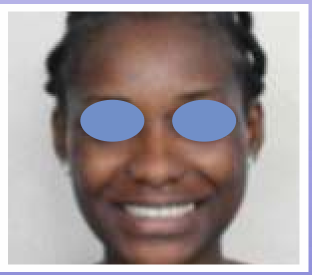
WEST AFRICAN JOURNAL OF ORTHODONTICS

Print ISSN: 2315-9634
E-ISSN: 3141-5822

VOLUME 9, NUMBER 2

DECEMBER 2020

Space closure with active-tieback and Ni-Ti coil springs



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OFFICIAL PUBLICATION OF ORTHODONTIC ASSOCIATIONS IN THE WEST AFRICA SUB-REGION
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West African Journal of Orthodontics

Website: www.nao-ng.com

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Original Articles

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A Comparative Evaluation of Rates of Space Closure using Nickel-titanium Closed Coil Springs and Active Tiebacks in Premolar Extraction Cases

Adebayo O,[a] Sanu OO,[b] Utomi IL,[b] Isiekwe IG[b]

Abstract.

Background: Space closure as an important step in orthodontic treatment requires an appropriate force system. Active tiebacks and Nickel titanium closed coil springs are two methods of force systems available. This study aimed to evaluate and compare the rates of space closure using both methods in premolar extraction cases.

Methods: This was a comparative clinical study with a split-mouth design carried out in the Orthodontic Clinics of Lagos University Teaching Hospital (LUTH) and Lagos State University Teaching Hospital (LASUTH), Lagos, Nigeria between July 2018 and July 2019. Patients who required the closure of first premolar extraction spaces as part of their treatment plan, who met the inclusion criteria and gave informed consent, were randomly recruited for the study. Fifteen subjects having forty-two quadrants were recruited in total. The rate of space closure with Nickel titanium [NITI] closed coil springs and Active tiebacks and a comparison between the two rates were evaluated.

Results: The participants in this study were within the age range of 13-39 years with a mean age of 23.13±9.37 years; 12 (80%) of the subjects were females and 3(20%) were males. The mean rate of space closure with NITI closed coil springs was faster at 1 mm/month when compared to 0.75mm/month for active tiebacks.

Conclusion: Space closure with NITI closed coil spring was significantly greater than Active tiebacks by 0.25mm/month. (p = 0.002) with a confidence interval of 95%. Thus, NITI closed coil spring may be considered a preferred option in various clinical scenarios.

Keywords: Rate of space closure, Nickel Titanium closed coil springs, Active tiebacks

ORIGINAL ARTICLE

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Introduction

Correction of malocclusions in orthodontics requires the extractions of premolars to achieve ideal treatment goals such as facial aesthetics, balanced occlusion, and post-treatment stability.[1-3]

The clinician must properly manage these premolar extraction sites with a known force system to ensure a balanced occlusion and avoid relapse at the end of treatment.[1,4]

Active tiebacks and Nickel titanium closed coil springs are examples of force systems used by clinicians to close premolar extraction spaces.[5-12] To the best of my knowledge there is no study to date among Nigerians where the rate and a comparison between the rates of the two force systems have been evaluated.[5-7] Studies previously conducted have indicated Nickel titanium closed coil springs to have a more consistent and significantly higher rate of space closure than Active tiebacks,[6,7,13] however, different rates have been documented.[6,7,13]

Active tiebacks are known to be cheap, easy to clean, and easy to place, thus, it has the advantage of being delegated during busy clinical hours. [14] They also produce lower forces (200g range) which creates less tipping and less archwire deflection and ultimately reduces friction to permit a more effective space closure.[15-17] Although they must be replaced every 4-6 weeks due to their ability to retain plaque[18] and due to a force loss of 50 to 70% in the first 24 hours intraorally followed by a more steady and stable force decay of 10 to 20% in the first 4 weeks.[14,19-21] Despite these variations in force levels they are widely accepted for effective space closure.[5-7,22,23]

Nickel-titanium (NITI) closed coil springs gained popularity in orthodontics after the introduction of nickel-titanium alloy in 1971.[24] They were primarily made of stainless steel (SS) and cobalt-chromium-nickel (Co-Cr-Ni) alloys.[24] The uniqueness of the Nickel Titanium alloy can be seen in its ability to transition between two phases - martensitic (flexible/low temperature) and austenitic (stiff/high temperature) phase [25]and this transition permits for shape memory and super elasticity; properties not found in any other dental materials.[24,26]

Nickel-titanium closed coil springs have the advantage of not exhibiting the rapid force decay seen with elastomers (elastic modules), [25,27] nor do they display the extremes in space closing forces of stainless steel coils or closing loops.[28] Their use also does not require reliance on patient cooperation, as does the interarch elastic wear[7] and they produce a faster rate of space closure due to the constant force produced by their super elasticity.[5,6,24]Thus, their use for physiologic orthodontic tooth movement is highly recommended.[7,12,15,24,29-31]

They can also be activated once during space closure because the super elastic character of the nickel-titanium alloy they are made from allows a low, constant force to be delivered and maintained over the distance of a whole extraction site.[32] Thus the advantage of reducing chairside time and conserving anchorage.[32]

This study sought to determine the rates of the two force systems among Nigerians and compare the rates to determine if there was any significant difference between the Nickel-Titanium closed coil springs and Active tiebacks in the closure of first premolar extraction spaces.

The study generated baseline rates for Nigerians and more recent data. It compared the rates generated with previous studies done amongst Caucasians [5-8,10,33]and described in detail the experimental method employed which previous studies lacked.[5-8,10,33]

Materials and Methods

In this split-mouth study, subjects were selected according to the following inclusion criteria

subjects with good general health. [American Society of Anaesthesiologists ASA 1]

(Subjects requiring extraction of first premolars in each arch, as in Angles class I: bimaxillary proclination cases; increased overjet in Angle's class II; mandibular prognathism in Angle's class III, and cases with severe crowding. Subjects who were 10–19 years old at the start of treatment representing the adolescent population and subjects who were 20 years and above - representing the adult population. Subjects with full permanent dentition. Subjects undergoing orthodontic treatment with upper and or lower pre-adjusted edgewise appliance (Roth 0.22 prescription Equilibrium® manufactured by Dentaurum) and subjects of Nigerian descent.

The exclusion criteria included the following: 1. Subjects with extra-oral anchorage. Subjects with severe skeletal discrepancy requiring orthognathic surgery. Presence of craniofacial anomalies, such as cleft lip and palate in subjects. Subjects with impacted teeth, with or without surgical exposure. Subjects on self-ligating appliances. Subjects with springs that showed permanent deformation at any of the recall visits. Subjects who were allergic to latex and nickel titanium. Subjects on medications such as contraceptives and bisphosphonates. Subjects who took non-steroidal anti-inflammatory drugs (NSAIDs) e.g. aspirin, ibuprofen, and diclofenac for pain, at any of the recall visits. Subjects were encouraged ahead of time and at every recall visit not to take NSAIDs for pain due to the potential confounding effect of slowing down tooth movement. They were advised to take paracetamol instead.

Ethical approval for the study was obtained from the Health Research and Ethics Committee of the Lagos University Teaching Hospital and Lagos State Teaching Hospital, Ikeja Lagos (ADM/DCST/HREC/APP/2024). The protocol for the study was explained in detail to the patient. Written and verbal informed consent regarding the nature of the study was obtained from both adult and adolescent subjects. Informed consent was obtained from the adult subjects and from the parents of the adolescent subjects whereas assent was obtained from the adolescent subjects.

Participants had their first permanent premolars extracted after which their teeth were levelled and aligned. Levelling and alignment were carried out after the initial set-up of both the upper and lower arches, or the upper arch only with Roth 0.022 brackets by Dentaurum, with the use of a sequence of Nickel-titanium wires. The wire sequence included 0.014, 0.016, 0.018-inch nickel titanium, and 0.020-inch stainless steel wires ligated with an elastomeric module into the brackets at six weeks interval. After the levelling and alignment stage was completed, the second stage was commenced by placing working arch wires i.e.0.019 x 0.025-inch stainless steel archwires with a post (G&H Orthodontics) for one month, to allow torque expression to begin. The arch wires were passive, and this was confirmed by sliding the archwire through the slots of the brackets.

After one month, the working archwire - 0.019 x 0.025-inch stainless steel archwires (G & H Orthodontics) were removed to take clinical photographs and alginate impressions with plastic stock trays of the upper and/or lower arch before the commencement of space closure with Active tie back and Nickel titanium closed coil spring on either the right or left halves of the subject's dentition via randomization in the split-mouth study design.

Randomization was done by balloting once at the beginning of space closure by the subject. The papers were rolled before the arrival of the subject. The random selection of Nickel Titanium closed coil springs or active tiebacks was done to achieve within patient control with the help of a research assistant. Nickel-titanium springs [Medium grade Sentalloy (Superelastic Nickel Titanium Alloy) –GAC International Inc., Central Islip, N.Y.] or active tiebacks with elastomeric modules from [Masel® 0.120 unicycle] were allocated to either the right or left half of each patient's dentition [Split Mouth] via balloting. The patient picked once from a cup of rolled papers containing an equal number of NR and AR and NL and AL with NR representing Nickel Titanium closed coil springs on the right half of the subject's dentition; AR representing active tiebacks on the right half of the subject's dentition; NL representing Nickel Titanium closed coil springs on the left half of the subject's dentition; AL representing active tiebacks on the left half of the subject's dentition. Thus, a subject picking NR signified Nickel-titanium closed coil springs on the right half and automatically active tiebacks on the left half of the subject's dentition. The subject picking AR signified Active tie back on the right and automatically Nickel Titanium closed coil spring on the left half of the subject's dentition. The lettered rolled paper selected by the subject

determined the intervention allocated to the right or left half of the subject's dentition; this was applicable for all subjects, regardless of the involvement of one or both arches.
This study was a single-blinded study for only the subjects were blinded. Each subject was unaware of the side to which each intervention was applied.

Before the impression was taken, the brackets were smeared with Vaseline® petroleum jelly to act as a separating medium in order not to dislodge the brackets while the impression was being taken. The impressions were taken using appropriately sized plastic stock trays under universal infection control measures. The alginate impression was gently rinsed under running tap water at room temperature to remove residual saliva and blood and then shaken gently to remove excess water. The impression was disinfected by spraying a solution of 0.05% sodium hypochlorite prepared with a ratio of 1 in 7 parts dilution and stored in a plastic bag for ten minutes. The disinfectant was rinsed out after 10 minutes with running tap water at room temperature.
The alginate impressions were cast using Gypstone® model stone immediately to prevent dimensional changes due to water gain and stored securely for measurement. The premolar extraction site on the baseline maxillary or mandibular arch casts obtained from the impressions taken was measured with Tresna digital calliper. This was measured from the cusp tip of the canine to the buccal groove of the first molar in all quadrants with the Digital Vernier Calliper with 0.02 mm accuracy and recorded as T0. All measurements on study models were repeated by the same operator (the researcher) three times and the mean was recorded to eliminate intra-examiner variability and measurement error.
The six anterior teeth were tied with a 0.010-inch stainless steel wire (G & H Orthodontics) i.e. [figure of eight]; the two posterior teeth [first molar and second premolar] were also tied with stainless steel ligature made of 0.010-inch stainless steel (G & H Orthodontics) to reinforce anchorage. Anchorage was reinforced to prevent the mesial drift of the first molar, which may alter the results obtained during space closure by the different interventions.
The archwire was then replaced and ligated with elastic modules using straight artery forceps to commence space-closing mechanics.
The Nickel Titanium closed coil springs were 9mm in length with 0.010 x 0.030-inch in diameters. The 9mm coil springs were used to provide a force of 200g. Forces were measured with a TECLOCK® force gauge (YDM Corporation Japan).
The Nickel titanium closed coil spring had two eyelets at either end. One eyelet was inserted into the first molar hook posteriorly whereas the other eyelet with a 25mm length of ligature wire (0.010 stainless steel ligature) in it was stretched mesially and tied anteriorly on the post on the archwire (G & H Orthodontics) just distal to the lateral incisor using straight artery forceps. A force of 200g was ensured with a TECLOCK® Force gauge [YDM Corporation Japan].
The Nickel Titanium closed coil springs were not replaced during treatment, but the force gauge was used to ensure a force of 200g at every recall visit and it was also ensured there was no kinking or deformation of the spring.
The Active tieback was a force of 200g. This was measured with a Teclock® Force Gauge [YDM Corporation Japan]. The active tiebacks consisted of an elastomeric module (Masel®0.120) unicycle and a 25mm length of ligature wire (0.010 stainless steel ligature). The module was held with straight artery forceps (Orthopli) and inserted into the first molar hook, the 0.010 stainless steel ligature has two arms, and one arm was placed beneath the 0.019 by 0.025 stainless steel archwire – (G & H Orthodontics) this ensured the stability of the active tiebacks and kept

the ligature away from the gingival tissues and helped prevent gingival irritation whereas the other arm was held straight and was tied around the brass post of the archwire with the other arm. The two arms were held together around the brass post and the module was stretched to twice its original size. The force was measured using a Teclock® Force Gauge to provide a force of 200g force.

During space closure, subjects were recalled for routine reviews at regular intervals with a mean time interval of one month, up to a maximum of four visits, and alginate impressions were taken at every visit.

At each monthly recall, the active tieback was replaced. Oral hygiene maintenance was reinforced at each appointment by asking the subject to brush after every meal, and the appliances were also checked, and subjects were also encouraged not to use Non-Steroidal Anti-inflammatory Drugs for pain rather encouraged to use paracetamol instead. Arch wires were inspected for any damage; the ends were trimmed using a distal-end wire cutter (Orthopli) to prevent any interference by the second molars from sliding.

No other form of force application (Elastics) was used at any time in the course of the study.

At routine reviews, the amount of space closure was determined from measurements on the study model from the canine cusp tip to the buccal groove of the first permanent molar with a Tresnar® Digital Vernier calliper with a 0.02mm accuracy. Space between the contact points of the canine and second premolar was not used because by 4 months the space was too small for a Vernier calliper to fit into. The study models were obtained from alginate impressions (PRO ALGIN®) taken with appropriate plastic stock trays under universal infection control measures. The study models obtained at each visit were measured three times and the mean was recorded. Baseline measurement (T0) was the measurement taken one month after placement of working archwire (0.019 by 0.025inch) before the application of intervention; T1is the first measurement taken after the commencement of space closure [at 2 months]; T2 is the second measurement [at 3months]; T3 is the third and final measurement (at 4months). The maximum duration of recording was four months. All the different measurements at each monthly interval were tabulated and compared for the two different force delivery systems. A rate of space closure in millimeters per month for each quadrant, and overall for each subject was calculated. The distance moved by the named intervention at every recall visit was calculated by subtracting the final measurement from the initial measurement. Distance moved at each visit = T0 – T1/T2/T3. T0 was the initial measurement taken before any named intervention at 1 month i.e. baseline; T1 was the measurement taken at the first recall visit at 1 month post-intervention; T2 was the measurement taken at the second recall visit at 2 months post-intervention; T3 was the final measurement taken at the third recall visit at 3 months post-intervention.

Rate = Distance/Time

Distance is the measurement from the canine tip to the buccal groove of the first permanent molar recorded at T1/T2/T3

Time is 1month/2months/3months [Post intervention]

The rate of space closure in mm per month (1 month) was calculated by dividing the distance moved with time (1/2/3months).

