# WEST AFRICAN JOURNAL OF ORTHODONTICS

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

VOLUME 8, NUMBER 1

JUNE 2019

Digit Sucking and Hyoid Bone Position

Evaluation of teatment changes in Class II Div I using Advansync 2 Appliance

Orthodontic reatment and Temporo-Mandibular Disorders

Orthodontic reatment of Moderate Lower Anterior Crowding

Orthodontic reatment of AOB in an Adult Patie t

OFFICIAL PUBLICATION OF ORTHODONTIC ASSOCIATIONS IN THE WEST AFRICA SUB-REGION
"DENTISTRY'S FIRST SPECIALTY JOURNAL IN SUB SAHARAN AFRICA"

# Impact of Digit-Sucking Habit on the Hyoid Bone Position in Nigerian Children.

Njokanma A, Otuyemi OD, Kolawole KA

## Abstract

*Background:* Digit sucking is the most common oral habit in children but its influence on the hyoid bone is not well established. This study aimed to determine the effect of digit-sucking habits on the vertical and horizontal position of the hyoid bone in Nigerian children.

*Methods:* Thirty children (4-12 years) with a digit-sucking habit were matched for age, sex and skeletal pattern with 30 children without any oral habit. Lateral cephalometric x-rays were used to determine the hyoid position. Data was analyzed using SPSS version 20.0. The percentages and frequencies of the categorical variables were determined. Assessment for data normality was carried out using Shapiro-Wilk's test. The association between categorical variables was determined using Chi-square and Fisher's exact test. Quantitative variables were analyzed and presented as means and standard deviation when normally distributed and median with interquartile range when skewed. Inferential statistics was done using the independent sample t- test to compare means. Statistical significance was set at $p<0.05$.

*Results:* There was a difference in the vertical and horizontal hyoid bone position, reflected by a significant increase in the mean values for the vertical and horizontal hyoid position in the digit-sucking group. ($p<0.05$).

*Conclusions:* The hyoid bone was significantly more inferiorly and anteriorly positioned in relation to the mandible and the third cervical vertebrae respectively, ($p<0.05$) among children with a digit-sucking habit.

*Keywords:* Digit sucking, Oral Habit, Hyoid bone position

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ORIGINAL ARTICLE

## Introduction

Oral habits, including digit sucking, are repetitive involuntary actions that utilize the oral cavity.[1] Digit sucking (DS) is the most common form of oral habit seen in children and is considered normal in infants and young children.[2-4] These habits can influence the developing occlusion and skeletal structures.[5]

The human hyoid bone is a horseshoe-shaped bone located in the neck opposite the lower portion of the third cervical vertebrae. The hyoid bone plays a role in mastication, deglutition, respiration, and speech.[6] The antero-posterior position of the hyoid bone is determined by the action of the muscles attached to the structures above and below it, and not by the position of the teeth.[7-9] The attachment of these muscles may affect the position of the hyoid bone through the tongue and mandibular movements.[10] The hyoid bone has shown considerable variation in positions, notably adapting to antero-posterior changes in head and mandibular positions.[11-14]

Adesina et al found the average values of the distance of Hyoid to mandibular plane (H-MP) to be 13.3mm ± 11.6mm in a Nigerian adult population with Bi maxillary proclination. Other values reported in the literature include the H-Ml values of 14.5mm ± 4.6mm vs 11.8mm ± 3.1mm; hyoid-third cervical

vertebra (Hy-C3ai) distance of 35.4mm ± 5.6mm vs 29.0mm ± 4.3mm; and the hyoid - retrognathion (Hy-Rgn) distance of 30.7mm ± 7.4mm vs 31.9mm ± 6.3mm in a Colombian population of children with digit-sucking habits vs the controls, respectively.

However, the hyoid position is not influenced by respiration or skeletal malocclusion.[15, 16] Prolonged digit sucking interferes with the correct motion of the tongue and may result in an incorrect swallow pattern and tongue thrusting habit.[17, 18] An altered tongue position may then influence the position of the hyoid bone because of the attachment of the muscles of the tongue to the hyoid.[7]

Despite the interest in the position of the hyoid bone, there is a dearth of information on the possible influence of digit sucking in the literature. Therefore, the purpose of this study was to evaluate the impact of digit sucking on the position of the hyoid bone in Nigerian children aged 4-12 years, who currently indulge in this habit. .

## Materials and methods

Ethical approval was obtained from the Ethics and Research Committee of the OAUTHC Ile-Ife, Nigeria (ERC/2016/10/04) and signed informed consent was obtained from the parents or guardians of the subjects, while assent was obtained from subjects aged 7-12.[19]

The sample size for this study was calculated using the formula for calculating sample size for comparative research studies.[20] The study sample consisted of sixty subjects recruited from patients who presented at the Child Dental Health clinic, Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria. They were divided into two equal groups based on their eligibility (DS and non-DS groups).

A pilot study was conducted to assist the calibration of the investigator, to ensure appropriate data collection and familiarize the investigator with the research protocol. Three subjects with digit-sucking habits were recruited into the DS group. Three other subjects who matched the subjects in the DS group for age and gender and who did not have a digit-sucking habit were recruited into the non-DS group. The investigator obtained and traced the lateral cephalometric radiographs of all subjects in the pilot study. A consultant orthodontist who is an expert in cephalometric studies also traced the same lateral cephalometric radiographs. Inter-examiner consistency was determined by calculating the intra-class coefficient scores (ICC). The ICC score calculated for all the cephalometric variables (hyoid bone) in the pilot study ranged from 0.86 to 0.91.

