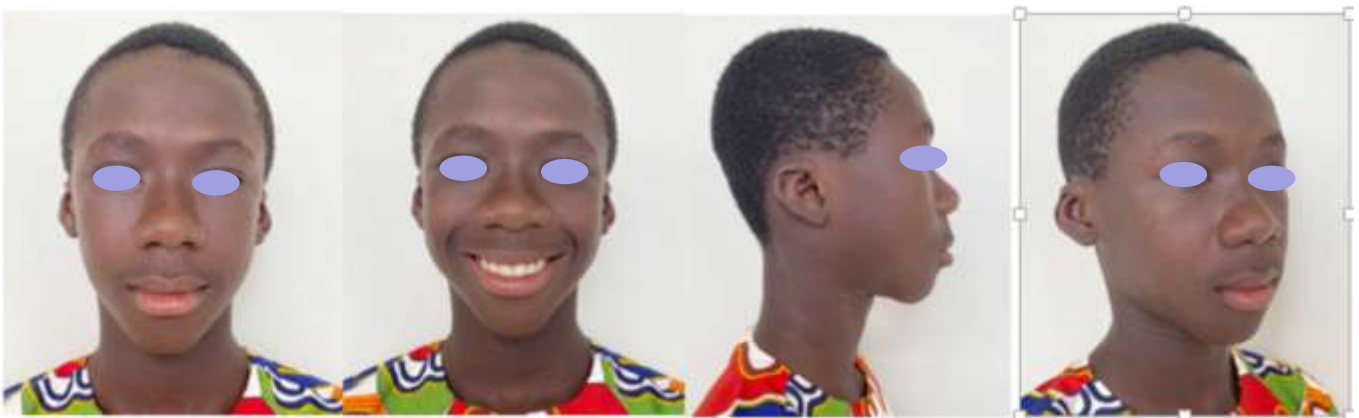


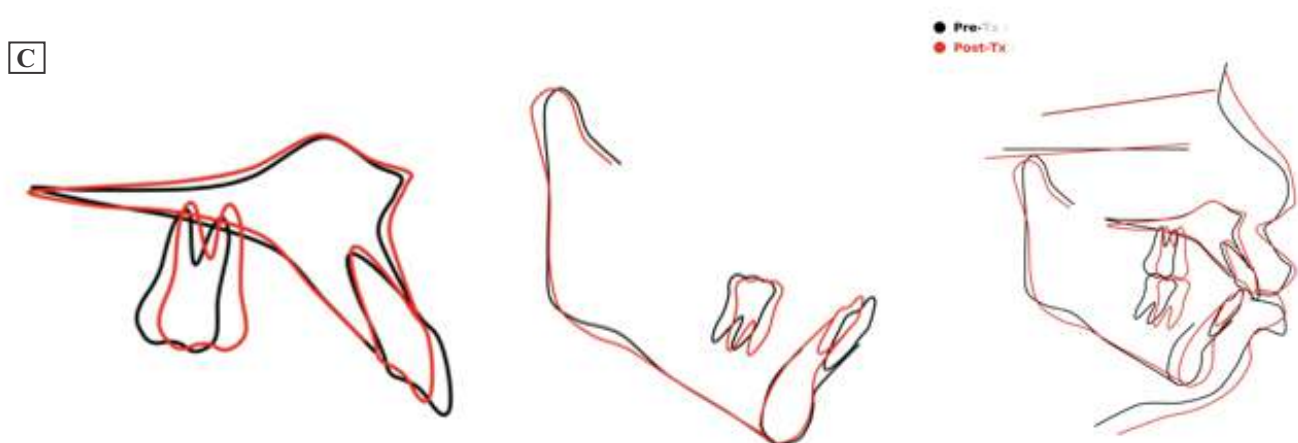
FIGURE 4- Post-treatment facial and intraoral photographs