All measurements were done by a calibrated examiner (researcher). Then they were subjected to analysis by SPSS (Statistical Package for the Social Sciences) version 23.0.0.0.

Measuring the space available on the study model three times and calculating a mean assessed random error. The space available is the space between the canine tip and the mesiobuccal groove of the first permanent molar.

Figure 1A. Intraoral (Right buccal) photograph during space closure with Nickel titanium closed coil spring

Figure 1B. Intraoral (Left buccal) photograph during space closure with Active tie backs

Data was collected using the methods below namely questionnaire-based method and a clinically based method. The questionnaire was an interviewer-administered questionnaire designed for the study. It had two sections; each subject filled the first section while the second section was filled by the researcher after assessing the subject clinically.

The first section of the questionnaire contained the sociodemographic data of the subject while the second section contained the orthodontic summary of the subject. This included type of malocclusion [Angles 1/11/111]; arches involved [Lower/Upper/Both]; site of force delivery system [Upper right or Upper left/Lower right or Lower left].

Statistical analysis

Microsoft Office Excel 2016 16.0.6741.2048 (Microsoft, Redmond Washington) was used to organize the data collected. All the statistical analysis was carried out through the Statistical Package for the Social Sciences (SPSS) version 23.0.0.0 [SPSS Inc., Chicago IL, USA], IBM Corp. [International Business Machines Corporation, Armonk, New York, USA].

Repeated ANOVA was used to determine the mean rates of space closure with NITI closed coil springs and Active tiebacks at different time intervals [T1/T2/T3]. Paired t-test was used to compare the mean rates of space closure between the NITI closed coil springs and Active tiebacks. A Bar chart was used to represent the interventions in the different quadrants.

Dahlberg formula was used to determine random errors and the intra-class correlation coefficient of reliability (ICC) was used to determine systematic errors between the two methods.

Results

A total of 19 subjects were recruited, and 4 were lost to follow-up. Fifteen subjects having 42 quadrants in total were analyzed for the study. These subjects satisfied the inclusion criteria with twenty-one quadrants for each intervention. There were 3 (20%) males and 12 (80%) females with a male-to-female ratio of 1:4. The 3 males recruited were adolescents whereas 4 of the 12 females were adolescents and the remaining 8 were adults. The age range of subjects was 13 – 39 years in the study with a mean age of 13.67±0.58 years for males and 25.50±9.01 years for females with an overall mean age of 23.13±9.37 years. (Table 1)

Table 1: Age and Gender distribution of subjects

Variable	Gender		
Age (Years)	Male	Female	Total
10-19	3 (20.0%)	4 (26.7%)	7 (46.7%)
20-29	0 (0.0%)	5 (33.3%)	5 (33.3%)
30-40	0 (0.0%)	3 (20.0%)	3 (20.0%)
Total	**3 (20.0%)**	**12 (80.0%)**	**15 (100.0%)**
(Mean±SD)	**13.67±0.58**	**25.50±9.01**	**23.13±9.37**

Active tiebacks were applied in nine upper right quadrants and six upper left quadrants; NITI closed coil springs were applied in six upper right quadrants and nine upper left quadrants whereas both interventions in the lower arch were equally distributed i.e. three in both lower left and right quadrants. Active tiebacks were placed more in the upper right quadrant than in any other quadrant whereas NITI closed coil springs were placed more in the upper left quadrants. Figure 2

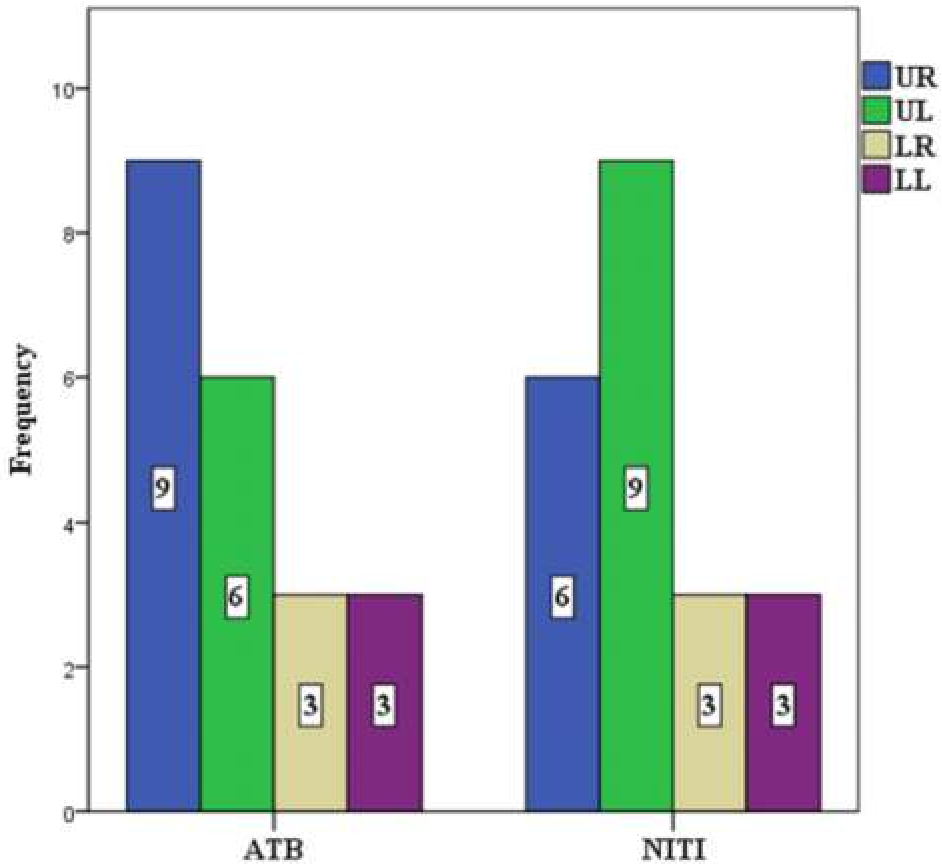

Figure 2: Quadrants in which interventions were applied

The mean rate of space closure using NITI closed coil springs at T1 was observed to be 1.18mm/month. This reduced at T2 and T3 to 0.93mm/month and 0.90mm/month respectively. However, these differences in the rate at the different time intervals were not significant, ($p > 0.05$). Figure 3.

The mean rate of space closure using ATB was measured at one-month post-intervention (T1), two months post-intervention (T2), and 3 months post-intervention (T3). The rate of space closure was highest at T1 (0.87mm/month) and lowest at T3 (0.68mm/month) whereas the rate at T2 was recorded to be 0.72mm/month.

The differences recorded at the different time intervals were not significant statistically, P-value> 0.05. Fig 3.

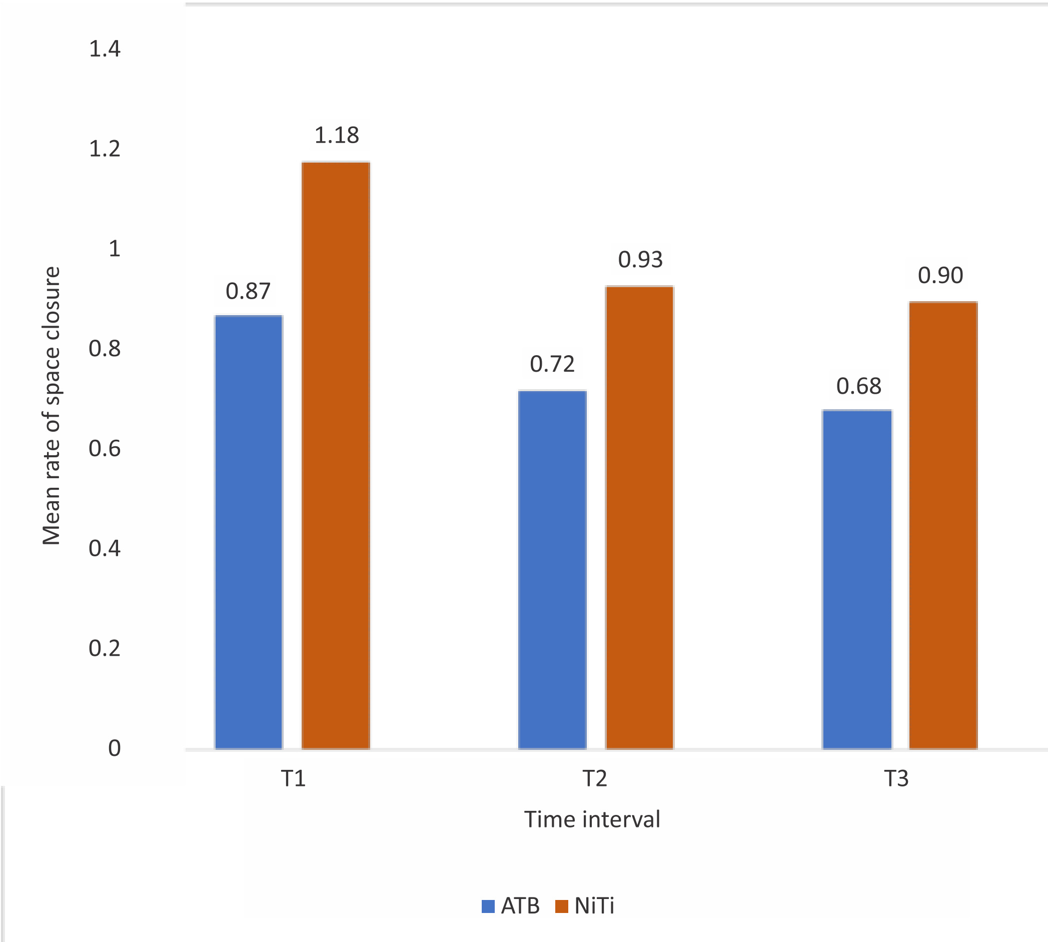

Figure 3: Rates of space closure at different time intervals using NITI and ATB

The differences between the mean rates at different time intervals and the overall mean using ATB and NITI closed coil springs were evaluated. The rate of space closure was faster using NITI closed coil springs when compared with ATB at every time interval [T, T2, T3] Fig 3.

The overall mean rate of space closure with Active tiebacks was 0.75±0.44 while that of NITI closed coil springs was 1.00±0.57mm/month. The overall mean rate of closure throughout the time of intervention was faster with NITI closed coil spring compared to ATB. Fig 4.

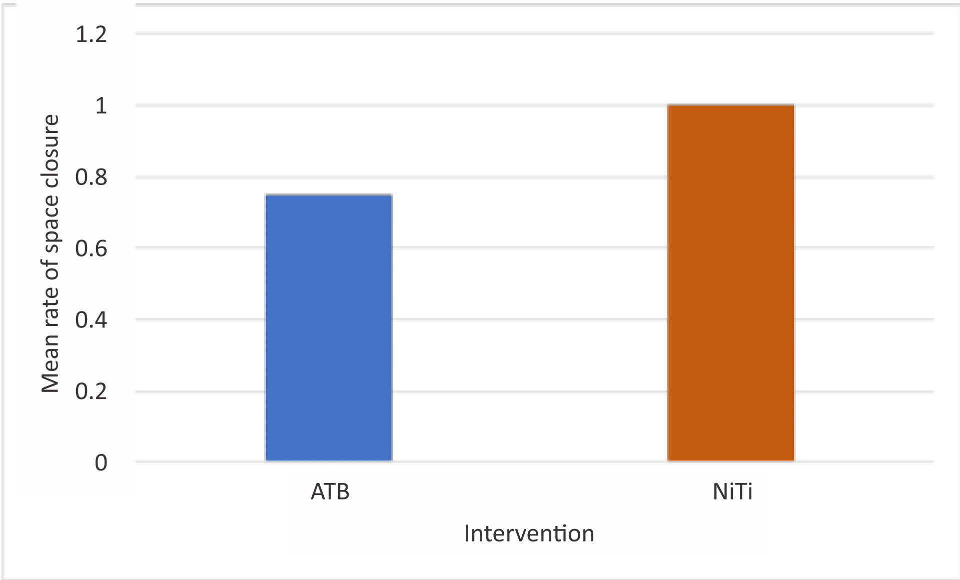

Figure 4: Comparison of the rates of space closure using NITI and ATB

Discussion

The choice of an appropriate force system in the closure of spaces following the extraction of premolars is vital in orthodontics.[1,4,34,35] The force component required to close the premolar extraction spaces may be delivered by applying Nickel-titanium (NITI) closed coil springs, Active tiebacks (ATB), or Elastomeric chains.[7,8,11,36,37]

This split-mouth comparative prospective clinical study was designed to evaluate and compare the rates of premolar extraction space closure using NITI closed coil springs and Active tiebacks amongst adolescents and adults attending the Orthodontic clinics of Lagos University Teaching Hospital, Idi Araba and Lagos State University Teaching Hospital, Ikeja, Lagos.

The overall mean rate of space closure recorded with NITI closed coil spring was 1mm/month. This is similar to the rate recorded by Samuels et al[5] with a rate of 0.96mm/month. The similarity in rates with Samuels et al[5] may be attributed to the superelastic and shape memory property of NITI closed coil springs which ensures light continuous forces are provided over a considerable range of activation and working times.[19,32,38] These light forces are highly recommended for biological tooth movement.[39]

However, a higher rate of 1.85mm/month was recorded by Bokas et al 11; Khanemasjedi et al [40] recorded 1.67mm/month while Aditya 41 recorded 1.62mm/month. This difference in rates with Bokas and Woods[11] may be attributed to the difference in the dimension of the archwires used. A two-step retraction on thinner archwires was employed by Bokas and Woods[11], whereas, an en-masse retraction on an 0.019 by 0.025-inch stainless steel archwire was carried out in this study even though en masse retraction has been documented by Schneider et al[42] to be faster than the two-step retraction.

Previous studies,[41,43,44] recorded a faster rate of space closure with thinner archwires than with large rectangular archwires due to the line contact of the bigger rectangular wire with the bracket. This is said to cause more friction and reduce the rate of tooth movement. [41,43,44] However the 0.019 by 0.025inch stainless steel archwire used in this study has the advantage of allowing full torque expression and allows for bodily movement which ensures the least tissue damage.[45]

Nickel Titanium closed coil spring used in this study at different time intervals recorded the fastest rates of space closure at T1 which is the first month following the application of the Nickel Titanium closed coil spring with a gradual reduction subsequently at the second and third months. These rates are in agreement with Khanemasjedi et al [40] and Chaudhari et al [10] who also recorded the fastest rate at T1 which is the first month following the application of the NITI closed coil spring.

This is in concordance with the phases of orthodontic tooth movement with a rapid rate of tooth movement following the application of force at the initial phase followed by a lag phase where there is a reduction in tooth movement and the final phase in which tooth movement occurs gradually.[46]

The gradual reduction recorded in the rates with the NITI closed coil springs at T2 and T3 compare well with Chaudhari et al 10 who recorded rates of 1.91,0.91,0.86,0.81mm/month at T1, T2, T3, T4. This could be attributed to the close similarity in the methodology of en masse retraction on 0.19 by 0.25-inch stainless steel archwires. However, the rates obtained at the different time intervals in this study are lower than those recorded by Khanemasjedi et al, [40] who compared the efficacy of elastic chains versus nickel titanium coil springs in canine retraction with rates such as 1.93,1.71, and 1.36 mm /month at T1/T2/T3. This difference could be a result of the denser bone density amongst Blacks.[47,48]

Previous studies [49,50] have indicated tooth movement to be affected by bone density. There is a slower rate of orthodontic tooth movement in denser bone.[49,50]

The overall mean rate of space closure using ATB was 0.75mm/month. These results are comparable with previous studies.[58,11] However, in this study a faster rate of space closure with Active tiebacks was recorded than that recorded by Dixon et al[7] and this differed by 0.40mm/month. Dixon et al[7] recorded an Active tieback rate of 0.35mm/month.

Although a faster rate of space closure using ATB was recorded by Shankar et al.[8] This may be due to single canine retraction with the MBT system rather than the en masse retraction carried out in this study with the Roth 0.22 system. Nevertheless, the results of this study compare well with the results by Sonis [12] who also carried out single canine retractions. This may be a result of the similarity in the bracket system of Roth 0.22 with the current study.

In a previous study by Mitra et al.[33], the rate recorded for active tiebacks was faster than the elastomeric chain it was compared with, this is among the few studies of note to have a faster rate for Active tiebacks,[33] even though the rate was not clearly stated as to whether it was rate per week or month thus we cannot truly compare this study with theirs.

Space closure rates with Active tiebacks at different time intervals were fastest at T1 and slowest at T3 but the difference in these rates was not significant. This is in agreement with previous studies [58,11] which could be a result of the force decay experienced by the elastic module of the active tieback in the oral cavity.[11,14] ATB being an elastomer experiences force decay in the first 24 hours of its use; loses 50% of its force after four weeks and is affected intraorally by plaque accumulation and temperature.[14,18]

In comparing the overall mean rates of space closure between NITI closed coil springs and Active tiebacks, NITI was seen to be faster than ATB and these results compare well with previous studies.[57] The faster rate of space closure with NITI closed coil springs in this study can be attributed to the fact that they perform better than ATB in an oral environment [17,27] and they also have a better load deflection than

ATB.38 Maganzini et al[25] also reported NITI to have "constant" unload forces within its designated deactivation range.

The faster rate with NITI closed coil springs than ATB recorded in this study were similar to rates by Samuels et al[5,6] This could be attributed to the close similarity in the methodology where anchorage was controlled by tying the second premolars and first molars together. Thus, space closure was from both anterior retraction and posterior protraction. However, anchorage control was by the use of transpalatal arches in other studies.[710]

In comparing the mean rates of space closure between NITI closed coil springs and Active tiebacks at different time intervals, NITI was faster than ATB at all the time intervals (Figure 1) and this is in agreement with previous studies.[5,6]

However, in a previous study by Shankar et al[8] Active tiebacks were observed to be faster than NITI closed coil springs in the third and fourth months of space closure but the reliability of this result cannot be validated as Shankar et al[8] measured distance moved by each intervention directly intraorally without cast measurements and this method of measurement has been recognized as unreliable due to interferences by the soft tissue.[41]

Conclusion

The rate of space closure with Nickel titanium closed coil springs in first premolar extraction cases was 1mm/month whereas the rate with Active tiebacks was 0.75mm/month.

Nickel-titanium closed coil springs provided a significantly faster rate of space closure than Active tiebacks by 0.25mm/month for premolar extraction cases in the sample studied.

Authors contribution: All the authors contributed to the manuscript.

Conflict of interest: None declared

Funding: Self funded

References

1. Travess H, Roberts-Harry D, Sandy J. Orthodontics. Part 8: Extractions in orthodontics. Br Dent J. 2004;196:195–203.
2. Onyeaso CO, Sanu OO. Psychosocial implications of malocclusion among 12-18-year-old secondary school children in Ibadan, Nigeria. Odontostomatol Trop. 2005;28:39–48.
3. Utomi IL, Onyeaso CO. Anteroposterior, vertical and space malocclusions in adolescents with special needs in Lagos, Nigeria. Odontostomatol Trop. 2011;34:17–23.
4. Braun S SR. On the management of extraction sites. Am J Orthod Dentofacial Orthop. 1997;112:645–55.
5. Samuels RHA, Rudge SJ, Mair LH. A clinical study of space closure with nickel-titanium closed coil springs and an elastic module. Am J Orthod Dentofacial Orthop. 1998;114:73–79.
6. Samuels RHA, Orth M, Rudge SJ, Mair LH. A comparison of the rate of space closure using a nickel-titanium spring and an elastic module: A clinical study. Am J Orthod Dentofacial Orthop. 1993;103:464–467.
7. Dixon V, Read MJF, O'Brien KD, Worthington H V., Mandall NA. A randomized clinical trial to compare three methods of orthodontic space closure. J Orthod. 2002;29:31–36.
8. Shankar S, Chandra S, Kumar Shahi A. A Comparison between Space Closure by Canine Retraction with Active Tiebacks and Closed Coil Springs: A Clinical Study with the MBT System. Int J Med Res Prof. 2017;365:365–370.
9. Al-sayagh NMS, Ismael AJ. Evaluation of space closure rate during canine retraction with nickel-titanium closed coil spring and elastomeric chain.

Al – Rafidain Dent J. 2011;11:146–53.

10. Chaudhari C, Tarvade Daokar S. Comparison of the rate of retraction and anchorage loss using nickel-titanium closed coil springs and elastomeric chain during the en-masse retraction: A clinical study. J Orthod Res. 2015;3:129.

11. Bokas J, Woods M. A clinical comparison between nickel titanium springs and elastomeric chains. Aust Orthod J. 2006;22:39–46.

12. Sonis AL. Comparison of NiTi coil springs vs. elastics in canine retraction. J Clin Orthod. 1994;28:293–295.

13. Chun YS, Rhee JN, Row J. A comparison between friction and frictionless mechanics with a new typodont simulation system. Am J Orthod Dentofac Orthop. 2001 Mar;119:292–299.

14. Oshagh M, Ajami S. A comparison of force decay: elastic chain or tie-back method? World J Orthod. 2010;11:e45-51.

15. Bennett JC, Dorth LDS, Mclaughlin RP. Controlled Space Closure with a Preadjusted Appliance System. J Clin Orthod. 1990;24:251–260.

16. McLaughlin RP, Bennett JC. Evolution of treatment mechanics and contemporary appliance design in orthodontics: A 40-year perspective. Am J Orthod Dentofacial Orthop. 2015;147:654–662.

17. Nattrass C, Ireland A J, Sherriff M. The effect of environmental factors on the elastomeric chain and nickel-titanium coil springs. Eur J Orthod. 1998;20:169–176.

18. Taloumis LJ, Smith TM, Hondrum SO, Meade FGG. Force decay and Deformation of Orthodontic Elastomeric Ligatures. Am J Orthod Dentofacial Orthop. 1997;111:1–11.

19. Eliades T, Bourauel C. Intraoral aging of orthodontic materials: The picture we miss and its clinical relevance. Am J Orthod Dentofacial Orthop. 2005;127:403–412.

20. Renick MR, Brantley WA, Beck FM, Vig KWL, Webb CS. Studies of orthodontic elastomeric modules. Part 1: Glass transition temperatures for representative pigmented products in the as-received condition and after orthodontic use. Am J Orthod Dentofacial Orthop. 2004;126:337–443.

21. Kanchana P, Godfrey K. Calibration of force-extension and force degradation characteristics of orthodontic latex elastics. Am J Orthod Dentofacial Orthop. 2000;118:280–287.

22. Awni KM. Comparison Between Laceback and Tieback in Sliding Mechanics (An in vitro study). Al– Rafidain Dent J. 2012;12:148–152.

23. Ribeiro GLU, Jacob HB. Understanding the basis of space closure in Orthodontics for a more efficient orthodontic treatment. Dental Press J Orthod. 2016;21:115–125.

24. Miura F, Mogi M, Ohura Y, Hamanaka H. The super-elastic property of the Japanese NiTi alloy wire for use in orthodontics. Am J Orthod Dentofacial Orthop. 1986;90:1–10.

25. Maganzini AL, Wong AM, Ahmed MK. Forces of various nickel titanium closed coil springs. Angle Orthod. 2010;80:182–187.

26. Angolkar P V., Arnold J V., Nanda RS, Duncanson MG. Force degradation of closed coil springs: An in vitro evaluation. Am J Orthod Dentofacial Orthop. 1992;102:127–133.

27. Vidoni G, Perinetti G, Antoniolli F, Castaldo A, Contardo L, Krishnan V, et al. Combined aging effects of strain and thermocycling on unload deflection modes of nickel-titanium closed-coil springs: An in-vitro comparative study. Am J Orthod Dentofac Orthop. 2010 Oct;138:451–457.

28. Thiesen G, Shimizu RH, Valle CVM do, Valle-Corotti KM do, Pereira JR, Conti PCR. Determination of the force systems produced by different configurations of teardrop orthodontic loops. Dental Press J Orthod. 2013;18:19e1–18.

29. Sueri MY, Turk T. Effectiveness of laceback ligatures on maxillary canine retraction. Angle Orthod. 2006;76:1010–1014.

30. Magno AF, Monini ADC, Capela MV, Martins LP, Martins RP. Effect of clinical use of nickel-titanium springs. Am J Orthod Dentofacial Orthop. 2015;148:76–82.

31. Barwart O, Hurst C, Duncanson M, Nanda R, Angolkar P, Andreasen G, et al. The effect of temperature change on the load value of Japanese NiTi coil springs in the superelastic range. Am J Orthod Dentofacial Orthop. 1996;110:553–558.

32. Wichelhaus A, Brauchli L, Ball J, Mertmann M, Boester CH, Johnston LE, et al. Mechanical

behaviour and clinical application of nickel-titanium closed-coil springs under different stress levels and mechanical loading cycles. Am J Orthod Dentofacial Orthop. 2010;137:671–678.

33. Mitra R, Londhe SM, Kumar P. A comparative evaluation of the rate of space closure after extraction using E-chain and stretched modules in bimaxillary dentoalveolar protrusion cases. Med J Armed Forces India. 2011;67:152–156.

34. Carlos A, Martins R, Romano FL, Pithon MM, dos Santos RL. Tooth extraction in orthodontics : an evaluation of diagnostic elements. Dental Press J Orthod. 2010;15:134–157.

35. Kucsera A, Struhár G. The role of occlusion and extraction in orthodontics. Historical overview. Fogorv Sz. 2012;105:13–18.

36. Samuels RH, Peak JD. Use of nickel-titanium closed-coil springs to align unerupted teeth: a case report. Am J Orthod Dentofacial Orthop. 1998;113:353–358.

37. Nightingale C, Jones SP. A clinical investigation of force delivery systems for orthodontic space closure. J Orthod. 2003;30:229–236.

38. Santos ACS, Tortamano AA, Naccarato SRF, Dominguez-Rodriguez GC, Vigorito JW. An in vitro comparison of the force decay generated by different commercially available elastomeric chains and NiTi closed coil springs. Braz Oral Res. 2007;21:51–57.

39. Kohno T, Matsumoto Y, Kanno Z, Warita H, Soma K. Experimental tooth movement under light orthodontic forces: Rates of tooth movement and changes of the periodontium. J Orthod. 2002;2:129–135.

40. Khanemasjedi M, Moradinejad M, Javidi P, Niknam O, Jahromi NH, Rakhshan V. Efficacy of elastic memory chains versus nickel–titanium coil springs in canine retraction: A two-centre split-mouth randomized clinical trial. Int Orthod. 2017;15:561–574.

41. Aditya T SR. Comparative evaluation of Nickel-Titanium closed coil spring and Elastomeric chain for canine retraction. A Randomized Clinical Trial. IOSR J Dent Med Sci. 2018;17:70–75.

42. Schneider PP, Kim KB, Monini A da C, Santos-Pinto A dos, Gandini Júnior LG. Which one closes extraction spaces faster: en masse retraction or two-step retraction? A randomized prospective clinical trial. Angle Orthod. 2019;00:1–7.

43. Frank CA, Nikolai RJ. A comparative study of frictional resistances between orthodontic bracket and archwire. Am J Orthod Dentofacial Orthop. 1980;78:593–609.

44. Kusy RP, Whitley JQ. Influence of archwire and bracket dimensions on sliding mechanics: Derivations and determinations of the critical contact angles for binding. Eur J Orthod. 1999;21:199–208.

45. Sifakakis I, Pandis N, Makou M, Eliades T, Katsaros C, Bourauel C. Torque efficiency of different archwires in 0.018- and 0.022-inch conventional brackets. Angle Orthod. 2014;84:149–154.

46. Smith RJ, Burstone CJ. Mechanics of tooth movement. Am J Orthod Dentofacial Orthop. 1984;85:294–307.

47. Hochberg MC. Racial differences in bone strength. Trans Am Clin Climatol Assoc. 2007;118:305–315.

48. Pilon JJ, Kuijpers-Jagtman a M, Maltha JC. Magnitude of orthodontic forces and rate of bodily tooth movement. An experimental study. Am J Orthod Dentofacial Orthop. 1996;110:16–23.

49. Giannopoulou C, Dudic A, Pandis N, Kiliaridis S. Slow and fast orthodontic tooth movement: An experimental study on humans. Eur J Orthod. 2016;38:404–408. Orthod. 2019;89:559–565.

50. Monini A da C, Gandini LG, Vianna AP, Martins RP, Jacob HB. Tooth movement rate and anchorage lost during canine retraction: A maxillary and mandibular comparison. Angle Orthod. 2019;89:559–565.

Relationship between Dental Calcification and Cervical Vertebrae Maturation in a Nigerian population

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Abstract

Background: This study aimed to determine the relationship between dental calcification and cervical vertebrae maturation in a Nigerian population.

Methods: The material consisted of lateral cephalometric and panoramic radiographs of 336 children aged 5 to 18 years (153 males and 183 females). Dental calcification stages were determined using panoramic radiographs according to the method described by Demirjian, while the stages of cervical vertebrae maturation were determined using lateral cephalometric radiographs and the method described by Baccetti et al.,(2005). Standard descriptive analyses were computed for chronological and dental ages concerning cervical vertebrae maturation stages. Spearman rank order correlations were performed to determine the associations between dental calcification stages and cervical vertebrae maturation stages.

Results: Good correlations ranging from 0.475 to 0.743 were observed between dental calcification stages and cervical vertebrae maturation stages. The tooth most highly correlated with cervical vertebrae maturation was the mandibular second molar in both genders. Females were more advanced in chronological age, dental age, and skeletal maturity than males.

Conclusion: This study suggests that dental calcification stages may be used as a preliminary measure in the determination of skeletal maturity.