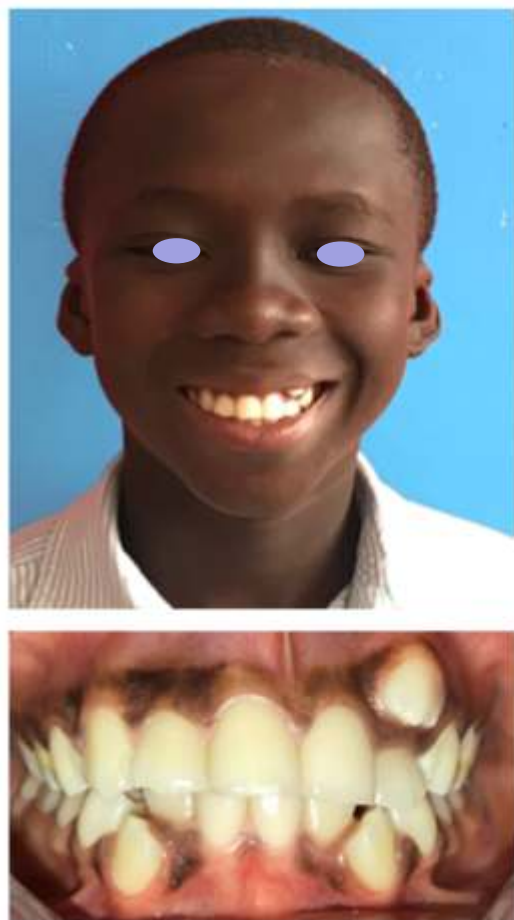
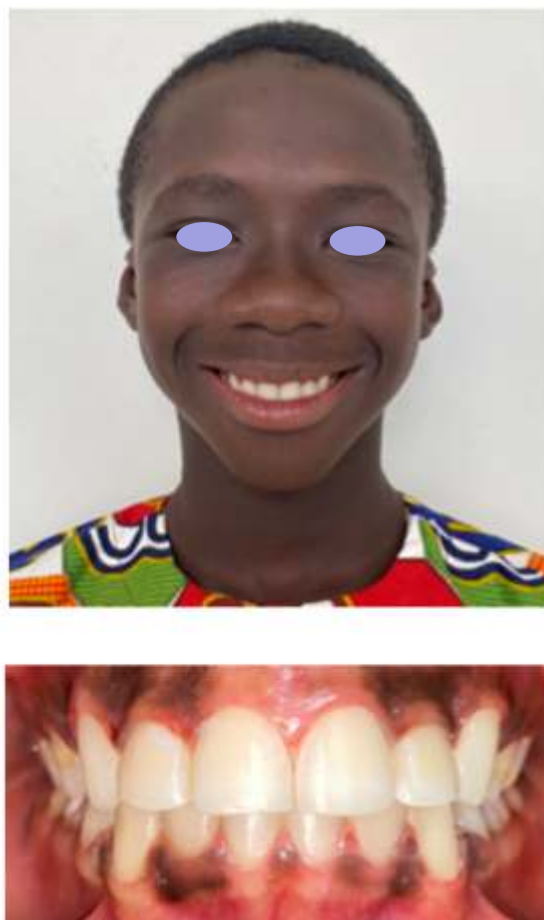


Figure 5- A) Post-treatment panoramic radiograph; (B) cephalogram; and (C) superimposition.



C - Superimpositions



Before**After**

Discussions

Crowding and severe overjet can interfere with social relations. Moreover, dissatisfaction with one's appearance is the main reason why people seek orthodontic treatment. The selection of an appropriate treatment approach may depend upon which factors influence the observed crowding. Extractions are routinely used to address dental crowding. The high prevalence of tooth crowding poses a constant dilemma to orthodontists: which treatment option to follow, with or without extractions? How many and which teeth should be extracted? Based on studies about different types of treatment to alleviate crowding, one of the routine procedures for Class I malocclusion and bimaxillary protrusion, is the extraction of the first premolars.

These teeth are usually chosen because of their position and size, which is compatible with most types of discrepancies in cases that require the retraction of anterior teeth. However, tooth-size discrepancies may also be found in the same case, which will require not only extractions but interproximal stripping as well.

Therefore, because of the severe crowding in the anterior region in both dental arches, the treatment plan included the extraction of the four first premolars to eliminate discrepancies and also make room for the correct positioning of the ectopic canine.

Midline discrepancies are the common problems encountered that pose both diagnostic and treatment difficulties. Midline discrepancy may be either skeletal or dental. Sometimes, the functional shift of

the mandible may contribute to the midline discrepancy. Extraction spaces created in this case were used in the correction of both the upper and lower midline shift before the final space closure in both jaws.

Several anchorage techniques are used for cases of severe crowding with associated ectopic canines. A moderate anchorage for the upper arch, by incorporating a Trans-palatal arch and a minimum anchorage during levelling and alignment, and moderate anchorage with banding of second molars during the retraction of the anterior segment for the lower arch was used.

Conclusion

The correction of severe crowding in this case of Class I malocclusion with ectopically placed canine and a midline shift in both upper and lower arch was successful after the extraction of the four first premolars.

There was a significant improvement in dental and gingival margin aesthetics, which gave the patient a quite agreeable and harmonious smile after orthodontic treatment.

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Conflict of interest - Nil

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Acknowledgements

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