ORIGINAL ARTICLE

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Introduction

Growth in humans is characterized by a significant variation in the rate of progress in different persons toward physiologic maturity.[1] It is one of the most variable events in nature playing an important role in the aetiology of malocclusion, evaluation, diagnosis, treatment plan, retention, and stability of any case.[1-4] Timing of treatment in orthodontics and dentofacial orthopaedics is as important as the selection of the specific treatment protocol.[5] It is therefore essential for the orthodontist to have an understanding of growth events to harness its potential advantages. During growth, all bones go through a sequence of changes, which can be seen radiographically.[4,6] This is referred to as skeletal maturity, which is the degree of ossification in bone. This sequence of changes is relatively constant for each given bone in each person.[4,6,7] Hassel and Farman[6] observed that though the timing of changes may vary as a result of each person's biologic clock, the events are mostly reproducible enough to allow a basis for comparison. Baccetti *et al*.[4] further stated that optimal timing for dentofacial orthopaedic treatment is connected to the identification of periods of accelerated growth. These periods of intense growth, identified as growth spurts, can contribute greatly to the correction of skeletal imbalances in individual patients.[4,8] Mandibular skeletal maturity has been assessed through various biologic indicators including an increase in body height, weight, skeletal development, dental development and eruption, chronological age, sexual maturation characteristics, and cervical vertebrae maturation.[6,9-19] The ability to evaluate skeletal maturation and predict mandibular growth peak from routinely obtained diagnostic lateral cephalometric radiographs through the assessment of cervical vertebrae maturation has the potential to eliminate the need for hand and wrist radiographs thus saving the patient the additional cost and exposure to radiation.[20] In addition the routine use of hand and wrist radiographs has lately been questioned from the radiation-hygiene-safety point of view.[21] Dental maturity on the other hand can be determined by the stage of tooth eruption or by the stage of tooth formation.[22,23] Various studies have however shown that tooth formation is a more reliable indicator of dental maturity than tooth eruption.[23-25] Knowledge of dental and skeletal age may be useful in determining treatment timing for orthodontic cases. In persons with delayed dental maturity, treatment may be deferred and commenced at a later stage resulting in shorter treatment time and more stable results.[26] The ease of recognition of dental developmental stages and the availability of periapical or panoramic radiographs in most orthodontic dental practices are practical reasons for attempting to assess dental maturity.[23] This is especially important in a developing continent where cost is a major consideration. The ability to determine ideal treatment timing from a panoramic radiograph would be of immense value to dental practitioners. The purpose therefore of the present study was to determine the correlation between dental calcification and cervical vertebrae maturation in a group of Nigerian orthodontic patients. If a strong correlation exists between cervical vertebrae maturation and dental calcification stages then the stages of dental calcification may be used as a first-level diagnostic tool in the estimation of the timing of the adolescent growth spurt and consequently ideal treatment time in Nigerian children.

Materials and Methods

The study was of a retrospective cross-sectional design and the material consisted of the panoramic and lateral cephalometric radiographs of 336 children (153 males and183 females) aged 5 to18 years. The data was taken from previous records of patients who had attended the Orthodontic Clinic of the Lagos University Teaching Hospital, Lagos from 2008 to 2013; six years. Inclusion criteria were the following: (1) All subjects of Nigerian ancestry; (2) all subjects aged between 5 and 18 years; (3) both lateral cephalometric and panoramic radiographs available with high clarity and good contrast, (4) all permanent teeth present on radiographs except for third molars and (5) no previous orthodontic treatment. Subjects with anomalies of the dentition and cervical vertebrae were excluded from the study. Chronological ages were computed by deducting the birth date of each subject from the date the radiograph was taken with the obtained value noted in years and decimal points. Utilizing the panoramic radiographs a single investigator (AA) determined the stages of dental maturity of the mandibular left seven permanent teeth for each subject using the method described by Demirjian.[14] Blinding to the ages of the subjects was done to eliminate bias. The eight-grade scale described by Demirjian was used to stage the teeth. Each tooth was assigned an appropriate numeric value representing the developmental stage using standard tables. These were then summed up giving the dental maturity score. This was used to determine the dental age as derived from standard tables for males and females respectively. On the lateral cephalometric radiographs cervical vertebrae C2, C3, and C4 were assessed (these are the vertebrae that can be seen when a patient has a protective thyroid collar on). Both visual and cephalometric analyses were performed as described by Baccetti *et al*.[5] and cervical vertebrae maturation stages were determined accordingly.

Statistical analysis

All statistical analyses were carried out using Epi-info version 7.1.0.6 (2012) software. Descriptive statistics (mean and standard deviations) of the chronological and dental ages of the subjects for the particular cervical stages of skeletal maturity were calculated, taking gender into consideration. Student's t-test was used to assess the differences in the mean between the two groups. Direct relationships between dental calcification stages and cervical vertebrae maturation stages were determined by computing the percentage distribution of dental development stages in subsequent cervical vertebrae maturation stages taking gender into account. Each tooth calcification stage was also correlated to the overall cervical vertebrae maturation stage. Spearman rank order correlation coefficients were run to measure the association between the cervical stages and dental calcification stages of all analyzed teeth. P values were calculated and P<0.05 was set as the level of statistical significance.

Results

Figure 1 shows the gender distribution and frequency of subjects in the different cervical vertebrae maturation (CVM) stages. CVM stage 1 was the most frequently occurring in both genders and was seen on average in over 40% of the subjects, at chronologic mean age group 9.1±2.0 years in females and 10.1 ±2.0 years in males (Table 1). Cervical stage 3, the stage where the pubertal growth spurt is expected to occur, was found on average in only 10% of the subjects (Figure 1) at chronologic age 11.4±2.1years in females and 11.9±2.0 years in males (Table 1).

The mean and standard deviations of both chronological and dental ages by CVM stage are shown in Table 1. Chronological and dental ages showed a high correlation in both males (r=0.863, P=0.00) and females (r=0.896, P=0.00) Table 2. Separate evaluations of the cervical stages showed that all correlations were statistically significant except in females at CVMS6 (P=0.496). This was also similar in males, where all correlations were statistically significant except in CVMS5 (P=0.957) and CVMS6 which could not be recorded (Table 3). The strongest correlation between chronologic and dental ages, in females, was observed in CVM stage 2 (r = 0.86) while for males the strongest correlation was recorded in CVM stage 1 (r = 0.86) both of which demonstrated the statistical significance of P=0.000. Conversely the lowest correlation was for CVMS6 in females (r=0.262, P=0.496) and CS5 (r=0.033, P=0.957) in males. The appearance of each CVM stage was consistently earlier in female subjects than in the male subjects using both chronological and dental ages. There was also a consistently earlier occurrence for each skeletal maturation stage in females (about 10 months). However, in males, no definite pattern was observed (Figure 2). All correlations between CVM stages and dental developmental stages of the teeth studied were statistically significant at P < 0.05 significance level using Spearman rank correlation coefficients (Table 4). The ranges for males and females were R = 0.186-0.485 and R =0.275-0.743 respectively. The tooth which showed the strongest relation to the CVM stage was the mandibular second molar in both males and females with R = 0.485 and R = 0.743 respectively. The teeth which showed the weakest correlations were the mandibular central incisor in females with R = 0.275 and the lateral incisor in males with R = 0.186.

The order of teeth as concerns increasing correlation with the CVM stage in males was the lateral incisor (R = 0.186), central incisor (R = 0.229), first molar (R = 0.239), canine (R = 0.423), first premolar (R = 0.456), second premolar (R= 0.477) and second molar (R = 0.485). The sequence varied marginally for females: central incisor (R = 0.275), lateral incisor (R = 0.395), first molar (R = 0.473), canine (R = 0.689), second premolar (R= 0.720), first premolar (R = 0.737) and the second molar (R = 0.743) (Table 4). The percentage distribution of dental developmental stages was calculated for the canines, first premolars, second premolars, and second molars (Table 5). The central incisors, lateral incisors, and first molars were excluded from the analysis as they showed the weakest correlation with CVM in this current study.

The most frequently observed dental development stage in CVM stage 1 was stage C in second molars (46.2%) in males and stage F in canines in both males (34.2%) and females (44.4%). In CVM stage 2 the most frequently observed stages in females were stages F for the canines (57.9%) and stages E for the second premolars (57.9%) and second molars (47.4%). In the males, stage E of the second premolar (38.9%) was the most predominant developmental stage. CVM stage 3 was accompanied by stages F for both the second premolar (58.8%) and the first premolar (52.9%) in females while 50% of the males exhibited stage H in both the canines and the first premolars indicating full development of these teeth. Stage H was the most predominant dental developmental stage in CVM stage 4, occurring in the first premolar in 68.8% of females and 59.1% of males, except in the second molars where stage G was most predominant with 45.5% in males and 43.8% in females. By CVM stage 5 most of the teeth assessed had achieved dental developmental stage H. All the male subjects studied exhibited stage H in the first premolar, second premolar, and second molar but only 60% of the canines had reached this stage. In females, 88.9% had achieved stage H in the canines at this stage but only 55.6% had achieved this stage in the second molar. In over 95% of the subjects studied, the final stage of dental development of the canines, first premolars, second premolars, and second molars had been accomplished by CVM stage 6. Stage G developmental stage of the second premolar was however still exhibited by 22.2% of the females.

Table 1: Mean chronological age and dental age by CVM stage

CVM Stage	Mean Chronologic age (years)			Mean Dental age (years)		
	Male n = 153	Female n = 183	Overall n = 336	Male n = 153	Female n = 183	Overall n = 336
1	10.1 ± 2.0	9.1 ± 2.0	9.7 ± 2.1	11.0 ± 2.4	9.8 ± 2.0	10.5 ± 2.3
2	11.3 ± 2.2	9.3 ± 1.3	10.4 ± 2.1	11.6 ± 2.5	10.3 ± 1.7	11.1 ± 2.4
3	11.9 ± 2.0	11.4 ± 2.1	11.7 ± 2.0	13.5 ± 2.5	12.3 ± 1.6	12.9 ± 2.2
4	13.8 ± 2.5	12.9 ± 1.9	13.2 ± 2.1	13.9 ± 2.2	13.7 ± 1.8	13.7 ± 2.0
5	16.1 ± 0.3	13.9 ± 1.9	14.2 ± 1.9	15.9 ± 0.2	14.7 ± 1.5	14.9 ± 1.4
6	15.5 ± 0.7	14.7 ± 1.7	14.9 ± 1.6	16.0 ± 0.0	15.6 ± 0.9	15.7 ± 0.8
Overall	11.3 ± 2.6	11.3 ± 2.8	11.3 ± 2.7	12.0 ± 2.7	12.1 ± 2.7	12.1 ± 2.7

Table 2: Comparison between dental age and chronological age in both genders using direct correlations

Paired Samples Correlations				
Gender		**N**	**Correlation Coefficient**	**p-value**
Female	Dental age and Chronologic age	183	0.896	0.000*
Male	Dental age and Chronologic age	153	0.863	0.000*

*Statistically significant at p<0.05

Table 3: Pearson's correlation of dental and chronological age for each cervical stage according to gender.

Cervical stages	Female		Male	
	r	p-value	r	p-value
1	0.849	0.000*	0.860	0.000*
2	0.860	0.000*	0.776	0.000*
3	0.518	0.001*	0.804	0.000*
4	0.698	0.000*	0.776	0.000*
5	0.718	0.000*	-0.033	0.957
6	0.262	0.496	------	-------
Total	0.896	0.000*	0.863	0.000*

*Statistically significant at $p<0.05$

Table 4: Correlation between dental development stages in teeth and cervical stages in both genders

Dental Development Stages in teeth	Female		Male	
	r	p-value	r	p-value
Central Incisor	0.275	0.000*	0.229	0.004*
Lateral Incisor	0.395	0.000*	0.186	0.022*
Canine	0.689	0.000*	0.423	0.000*
First Premolar	0.737	0.000*	0.456	0.000*
Second Premolar	0.720	0.000*	0.477	0.000*
First Molar	0.473	0.000*	0.239	0.003*
Second Molar	0.743	0.000*	0.485	0.000*

* Statistically significant at p-value < 0.05

Table 5: Percentage distribution of dental development stages according to Demirjian's method for subsequent cervical vertebrae maturation stages (CVMS)

Dental stage	Canine		First premolar		Second premolar		Second molar	
	Gender		Gender		Gender		Gender	
	Female	Male %	Female	Male %	Female	Male %	Female	Male %
CVMS								
C	1.6	1.3	6.31	3.8	12.7	6.3	11.1	46.2
D	6.3	2.5	1.13	11.4	17.5	13.9	27	21.5
E	19	26.6	1.73	26.6	27	25.3	34.9	25.3
F	44.4	34.2	3.31	24.1	30.2	22.8	19	21.5
G	20.6	25.3	2.7	15.2	11.1	24.1	6.3	19
H	7.9	10.1	4.8	19	1.6	7.6	1.6	5.1
Total	100	100	100	100	100	100	100	100

CVMS								
C	—	—	—	—	—	3.7	—	11.1
E	10.5	18.5	42.1	18.5	57.9	38.9	47.4	22.2
G	15.8	25.9	15.8	25.9	—	29.6	—	22.2
H	15.8	18.5	10.5	25.9	—	11.1	—	7.4
Total	100	100	100	100	100	100	100	100
CVMS								
C	—	—	—	—	—	—	—	—
D	—	—	—	—	—	5.6	—	5.6
E	—	11.1	—	11.1	5.9	5.6	23.5	22.2
F	29.4	16.7	52.9	27.8	58.8	27.8	47.1	16.7
G	23.5	22.2	11.8	11.1	23.5	16.7	23.5	22.2
H	47.1	50	35.3	50	11.8	44.4	5.9	33.3
Total	100	100	100	100	100	100	100	100
CVMS								
C	—	—	—	—	—	—	—	—
D	—	—	—	—	—	4.5	—	4.5
E	—	4.5	—	4.5	4.2	—	6.3	4.5
F	14.6	18.2	18.8	18.2	20.8	13.6	22.9	9.1
G	29.2	31.8	12.5	18.2	20.8	40.9	43.8	45.5
H	56.3	45.5	68.8	59.1	54.2	40.9	27.1	36.4
Total	100	100	100	100	100	100	100	100
CVMS								
C	—	—	—	—	—	—	—	—
D	—	—	—	—	—	—	—	—
E	—	—	—	—	—	—	3.7	—
F	—	20	3.7	—	14.8	—	14.8	—
G	11.1	20	11.1	—	11.1	—	25.9	—
H	88.9	60	85.2	100	70.4	100	55.6	100
Total	100	100	100	100	100	100	100	100
CVMS								
C	—	—	—	—	—	—	—	—
D	—	—	—	—	—	—	—	—
E	—	—	—	—	—	—	—	—
F	—	—	—	—	—	—	11.1	
G	—	—	—	—	22.2	—	—	—
H	100	100	100	100	77.8	100	80	100
Total	100	100	100	100	100	100	100	100

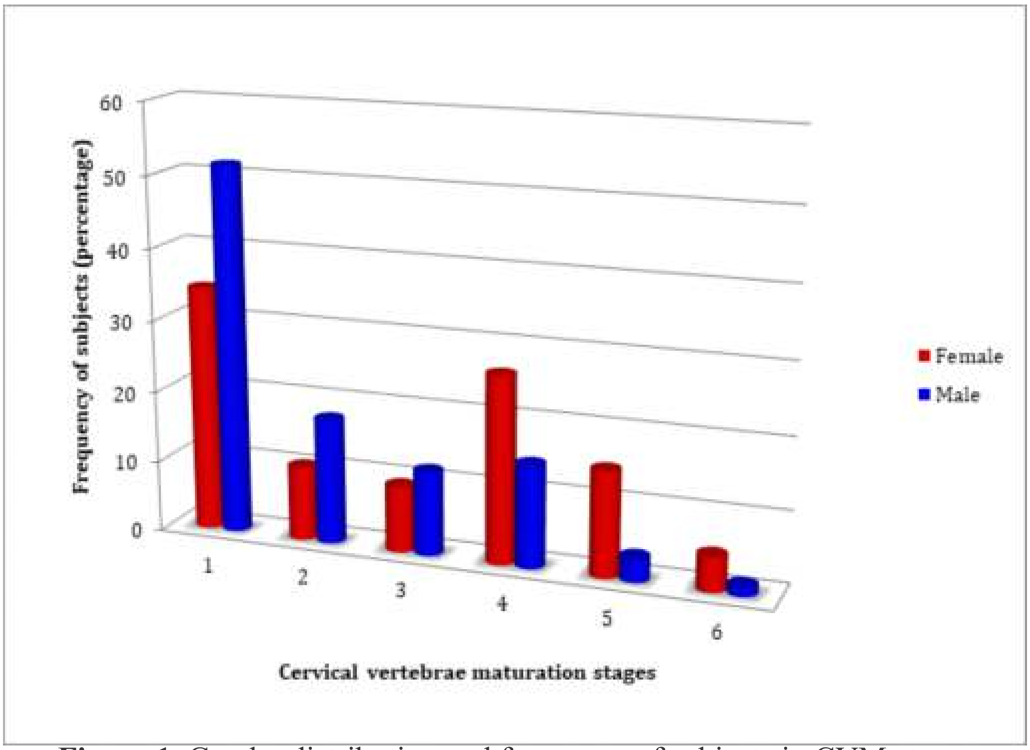

Figure 1. Gender distribution and frequency of subjects in CVM stages

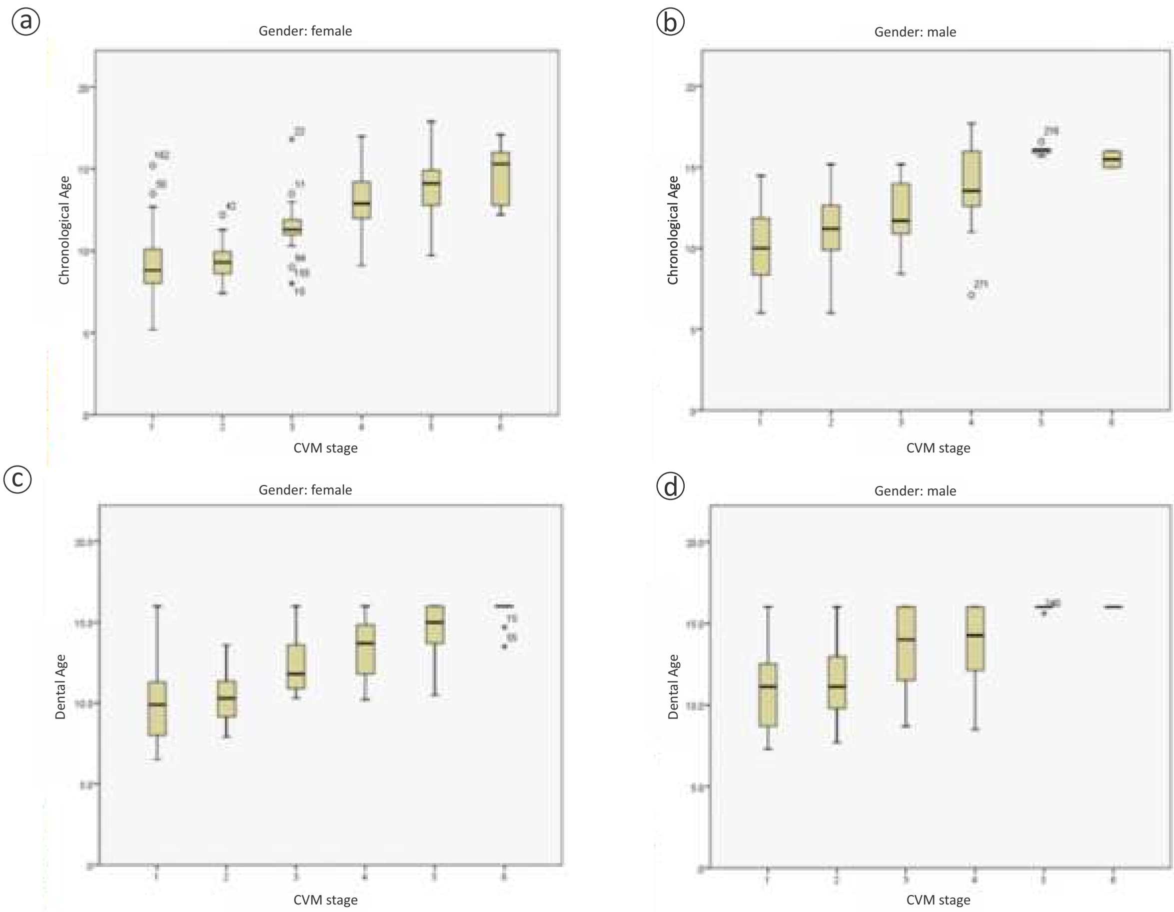

Figure 2: Distribution of chronological and dental age, related to cervical vertebrae maturation stage (CVMS)

Discussion

Reports in the literature agree that there is a strong relationship between skeletal, somatic, and sexual maturation.[10,11,14,17] However, previous studies to investigate the relationship between skeletal and dental maturation have shown low or no correlations between the two.[10,14,27-29] In this present study however the contrary was the case. Cervical vertebrae maturation stages were found to correlate well with dental developmental stages with all the stages displaying a p-value less than 0.05. This showed a good relationship between dental and skeletal maturation. In both genders, the second mandibular molar showed the greatest correlation with CVM with values R= 0.743 in females and R= 0.485 in males. This finding is similar to that of other studies.[30-33] Uysal *et al*.[23] also observed high correlations between dental and skeletal maturation in the second mandibular molar although they assessed skeletal maturity with the use of hand-wrist radiographs. At variance to this study however other authors have recorded higher correlations with other teeth ranging from the first and second premolar to the canine.[22,34,35] Some authors have suggested a significant relationship between the calcification of the mandibular canine and skeletal maturity.[15,32,36-38] Interestingly in this study there was a moderate correlation of the mandibular canine to skeletal maturity (R= 0.689 in females and R= 0.423 in males). These variations in teeth observed to most strongly correlate with skeletal maturation may be attributed to varying protocols followed, ethnicities, varying ages studied, number of subjects recruited in the studies, and nutrition, and environmental factors.[15,34,38-40] Weaker correlations of CVM to the permanent incisors and first molars seen in this study and various other studies have been attributed to early apical closure of these teeth.[35] Surendran and Thomas[41] further implied that stronger associations found between canines, premolars, second molars, and skeletal maturity were a result of the maturation of these teeth during the circum-pubertal period. Some authors have however questioned the diagnostic value of high correlation coefficients obtained in predicting specific stages of skeletal maturity and the pubertal growth spurt arguing that the diagnostic performance of dental maturity for recognizing growth phases, especially the growth spurt is extremely limited.[33,41] Although its usefulness may be limited to certain stages, determination of dental maturity is still beneficial for those stages, especially in a developing continent, and therefore cannot be overlooked. Wide variation was seen in tooth calcification stages, especially in the earlier stages. Cervical stage 1 was the most frequent CVM stage observed, a finding at variance to other studies.[23,42] In CVM stage 2 the most frequently observed stage in females was stage F for the canines and stage E for the second premolars in males and females. Since CVM stage 2 can be regarded as the pre-pubertal phase, it may be postulated that in Nigerian children stage F of the canine in females and stage E of the second premolars in both genders may be indicative of this phase. CVM stage 3 is a crucial stage of development described by Baccetti *et al*.[5] as that in which and following, the peak in mandibular growth will occur. It is the ideal stage in which functional orthopaedic treatment should commence to harness the growth spurt. In this study, CVM3 was accompanied by stage F of the second premolar (which also correlated well to CVM) in females showing the highest percentage. It can therefore be suggested that stages of calcification in the second premolar, especially in females, may be used to predict the pubertal peak in the population studied. The finding of female subjects being dentally and chronologically advanced in age and CVM stages compared to male subjects is in keeping with various other studies.[15,22,30-32,34,43,44] However concerning tooth mineralization stages relative to skeletal maturation, males showed a more advanced trend, except in CVM stage 4, whereas females showed a more advanced trend in all teeth examined except the second molar. This finding is quite similar to that of other authors.[22,23,37] An increase in the CVM stage was also observed with an increase in both chronologic and dental age indicating an increase in maturity and further buttressing the validity of the CVM method.

Conclusion

The assessment of skeletal maturity from the dental developmental stages of canines, premolars, and second molars may be used to assist in treatment planning in Nigerian subjects. In females, canines in stage F may be indicative of the pre-pubertal phase. The second premolar in stage F may be used to predict the pubertal growth spurt in Nigerian female children. The second molar in stage H may be indicative of the post-pubertal period in both genders.

Authors contribution: All authors contributed to the manuscript.

Conflict of Interest: None declared

Funding: Self funded

References

1. Mahajan S. Evaluation of skeletal maturation by comparing the hand wrist radiograph and cervical vertebrae as seen in lateral cephalogram. Indian J Dent Res 2011; 22:309-16.
2. Rickets RM. Facial and denture changes during orthodontic treatment as analysed from the temporomandibular joint. Am J Orthod 1955; 41:163-179.
3. Moore RN, Moyer BA, DuBois LM. Skeletal maturation and craniofacial growth. Am J Orthod Dentofacial Orthop 1990; 98: 33-40.
4. Baccetti T, Franchi L, McNamara JA Jnr. An improved version of the cervical vertebral maturation (CVM) method for the assessment of mandibular growth. Angle Orthod 2002; 72:316-323.
5. Baccetti T, Franchi L, McNamara JA Jnr. The cervical vertebral maturation (CVM) method for the assessment of optimal treatment timing in dentofacial orthopaedics. Semin Orthod 2005; 11:119-129.
6. Hassel B, Farman AG. Skeletal maturation evaluation using cervical vertebrae. Am J Orthod Dentofacial Orthop 1995; 107:58-66.
7. Tofani MI. Mandibular growth at puberty. Am J Orthod 1972; 62:176-195.
8. Flory C.D. Osseous development in the hand as an index of skeletal development. Monographs of the Society for Research in Child Development 1936; 1
9. Tanner JM, Whitehouse RH, Marubini E, Resele LF. The adolescent growth spurt of boys and girls of the Harpenden growth study. Ann Hum Biol 1976; 3:109-126.
10. Green LJ. The interrelationships among height, weight, and chronological, dental, and skeletal ages. Angle Orthod 1961; 31:189-193.
11. Grave KC, Brown T. Skeletal ossification and the adolescent growth spurt. Am J Orthod Dentofacial Orthop 1976; 69:611-619.
12. Fishman LS. Radiographic evaluation of skeletal maturation. A clinically oriented method based on hand-wrist films. Angle Orthod 1982; 52: 88-112.
13. Isiekwe MC. Skeletal maturity of children in Lagos Nigeria. Odontostomatol. Trop 1987; 2:111-114.
14. Demirjian A, Goldstein H, Tanner JM. A new system of dental age assessment. Hum Biol. 1973; 45:211-227.
15. Coutinho S, Buschang PH, Miranda F. Relationships between mandibular canine calcification stages and skeletal maturity. Am J Orthod Dentofacial Orthop 1993; 104:262-268.
16. Taranger J, Hagg U. The timing and duration of adolescent growth. Acta odontologica scandinavica

1980; 38:57-67.
17. Fishman LS. Chronological versus skeletal age: an estimation of craniofacial growth. Angle Orthod 1979; 49:181-189.
18. Lamparski D. Skeletal age assessment utilizing cervical vertebrae. (Master's Thesis) Pittsburgh: University of Pittsburgh Pennsylvania 1972.
19. Franchi L, Baccetti T and McNamara JA Jnr. Mandibular growth is related to cervical vertebral maturation and body height. Am J Orthod Dentofacial Orthop 2002; 118:335-40.
20. Alhadlaq AM. Prediction of mandibular growth potential using cervical vertebral bone age in Saudi subjects. J King Saud Univ 2009; 22: 1-7.
21. Kumar S, Singla A, Sharma R, Virdi M.S, Anupam A, Mittal B. Skeletal maturation evaluation using mandibular second molar calcification stages. Angle Orthod 2012; 82:501-506.
22. Krailassiri S, Anuwongnukroh N, Dechkunakorr S. Relationship between dental calcification stages and skeletal maturity indicators in Thai individuals. Angle Orthod 2002; 72:155-166.
23. Uysal T, Sari Z, Ramoghu SI, Bascifiti FA. Relationship between dental and skeletal maturity in Turkish subjects. Angle Orthod 2004; 74:657-664.
24. Nolla CM. The development of permanent teeth. J Dent Child 1960; 27:254-263.
25. Fanning EA. Effect of extraction of deciduous molars on the formation and eruption of their successors. Angle Orthod 1962; 32:44-53.
26. Ogodescu AE, Ogodescu A, Szabo K, Tudor A, Bratu E. Dental maturity- a biologic indicator of chronological age: Digital radiographic study to assess dental age in Romanian children. Int. J Biol Biomech Eng 2011; 5: 32-40.
27. Bambha JK, Van Natta P. A longitudinal study of occlusion and tooth eruption in relation to skeletal maturation. Am J Orthod 1959; 45:847-855.
28. Lewis AB, Garn SM. The relationship between tooth formation and other maturational factors. Angle Orthod 1960; 30:70-77.
29. Lewis AB. Comparisons between dental and skeletal ages. Angle Orthod 1991; 61:87-92.
30. Mittal SK, Singla A, Virdi MS, Sharma R, Mittal B. Co-Relation between the determination of skeletal maturation using cervical vertebrae and dental calcification stages [online] 2009. Available at: ispub.com/IJFS/4/2/5855 (Accessed 19 May 2012)
31. Basaran G, Ozer T, Hamamci N. Cervical vertebral and dental maturity in Turkish subjects. Am J Orthod Dentofacial Orthop 2007; 131:447e13-447e20.
32. Chen J, Hu H, Guo J, Liu Z, Liu R, Li F, Zou S. Correlation between dental maturity and cervical vertebral maturity. Oral Surg Oral Med Oral Pathol Oral Radiol Endo 2010; 110:777-83.
33. Perinetti G, Contardo L, Gabrieli P, Baccetti T, Di Lernarda R. Diagnostic performance of dental maturity for identification of skeletal maturation phase. Eur J Orthod 2012; 34: 487-492.
34. Rozylo-Kalinowska I, Kolasa-Raczka A, Kalinowski P. Relationship between dental age according to Dermijian and cervical vertebrae maturity in Polish children. Eur J Orthod 2011; 33:75-83.
35. Valizadeh S, Eil N, Ehsani S, Bakhshandeh H. Correlation between dental and cervical vertebral maturation in Iranian females. Iran J Radiol 2013; 10:1-7.
36. Chertkow S, Fatti P. The relationship between tooth mineralization and early radiographic evidence of the ulnar sesamoid. Angle Orthod 1979;49:282-288.
37. Chertkow S. Tooth mineralization as an indicator of the pubertal growth spurt. Am J Orthod 1980; 77:79-91.
38. Sierra AM. Assessment of dental and skeletal maturity-A new approach. Angle Orthod 1987; 57:194-208.
39. Garn SM, Wertheimer F, Sandusky ST, Mccann MB. Advanced tooth emergence in Negro

individuals. J Dent Res 1972; 51:1506.
40. San Roman PS, Palma JC, Oteo MD, Nevado E. Skeletal maturation determined by cervical vertebrae development. Eur J Orthod 2002; 24:303-311.
41. Surendran S, Thomas E. Tooth mineralization stages as a diagnostic tool for assessment of skeletal maturity. Am J Orthod Dentofacial Orthop 2014; 145:7-14.
42. Ize-Iyamu IN. Cervical vertebrae staging in pre-orthodontic patients in Benin City, Nigeria. Nig Dent J 2013; 21:13-17.
43. Qudeimat MA, Behbehani F. Dental age assessment for Kuwaiti children using Demirjian's method. Ann Hum Biol 2009; 36:695-704.
44. Goyal S, Goyal S, Gugnani N. Assessment of skeletal maturity using the permanent mandibular canine calcification stages. J Orthod Res 2014; 2:11-16.

Assessment of Transverse Occlusal Discrepancy in the First One Hundred Orthodontic Patients Seen at the University of Calabar Teaching Hospital, Calabar, Nigeria.

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Abstract

***Background**:* Dental occlusion is examined in three planes, the vertical, antero-posterior, and transverse planes. The objective of this study was to evaluate the prevalence of transverse discrepancy seen in the first one hundred orthodontic patients who visited the clinic, between the period of 2016 and 2020, at the University of Calabar Teaching Hospital, Cross River state.

***Methods**:* A retrospective study on the transverse occlusal discrepancy of the first 100 patients who visited the orthodontic unit of the University of Calabar Teaching Hospital for four years. The data on the patients were obtained from the clinical record book of the unit and these include age, sex, molar relationships, and transverse occlusal variables; crossbite and scissors bite.

***Results**:* The prevalence of scissors bites was 2% and the crossbite was 8% in the study population. Crossbite was predominant in males and it occurred more in children. Scissors bite, in this study population, was not common.

***Conclusion**:* The study has provided the baseline prevalence of scissors bite and crossbites in Cross River state. This will increase the clinician's ability to make rational decisions in the prevention and treatment of transverse discrepancies and also add to the body knowledge.

Keywords: Scissors bite, crossbite, constricted arches, molar relationships

ORIGINAL ARTICLE

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Introduction

The transverse discrepancy between the maxilla and mandible results in a mismatch, causing either a crossbite or scissors bite. Crossbite occurs when the buccal cusp of the upper tooth occludes lingually to the opposing lower tooth, while scissor bite refers to the presence of total maxillary buccal crossbite with the mandibular dentition completely contained within the maxillary dentition in habitual occlusion.[1,2]

The aetiological factors involved in posterior crossbite and scissors bite could be classified into dental, skeletal, and muscular.[3] Displaced teeth as a result of deficient arch length, retained deciduous teeth, deranged eruption sequence, and anomaly in tooth structure are the dental factors implicated in posterior crossbite.[3] Skeletal factors causing posterior crossbite include a true maxillary constriction which exists when the maxillary skeleton and/or teeth is narrow in width, on its own[4], or a relative maxillary constriction existing when the maxillary skeleton is normal in width, but the mandibular skeleton and/or teeth are too wide. On the other hand, a narrow mandible or an excessively wide maxilla or a combination of both would result in a scissors bite[4]. Oral habits like sucking of digits/thumb or tongue thrusting are muscular causative factors of posterior crossbite and scissor bite respectively.[3,5]

Crossbite and scissors bite can be classified, according to their position, unilateral or bilateral, while crossbite can further be anteriorly or posteriorly located.[6,7]

Common features associated with transverse discrepancy are functional shift of the mandible, leading to a negative cosmetic and functional impact on patients, especially when it is a unilateral crossbite[1,8], total disocclusion of the posterior teeth, narrow mandibular arch with an increase in the Curve of Wilson, asymmetric mandibular growth in case of a unilateral crossbite or scissors bite.[5]

The possible orthodontic treatment modalities range from removable appliances, and fixed appliances, combined with the extraction of some teeth and use of intermaxillary elastics, to orthognathic surgical procedures.[9,10,11]

There is very little literature published on transverse discrepancy nationwide, and none have been carried out in the South-south region of Nigeria. It is, therefore, necessary to evaluate the incidence of crossbite and scissors bite in the first set of orthodontic patients seen at the orthodontic unit of the university of Calabar Teaching Hospital. The study will provide base line values for this South-South region, and at the same time be beneficial in improving patient care comparable to international standards.

Materials and Methods

The study was carried out at the Orthodontic unit of the Department of Child Dental Health, University of Calabar, Calabar, Cross River State

A retrospective study on the first one hundred patients (44 males and 56 females) who presented at the University of Calabar Teaching Hospital for a period of 4 years spanning from 2016 to 2020. Patients' data were obtained from a standard orthodontic diagnostic record book. The patient's information such as age, gender, presence or absence of crossbite and scissors bite were all retrieved from the orthodontic record book for new patients and recorded in the data form as dependent variables. All the patients who presented with one or more teeth in crossbite or scissors were included in this study.

Crossbite was classified as anterior or posterior, unilateral or bilateral. Anterior crossbite was recorded as present when one or more upper incisors and canines occluded lingually to their lower counterparts.

Posterior crossbite, which is a transverse discrepancy, was recorded when the buccal cusps of the upper premolars and molars occluded lingually to the opposing teeth.

Data Analysis

The data were analyzed using the Statistical Package of Social Science version 20. Descriptive statistics such as frequencies and percentages were used to analyze the transverse discrepancies. Summary statistics such as the mean was used to represent continuous variables together with the standard of deviations.

Results

Table 1 shows the demographic distribution of the first 100 Orthodontic patients seen at the orthodontic unit of the Teaching Hospital, 57 were females and 43 were males. The age range was from 6 years to 35years, with a mean age of 14.77±6.9(SD) years, table 2.

Angle's class I molar relationship was recorded in more than 70% of the study population, with the females having more than the males. More males appeared to have Angle's class II than females. Though the prevalence of class II was low, the same low value was recorded for class III, as seen in table 3a.

Angle's molar relationship I was seen more in patients with crossbites, whereas Angle's class II was more frequent in patients with scissors bites, Table 3b.

The incidence of scissors bite in the first hundred orthodontic patients seen in the orthodontic unit of the University of Calabar Teaching Hospital was 2%, and there was no significant sex predilection. Table 4.

When age was stratified against scissors bite, it was found in 11-year and 28-year-old patients, figure 1.

Crossbite was recorded in 8 of the 100 patients. There was a male preponderance, 5:3 (table 4). When crossbite was stratified against age, it revealed that crossbite was seen more in the first 2 age groups and the 21-25 age group (figure 4).

Table 1: Sex Distribution of Respondents

SEX	n	(%)
Male	43	(43.0)
Female	57	(57.0)

Table 2: Age Classes

		Frequency	Percent(%)	Valid (%)	Cumulative (%)
Valid	6-10	29	29.0	29.0	29.0
	11-15	39	39.0	39.0	68.0
	16-20	13	13.0	13.0	81.0
	21-25	8	8.0	8.0	89.0
	26-30	8	8.0	8.0	97.0
	31-35	3	3.0	3.0	100.0
	Total	100	100.0	100.0	

The age ranged from 6 to 32 years with a mean of 14.77 and a standard deviation of 6.87

Table 3A: Stratification of Angle's classification into age and gender

(A) Angle classes

Variable: Angle Classes Stratification: Age	I n(%)	II n(%)	III n(%)
Stratification:			
Age			
6-10	22 (22.0)	6 (6.0)	1 (1.0)
11-15	24 (24.0)	9 (9.0)	5 (5.0)
16-20	12 (12.0)	0 (0.0)	1 (1.0)
21-25	7 (7.0)	1 (1.0)	0 (0.0)
26-30	8 (8.0)	0 (0.0)	0 (0.0)
31-35	3 (3.0)	0 (0.0)	0 (0.0)
Gender:			
Male	30 (30.0)	9 (9.0)	4 (4.0)
Female	46 (46.0)	8 (8.0)	3 (3.0)

Table 3B. Stratification of transverse variables by Angle's classification

	Angle Classes				
Variable (n=100)	**I**	**II**	**III**	**Chi-square**	**P-Value**
Crossbite				0.912	0.634
Present	5	2	1		
Absent	71	15	6		
Scissors bite				8.249	0.016*
Present	0	1	1		
Absent	76	16	6		

Table 4. Transverse variables

Variable: Scissors Bite	**Present n(%)**	**Absent n(%)**
Age groups:		
6-10	0 (0.0)	29 (29.0)
11-15	1 (2.0)	38 (38.0)
16-20	0 (0.0)	13 (13.0)
21-25	1 (1.0)	7 (4.0)
26-30	0 (0.0)	8 (8.0)
31-35	0 (0.0)	3 (3.0)
Gender:		
Male	1 (1.0)	42 (42.0)
Female	1 (1.0)	56 (56.0)
Variable Crossbite		
Age Groups		
6-10	2 (2.0)	27 (27.0)
11-15	5 (5.0)	34 (34.0)
16-20	0 (0.0)	13 (13.0)
21-25	1 (1.0)	7 (7.0)

26-30	0 (0.0)	8 (8.0)
31-35	0 (0.0)	3 (3.0)
Gender		
Male	5 9.6	38 (38.0)
Female	3 5.8	54 (54.0)

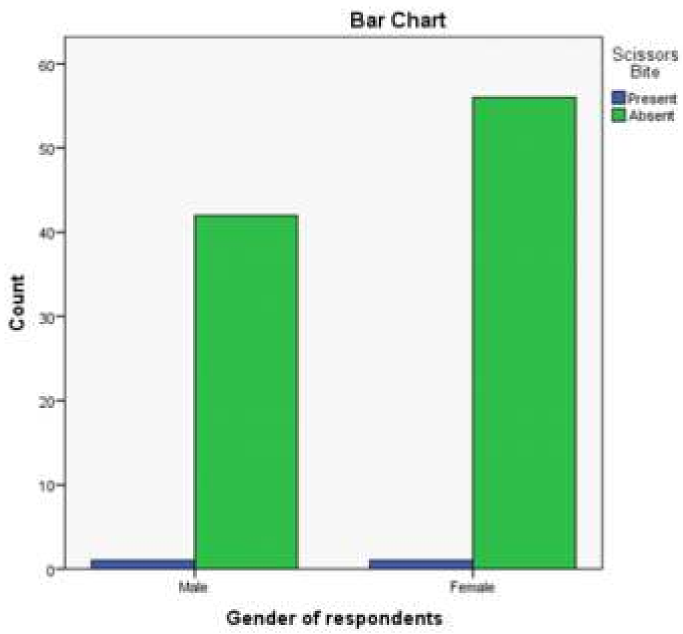

Figure 1. Gender distribution of scissors bite

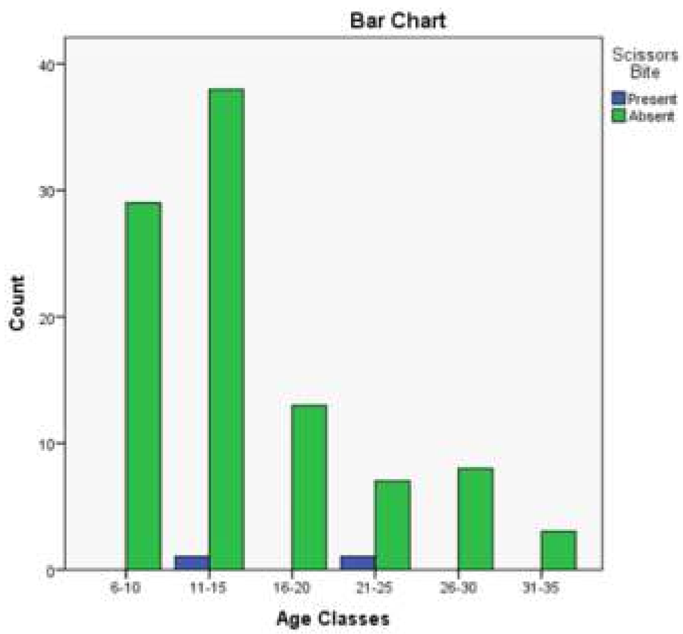

Figure 2: Age distribution of scissors bite

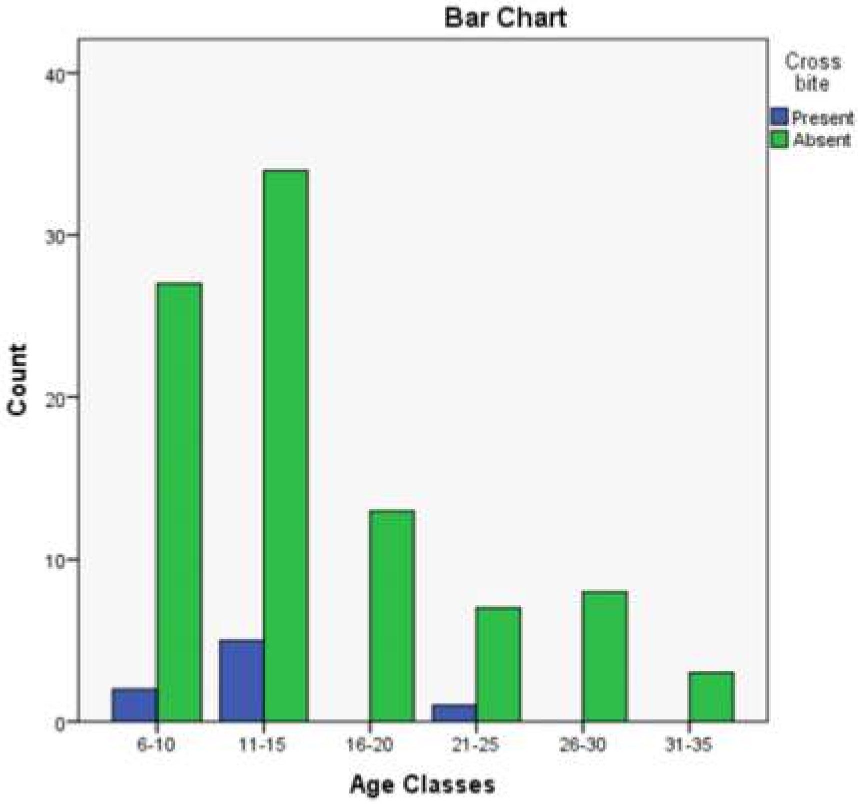

Figure 3: Age distribution of crossbite

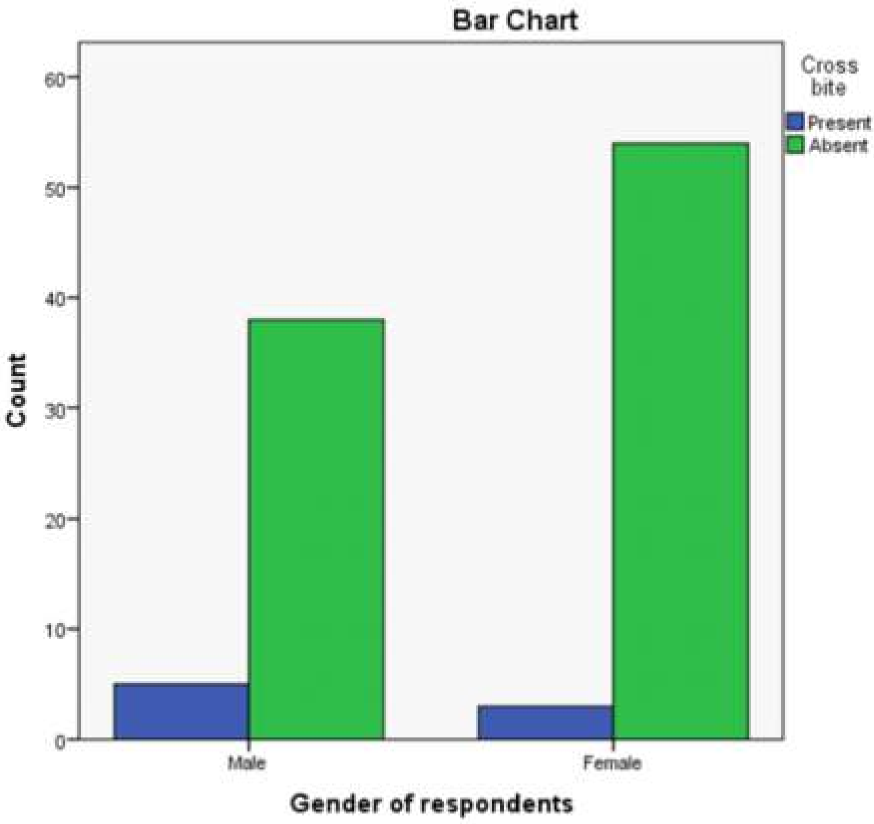

Figure 4: Gender distribution of crossbite

Discussion

Crossbite, either anterior or posterior, and scissors bites are important malocclusion traits. When they are left untreated, the result could be devastating, leading to a disrupted oral cavity milieu and this can cause severe aesthetic disharmony and compromised function.[12]

The findings of this study revealed that crossbite was found in 8 per cent of the study population. This finding is slightly lower than that reported by daCosta and Utomi[3], who revealed that 10 per cent of the study population had a posterior crossbite. These values are much higher than the findings reported by Adekoya et al,[13] and Alharbi,[14] they reported a prevalence of 3.7% and 3.8% respectively. Alogaibi et al[15] reported 25%, which is far higher than the previous findings. This could be due to the difference in sample sizes and the variations in the method of measurement. Vindikas and Roberts[16] and Harrison et al.,[17] reported that in the primary and mixed dentitions, posterior crossbite is one of the most prevalent transverse occlusal variations. Skeletal posterior crossbite is associated with a smaller maxillary to mandibular dental arch widths ratio and lower facial height.[18,19]

Patients with crossbite were found to have more angle's class I molar relationship when compared with patients with scissors bite, who presented more with Angle's class II molar relationship. This is not surprising, as many studies, both local and international, have confirmed that Angle's class I molar relationship is more common.[3,13,15,20,21]

About 7% of the study population who presented with crossbite were children and 1 was an adult. This result is the exact opposite of the findings by daCosta and Utomi[3], who reported that almost a third of the patients in their study were adults. This could be attributed to the large sample size used in their study. When crossbite is managed early in the deciduous or mixed dentition stage, it makes way for the spontaneous correction of the permanent teeth. Lidner,[22] reported that early management of crossbite will eliminate the possibility of alveolar ridge warp which can occur as a compensatory change to accommodate the malocclusion.

This study revealed a sex predilection, with crossbite occurring more in males. The finding is not in agreement with the reports by Allen, who in his study, showed that crossbite occurred twice more in females than in males. Although in the study by daCosta and Utomi[3], there was no difference in the frequency between the genders. Some other studies also reported the absence of significant gender bias.[2,23]

Scissors bite was present in about 2% of the study population. The finding of this study is in accordance with what Sodagar et al.,[24] reported as the prevalence of scissors bites being between 1-1.5%. Scissors bite is a complication of malocclusion that is uncommonly encountered routinely. Scissors bite cannot be resolved by itself, and if left untreated, can affect chewing, and impair the normal growth and development of the mandible. There was no significant difference in age or gender when stratified with scissors bite.

Early management of both crossbite and scissors bite is advocated, either in the deciduous or mixed dentition stage, this will encourage the spontaneous correction of the permanent teeth.[3,24] It was reported by Kutin and Hawes[2] that crossbite occurring in the deciduous dentition usually translated into the permanent dentition.

Various treatment modalities are available for the treatment of crossbite and scissors bite. They range from simple removable appliances, and arch expansion appliances to more complex ones like orthodontic appliances with intra-oral cross elastics, and orthognathic surgeries in complex cases.[24,25] A major limitation of this study was the small population size used. A larger population is therefore advocated for future studies.

Conclusion

The prevalence of scissors bite was 2% and the crossbite was 8% in the study population.

Crossbite was recorded more in males and children while Scissors bite was not common in this study population.

This study, being the only literature on the transverse discrepancy of dental malocclusion in this region, has provided the baseline prevalence of scissors bite and cross bite in Cross River state, Nigeria. The reports from this study would increase the clinician's ability to make rational decisions in the prevention and treatment of transverse discrepancies. The findings will also help the government and hospital management to plan their budgets for dental and orthodontic training and treatments.

Acknowledgement: We sincerely thank all those that helped to make this study a success in various ways, Dr. Isiekwe and Dr. Osunde.

Authors contribution: All the authors were involved in the conceptualization of the study, data analysis, results, discussion, conclusion, and manuscript writing. Dr M.N. Adekoya collected the data.

Conflict of interest: None declared

Funding: Self funded

References

1. McNamara JA. Maxillary transverse deficiency. Am J Orthod Dentofacial Orthop 2000;117: 567-570.
2. Kutin G, Hawes RR. Posterior cross-bites in the deciduous and mixed dentitions. AmJ of Orthod 1969;56: 491-504.
3. Dacosta OO, Utomi IL. A clinical review of crossbite in an orthodontic population. West Afr J Med. 2011 Jan-Feb;30(1):24-8.
4. McNeill C. Occlusion: what it is and what it is not. J Calif Dent Assoc. 2000 Oct;28(10):748-58.
5. Conley R, Legan H. Mandibular Symphyseal Distraction Considerations. Angle Orthod 2003;73(1):3-11.
6. Haas AJ. Long-term posttreatment evaluation of rapid palatal expansion. Angle Orthod 1980;50: 189-217.
7. Kennedy DB, Osepchook M. Unilateral posterior crossbite with the mandibular shift: a review. Journal-Canadian Dental Association 2005; 71:569.
8. Harper DL. A case report of a Brodie bite. Am J Orthod Dentofacial Orthop 1995;108(2):201-206.
9. B. A. Troy, S. Shanker, H. W. Fields, K. Vig, and W. Johnston, "Comparison of incisor inclination in patients with Class III malocclusion treated with orthognathic surgery or orthodontic camouflage," Am J Orthod Dentofacial Orthoped 2009: 135,.
10. Yahya A. Alogaibi , Ahmed R. Afify , Ahmad A. Al-Fraidi, Ali A. Hassan. Nonsurgical Treatment of Class III Malocclusion with Both Anterior and Posterior Crossbites Combined with Impacted and Congenitally Missed Teeth. Volume 2020 |
11. Shetty, S, and Kumar, A. Telescopic Bite – A Literature Review. Int J Recent Sci Res. 2021: 12(01), pp. 40462-404
12. Krishna V, Sivakumar A, Indumathi S, Sam PM, Padmapriya CV. Treatment of 3-prong anterior crossbite and unilateral lingual posterior crossbite malocclusion in an adolescent boy. J Indian Orthod Soc 2017; 51:284-8.
13. Adekoya MN, Ayedun OS, Adeyemi TE. Prevalence of Malocclusion in Children Between the Age of 10-15 Years in Calabar Metropolis, Cross River. WALM 2021; 38(11): 1095-1100.
14. Alharbi F. The prevalence of malocclusion traits Saudi Arabia 2015-2019. An epidemiological cross-sectional study. J Int Oral Health 2020; 12:129-34.
15. Alogaibi YA, Murshid ZA, Alsulimani FF, Linjawi AI, Almotairi M, Alghamdi M, Alharty H, Hassa AA. Prevalence of malocclusion and orthodontic treatment needs among young adults in Jeddha city. J Orthod Sci 2020; 9: 3.
16. Vidikas GP, Roberts MW. Primary posterior crossbite: diagnosis and treatment. J Clin Paed Dent 2001; 16:1-4.
17. Harrison RL, Leggott PJ, Kennedy DB, Lowe AA, Robertson PB. The association of simple anterior dental crossbite to gingival margin discrepancy. Paediatr Dent 1991; 13:296-300.
18. Allen D, Rebellato J, Sheats R, Ceron A. Skeletal and Dental contributions to posterior crossbite. Angle Orthod 2003;73: 515-524.
19. Castello PM, Bonjardin LR, Periera LJ, Caviao MBD. Facial dimensions, bite force and masticatory muscle thickness in pre-school children with a functional posterior crossbite. Braz Oral Res 2008; 22:48—54.

20. Onyeaso CO. Prevalence of malocclusion among adolescents in Ibadan, Nigeria. Am J Orthod Dentofacial Orthop 2004; 126**:** 604-7.
21. Adeyemi TE, Otuyemi OD. The Pattern of presentation of malocclusion at Aminu Kano Teaching Hospital. West Afr J Orthod 2016; 5: 23-26.
23. lidner A. longitudinal study of the effect of early interceptive treatment in 4-year-old children with unilateral crossbites. Scand J Dent Res 1989; 97:432-438.
23. Adegbite K. The prevalence of orthodontic problems requiring interceptive orthodontic management in 5-12-year old children in Lagos and the treatment of some cases. FMCDS Thesis 2000.
24. Sodagar A, Emadian Razavi E S, Farhadifard H. Treatment of a Bilateral Scissors-Bite in an Adolescent with Fixed Appliances, Iran J Ortho. 2016; 11(1):e5171. DOI: 10.17795/ijo-
25. Pinho T. Early treatment of scissor bite. J Clin Orthod 2011;45:498-506.

Psychological Impact of Malocclusion: A Case Report

Ernest MA, Adeyemi MF, Sanni-Abdullahi SO

Abstract

A 35year old female patient presented to the clinic an account of dissatisfaction with her protruding upper anterior teeth. She had serious psychological issues while in secondary school due to constant verbal abuse from her mother and her schoolmates resulting in her attempt to cut her tooth with a knife. On examination, there was a traumatic dental injury running horizontally across the upper right central incisors. The patient's personality was assessed using the Big 5 personality test.

Keywords: Psychological Impact, Malocclusion, Traumatic Dental Injury

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Introduction

Malocclusions are highly prevalent and they have a profound effect on the quality of life. It is common for individuals to associate difficulty in a relationship, or loss of a job with malocclusion[1]. Individuals with attractive physical characteristics make a better impression on others and obtain more privileges due to their appearance[2]. Indeed, orthodontic treatment is generally associated with gains in quality of life due to improvements in physical, social, and psychosocial aspects.[3]

Presenting Complaint

A 35year old female patient presented to a government-owned Orthodontic clinic in Ilorin, Kwara, Nigeria with the chief complaints of dissatisfaction with her protruding upper anterior teeth.

Medical and Dental History

No medical history of clinical importance, but dental history revealed a history of self-inflicted traumatic injury to the upper right central incisors. She had serious psychological issues while in secondary school due to constant verbal abuse from her mother and her schoolmates. She was 15 years of age when she attempted to use a knife to cut off her upper right central incisors following an altercation with her classmate who insulted her and said her teeth were like a digger. Her mother had also on different occasions called her the same name. Out of frustration, she made an unsuccessful attempt of cutting up the teeth with a knife. She traumatized the tooth leaving an injury that extends to the dentine with the resultant sensitivity of the tooth to air and water. She was seen and addressed both at home and in public as the girl with the digger teeth.

The patient believes her proclined incisors was a contributory factor to some romantic relationship

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loss. She claimed she lost many relationships that could have led to marriage as the men claimed she was beautiful except for her teeth. They eventually ended the relationship with her. She however didn't know of the possibility of an orthodontic correction until she was in the university and had since then vowed to have the treatment done as soon as she is financially buoyant. Due to her present poor financial state, she has been unable to commence treatment.

Diagnosis

Clinical Assessment

External finding: Examination showed protruding upper jaw. The lips are potentially competent with vertical maxillary excess. Skeletal assessment is pattern II.

Intraoral finding: - Examination showed full complement of permanent dentition. Angle's class II malocclusion is complicated by increased overjet 14mm &11mm, deep and complete bite, severe upper anterior spacing 11mm, mild lower anterior spacing 2.5mm, lower midline shift to the Rt (2mm), increased upper and lower incisal angle, constriction of upper and lower jaw anteriorly and traumatic dental injury on the upper right central incisors. (Fig. 1)

Traumatic injury on the upper right central incisor

Fig 1 (A-H) Facial and intraoral photograph

Radiographic Evaluation

Intra-oral periapical radiograph of the upper incisors shows horizontal bone loss and radiolucency at the apex of the centrals. There is also coronal radiolucency with pulpal communication (fig 2)

The Patient whose case we reported had her Personality assessed using the Big 5 personality test.

The scores are between 0 and 40.

Table 1

Traits	**Score**	**Comment**
Extroversion (E)	**18**	This is the personality trait of seeking fulfilment from sources outside the self or in the community. The patient Scored 18/40. A low score means patient tends to work on their projects alone**.**
Agreeableness (A)	**33**	High scorers are typically polite and adjust their behaviour to suit others
Conscientiousness (C)	36	High scorers tend to follow rules.
Neuroticism (N)	9	A low score shows the patient is confident
Openness to Experience (O)	28	High scores may daydream a lot, while low scorers may be very down to earth

She had high scores on agreeableness and conscientiousness which may indicate a personality that may want to please others; if people say my teeth are like diggers then let me cut them off. She wants to take charge and deal with the problem. Her low score on Neuroticism shows her confidence in wanting to solve the problem instead of becoming moody and resorting to self-pity.

Treatment Objectives

1. To restore traumatized maxillary central incisor
2. Periodontal therapy of upper anterior teeth
3. To create a satisfactory occlusion correcting

the class ll molar relationship to a class l molar relationship
4. To correct the increased overjet
5. To correct the deep bite
6. To close up the spaces
7. To correct the rotations

Treatment Alternatives

1. Restorative and periodontal treatment followed by upper and lower fixed appliance therapy non-extraction.
2. Restorative and periodontal treatment followed by upper and upper fixed appliance therapy with 2-unit extraction.

Treatment could not be carried out on the patient whose case we have reported due to financial constraints.

Discussion

In today's world perfect white straight teeth are seen as a social standard. People are accorded respect based on the appearance of the teeth or deviation of their teeth from normal [4]

Severe malocclusion is almost always a hindrance, people with protruding upper incisors are likened to idiots and a prognathic lower jaw is always used in the description of a "witch". In all, well-aligned teeth always carry and infer a positive status to the possessor, and not so well- aligned teeth or other dentofacial deformities and malocclusions have a negative impact[4]

Hadam et al concluded that around 40% of patients requesting orthodontic treatment had been made fun of due to the appearance of their teeth, whereas there was no association between the degree of need for orthodontic treatment and the need perceived by the patients themselves[5]. This implies patient's perceived need is increased due to taunting from other people about their appearance.

Multiple studies have shown an association between malocclusion and a greater psychosocial impact as the condition worsened[6-9] revealing also that a correction of the malocclusion improved psychosocial impact results and the impact decreased after orthodontic treatment.

The objective of the patients that undergo orthodontic treatment is to improve their dentofacial aesthetics to enhance their self-esteem and to feel socially accepted according to Kiekens et al .[10]

Some studies found a significant correlation between lower self-esteem and malocclusion and the improvement of self-esteem as a result of orthodontic treatment[11-12], but Kiyak reported that orthodontic intervention did not significantly affect self-esteem.[13]

In a study titled "The emotional effects of malocclusion among Nigeria orthodontic patients" by Onyeaso, Utomi et al [14], 27% of the subject were depressed the first time they noticed their malocclusion, and 55% of them felt the malocclusion negatively affected their general facial appearance. According to Ernest M.A et al [15] in an article on the Perception of facial attractiveness among a young Nigerian Population, the most important facial feature the subjects in the study wanted to change was their teeth, however, concerning important features that make facial attractiveness, the teeth ranked second.

The mental effect of malocclusion can affect a patient's lifestyle and the day-to-day interactions of individuals with malocclusion. Different results of psychosocial attractiveness research suggest that the perception of one's physical appearance is often associated with concerns about other people's reactions and a negative body concept[16]

It has been shown, for instance, that minor dental aesthetic impairment in young adults was associated with social apprehension, appearance disapproval, and appearance-related insecurity[17]

This is in accordance with what our patient experienced in school and at home, prompting her to self-harm. This is in agreement with the study by A. N.Anosike et all[18].

Also, previous studies showed that the appearance of teeth was found to be very significant for young women[19]. An association between teeth appearance satisfaction and gender has been consistent in the literature, with some studies reporting a higher concern in women[20]

Conclusion

The psychological effect of malocclusion is significant and is associated with appearance dissatisfaction and body mutilation. There is an urgent need for increased Orthodontic awareness creation in the population as this patient was unaware of Orthodontic treatment and so sought self-help.

Professional counselling must be considered for individuals with handicapping malocclusion to address their psychological needs.

Treatment could not be carried out on the patient whose case we have reported due to financial constraints. Due to the economic downtown post-Covid, a lot of patients cannot afford it. Orthodontic care because of competing family needs and the dwindling national economy with resulting high inflation. Patients like these can benefit from the Nigeria Association of Orthodontists establishing free orthodontic services for such special cases. Financial plans for instalment monthly payments like the Carbon Zero financial plan should be made more accessible to the public so more clients can assess orthodontic treatment.

Authors contribution: All the authors were involved in the study.

Conflict of interest: None declared

Funding: Self funded

References

1. Goursand D, Paiva SM, Zarzar PM, Ramos-Jorge ML, Cornacchia GM, Pordeus IA, Allison PJ. Cross-cultural adaptation of the Child Perceptions Questionnaire 11–14 (CPQ11–14) for the Brazilian Portuguese language. Health and quality of life outcomes. 2008 Dec;6(1):1-7.
2. Keruso H, Hausen H, Laine T, Shaw WC. The influence of incisal malocclusion on the social attractiveness of young adults in Finland. Eur J Orthod. 1995;17: 505-12
3. Zhang, McGrath, Hagg. Changes in oral health-related quality of life during fixed orthodontic appliance therapy. Am J Orthod Dentofacial Orthop. 2008; 133:25-9.
4 Hay GG, Heather BB. Changes in psychometric test results following cosmetic nasal operations. The British Journal of Psychiatry. 1973 Jan;122(566):89-90.
5. Hamdan, A. M. The relationship between patient, parent, and clinician perceived need and normative orthodontic treatment need. Eur. J. Orthod 2004: **26**, 265–271
6. Kiekens RM, Maltha JC, Hof MA, Kuijpers-Jagtman AM. Objective measures as indicators for facial esthetics in white adolescents. The Angle Orthodontist. 2006 Jul;76(4):551-6.
7. De Oliveira, C. M. & Sheiham, A. Orthodontic treatment and its impact on oral health-related quality of life in Brazilian adolescents. J. Orthod. 2004: **31**, 20–27
8. Bellot-Arcis, C., Montiel-Company, J. M. & Almerich-Silla, J. M. Psychosocial impact of malocclusion in Spanish adolescents. Korean J. Orthod. 2013:**43**, 193–200
9. Bellot-Arcís C, Montiel-Company JM, Pinho T, Almerich-Silla JM. Relationship between perception of malocclusion and the psychological impact of dental aesthetics in university students. Journal of clinical and experimental dentistry. 2015 Feb;7(1):e18.
10. Twigge, E., Roberts, R. M., Jamieson, L., Dreyer, C. W. & Sampson, W. J. The psycho-social impact of malocclusions and treatment expectations of adolescent orthodontic patients. Eur. J. Orthod 2016:**38**, 593–601
11. Shaw BA, Liang J, Krause N. Age and race differences in the trajectories of self-esteem. Psychol Aging. 2010; 25:84–94.
12. Jung MH. An evaluation of self-esteem and quality of life in orthodontic patients: Effects of crowding and protrusion. Angle Orthod. 2015; 85:812–9
13. Kiyak HA. Does orthodontic treatment affect patients' quality of life? J Dent Educ. 2008;72:886–94
14. Onyeaso CO, Utomi IL, Ibekwe TS. Emotional effects of malocclusion in Nigerian Orthodontic Patients. J Contemp Dent Pract 2005 February;(6) 1: 064-073
15. Ernest MA, Sanu OO, Utomi IL, Ibeabuchi NM, Perception of Facial attractiveness among a Young Nigerian Population. West Afr J Orthod., June

2015: Vol. 4 No 1.

16. Klages U, Zentner A. Dentofacial aesthetics and quality of life. InSeminars in orthodontics 2007 Jun 1 (Vol. 13, No. 2, pp. 104-115). WB Saunders.
17. Klages U, Bruckner A, Zentner A. Dentalaesthetics, self-awareness, and oral health-related quality of life in young adults. Eur J Orthod. 2004: 26: 507 – 514...
18. Anosike AN, Sanu OO, DaCosta OO. Malocclusion and its impact on quality of life school children in Nigeria.West Afr J Med. 2011 Sep. 29(6): 417-24.
19. Klages U, Claus N, Wehrbein H, Zentner A.Development of a questionnaire assessing the psychosocial impact of dental aesthetics in young adults. Eur J Orthod. 2006: 28:103 – 111
20. Alhaija ESJA, Al-Nimri KS, Al-Khateeb SN.Self-perception of malocclusion among north Jordanians. \ Eur J Orthod 2005: 27:292 - 5

Appendix:

Instructions

In the table below, for each statement 1-50 mark how much you agree with on a scale of 1-5, where

1=disagree, 2=slightly disagree, 3=neutral,

4=slightly agree and 5=agree

1. I'm the life of the party.
2. Feel little concern for others.
3. I'm always prepared.
4. Get stressed out easily
5. Have a rich vocabulary
6. Don't talk a lot.
7. I'm interested in people.
8. Leave my belongings around
9. I'm relaxed most of the time.
10. Have difficulty understanding abstract ideas.
11. Feel comfortable around people.
12. Insult people.
13. Pay attention to details.
14. Worry about things.
15. Have a vivid imagination.
16. Keep in the background.
17. Sympathize with others' feelings.
18. Make a mess of things.
19. Seldom feel blue
20. I'm not interested in abstract ideas.
21. Start conversations.
22. I'm not interested in other people's problems.
23. Get chores done right away.
24. I'm easily disturbed.
25. Have excellent ideas.
26. Have little to say.
27. Often forget to put things back in their proper place
28. Have a soft heart.
29. Get upset easily.
30. Do not have a good imagination.
31. Talk to a lot of different people at parties.
32. I'm not really interested in others
33. Like order.
34. Change my mood a lot.
35. I'm quick to understand things
36. Don't like to draw attention to myself
37. Take time out for others
38. Shirk my duties
39. Have frequent mood swings.
40. Use difficult words.
41. Don't mind being the centre of attention
42. Feel others' emotions
43. Follow a schedule.
44. Get irritated easily.
45. Spend time reflecting on things.
46. I'm quiet around strangers
47. Make people feel at ease.
48. I'm exacting in my work
49. Often feel blue
50. I'm full of ideas

Instructions for Authors

West African Journal of Orthodontics is a peer-reviewed journal published by affiliated Orthodontic Groups and Associations in the West African Sub region. The journal gives priority to reports of outstanding clinical and experimental and epidemiological works on malocclusion, dento-facial defects as well as important contributions related to common orthodontic problems in children, adolescents and adults worldwide.

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Manuscripts and registered letters should be sent to: the Editor, West African Journal of Orthodontics, Department of Child Dental Health, Faculty of Dentistry, College of Health Sciences Obafemi Awolowo University, Ile-Ife, Osun State. Nigeria.

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Manuscripts should meet the following criteria: original material, clear writing, appropriate study methods, valid data, and reasonable conclusions supported by the data, in short, they should contain important information on topic of general orthodontic interest.

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All the manuscripts that adhere to its style and Instructions for Authors are referred to peer-review.

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Manuscripts should be prepared in accordance with the Uniform Requirements for Manuscripts submitted to Biomedical Journals. 2 A summary of technical requirements for preparing the manuscript is provided below:

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- Use 1 side of standard size 21.6x27.9 cm A4, white bond paper, with margins of at least 2.5 cm on each side.
- Double-space throughout including title page, abstract, text, acknowledgements, references, tables and figure legends. Start each of these sections (in same order) on a new page, numbered consecutively in the upper right hand corner, beginning with the title page.
- Use at least 12 point font size (Times New Roman or Arial).
- Submit photographs and transparencies in a separate heavy paper envelope (enclosed in cardboard, to prevent bending during mail handling).
- Conventional units are preferred with SI units in parenthesis, if available. The metric system is preferred for the expression of length, area, mass and volume.
- Use nonproprietary names of material rugs, devices and other products.
- All manuscripts should be accompanied by a signed statement by all authors regarding authorship, responsibility, financial disclosure and acknowledgements, as per standard format (Appendix J)[23 1 Those sending their manuscript through email are also required to submit this form by post with original signatures.

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The page should contain (i) the title of the article: which should be concise but informative (simpler the title the better; preferably it should contain all the key words to help electronic retrieval reliably); (ii) a short running title of less than 40 characters placed at the foot end of the title page; (iii) initials and surname of each author with the highest academic degree(s) and designation at the time when the work was done; (iv) details of the contribution of each author; (v) name of department(s) and institution(s) to which the work should be attributed; (vi) disclaimers, if any; (vii) name, address, telephone, fax, email address of the corresponding author, (viii) source(s) of support in the form of grants, equipment, drugs or all of these; and (ix) declaration on competing interests.

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Competing interest for a given manuscript exists when the author has ties to activities that could inappropriately influence his or her judgment, whether or not judgment is in fact affected. Financial relationships with industry for example, through employment, consultancies, stock ownership, honoraria, expert testimony, either directly or through immediate family, are usually considered to be the most important competing interests. However, conflicts can

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Original articles should report original research relevant to basic and clinical orthodontics including randomized trials, intervention studies, studies of screening and diagnostic tests, cohort studies, cost effectiveness analyses and case control studies. While reporting randomized controlled trials (RCT), authors must attempt to be in conformity with the consolidated standards of reporting trial.

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Each manuscript should be accompanied with a structured abstract (divided into background, methods, results and conclusions) in no more than 250 words. Four to five key words to facilitate indexing should be provided in alphabetical order along with the abstract. The text should be divided in sections on introduction, methods, results, discussion and conclusion.
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Short accounts of original studies are published as brief reports. The text should be divided into sections, i.e., abstract, introduction, methods, results and discussion.
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A short text of about 150 words depicting the condition with color photographs (vide infra) is needed.
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Acknowledgements

In acknowledgements section, it is suitable to list all contributors who do not meet the criteria for authorship, such as a person who provided purely technical help, writing assistance, or a department head who provided only general support. Financial and material support should also be acknowledged.

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Journal Article

List all authors when 6 or less. When 7 or more, list only first six and add et al. Ngan P, Yiu C, Hu A, Hagg U, Ei SHY, Gunel E. Cephalometric and occlusal changes following maxillary expansion and protraction. Eur J Orthod 1998; 20: 237-254.

Organization as Author

Australian Dental Association Inc. An Australian Schedule of Dental Services and Glossary. 7th edn. Sydney: Australian Dental Association Inc., 1996.

Complete Book

Department of Health. Shifting the balance of power within the NHS: securing delivery. London: Doll, 2001.

Clayton D, Hills M. Statistical models in epidemiology. Oxford: Oxford University Press, 1993.

Farkas LG. Anthropometry of the Head and Face, 2nd Edn, New York; Raven Press; 1994

Book Chapter Lekholm U, Zarb GA. Patient selection and preparation. In: Branemark P1, Zarb GA, Albrektsson T, editors.

Tissue integrated Prostheses: Osseointegration in Clinical Dentistry, Chicago: Quintessence; 1988,199-209

Thesis and Dissertation

Yong SJ. Bone mineral density of normal Korean adults. Ph.D. Thesis. Seoul, Korea; 1989 Anozike, AN. Orthodontic treatment needs and its impact on oral health related quality of life in Lagos school children aged 12-16 years. FMCDS. Dissertation. Lagos, Nigeria; 2006

Conference Proceedings

Marshall SJ, Rixon RC, Whiteford DN, Cumming JT. The OrthoForm 3-Dimensional Clinical Facial Imaging System. Proceedings of the 15th IFHE Congress 1998; 15:83-87.

Dictionary and Similar References

Stedman's medical dictionary. 26th ed. Baltimore: Williams & Wilkins; 1995. Apraxia; p.11 9-120. Unpublished accepted material Leshner Al. Molecular mechanism of cocaine addiction. N Eng J Med. In Press 1996.

Material from Internet

World Health Organization, 2002.
www .who.intlmental-health!prevention/suicide
(accessed August 1, 2004).

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Each table should be typed in double-space on a separate sheet of paper. Tables not submitted as photographs must be numbered consecutively (Arabic numerals) in the order of their first citation in the text, with a brief but self explanatory title for each.
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The full term for which an abbreviation stands should precede its first use in the text unless it is a standard unit of measurement. Year, month, day, hour, minute and second should be abbreviated as yr, mon, d, h, mm, and s in tables respectively.

References
1. Mother M, Schulz KF, Altman DG, for the CONSORT Group. The CONSORT statement Revised recommendations for improving the quality of reports of parallel group randomize Trials. Lancet 2001; 357: 1191-1194. (Also available from: URL: http ://www.consort-statement.orgl). Accessed June 28, 2002.
2. International Committee of Medical Journal Editors. Uniform Requirements for Manuscripts Submitted to Biomedical Journals. Ann Intern Med 1997;126:36-47. (Updated October 2001 version Available from: URL: http: //www.icmje.org/). Accessed June 28,2002.
3. JAMA Instructions for Authors. Available from URL: http :// jama.ama-assn.org/. Accessed June 28, 2002.
4. HaIl GM. Structure of a scientific paper. In: Hall GM, ds. How to write a paper. London:BMJ Books, 2000.
5. 52nd WMA General Assembly. World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. Available from: URL: http://www.wma.netl. Accessed June 28,2002.

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