Subjects who met the following criteria were recruited into the study. (1) Subjects aged 4-12 years (2) Subjects who fell within the 5$^{th}$ to 85$^{th}$ percentile of the Center for Disease Control BMI to percentile chart[21] (3) Subjects whose parents gave consent.

Subjects who had a history of any other oral habit, previous history of orthodontic treatment, history of trauma, or congenital anomaly to the lips, face or craniofacial complex were excluded from the study.

The subjects in the DS group were recruited from patients who presented at the Child Dental Health Clinic with a digit-sucking habit. They were matched for age (+/- 12 months), sex, and skeletal pattern (based on lateral cephalometric analysis) through a convenience sampling method with a population of patients who had no history of engaging in digit-sucking habit (non-DS). Each participant was weighed wearing light clothing on a digital weighing scale, and their height measured using a stadiometer. Body Mass Index, (BMI) was calculated using the formula:

$$BMI = \frac{\text{Weight (kg)}}{\text{Height (m}^2\text{)}}$$

The Center for Disease Control and Prevention (CDC) chart[21] was used to categorize the BMI scores into underweight (below the 5$^{th}$ percentile),

normal/healthy (5th- 85th percentile) and overweight (above 85th percentile). Only those patients within the normal/healthy percentile range were recruited into the study.

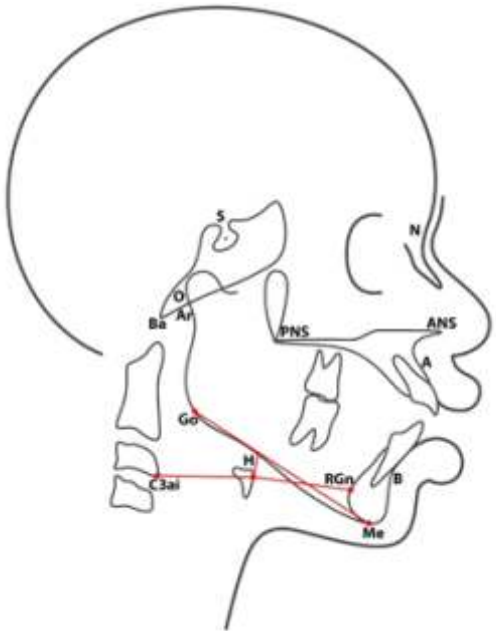
Information was collected via a questionnaire which included the number of digits sucked, the periods of the day the habit is practiced, the duration of the habit (number of hours per day/ or years) and severity of the habit based on the classification by Kolawole *et al.*[19]

Standardized lateral skull radiographs were taken for all the subjects using a Pan- Blue-Oris Machine (BlueXTM Imaging SRL BLD XP PANCEPH METRIC 71680000700 ASSAGO, ITALY). The cephalometric radiographs were traced manually using a sharp HB lead pencil on a 0.003" matte finish acetate sheet placed over the radiograph and secured with masking tape on an illuminated viewing box. All radiographs were traced by the principal investigator (A.N)

Linear measurements were recorded in millimeters (mm). The landmarks shown in Table 1 and Figure 1 were identified on the cephalometric radiograph of each participant in this study and the values obtained were compared between subjects in the DS group and the non-DS group.

**Table 1: Skeletal reference points and planes**

| Measurement | Abbreviation | Definition |
|---|---|---|
| Hyoid–Mandibular line. (vertical position) | H-ML | Perpendicular distance of the hyoid point from the mandibular plane |
| Hyoid-third cervical vertebra (horizontal position) | H-C3ai: | Linear distance from the hyoid to the third cervical vertebra |
| Hyoid-retrognathion (horizontal position) | H-Rgn: | Linear distance from the hyoid to the retrognathion |




| Measurement | Description |
|---|---|
| Vertical position of the hyoid bone | H-Ml |
| Horizontal position of the hyoid bone | H-C3ai |
| Horizontal position of the hyoid bone | H-Rgn |

**Figure 1: Diagram showing the cephalometric hyoid parameters measured.**

The random errors during tracing, landmark selection, and measuring were determined by repeating the tracings of 25 randomly selected radiographs two weeks after completion of the sample collection. Dahlberg's formula,[22]

$$D = \sqrt{\sum_{i=1}^{N} \frac{d_i^2}{2N}}$$

was used to calculate measurement error, where *d* is the difference in the measurement between the first and second tracings and *n* is the sample size.[23] The error of linear measurements were minimal, ranging from 0.1 to 0.5mm. Systematic errors were determined by using a paired t test and the differences between the first and second measurements were not statistically significant.

Data was analyzed using IBM SPSS version 20, while the association between categorical variables was determined using Fisher's exact test. Quantitative variables (vertical and horizontal hyoid positions) were analyzed and presented as means and standard deviation. Independent sample t-test was used to compare the means of the various hyoid positions between both groups. Statistical significance was inferred at $p < 0.05$ and based on a 95% confidence interval.

## Results

A total of 60 subjects were recruited into the study, 30 subjects in each group, with each group comprising 16 males and 14 females . The mean age of subjects in the DS and non-DS group were 7.7 ± 2.2 years and 8.1 ± 2.1 years respectively. There was no statistically significant difference between both groups in age and gender ($p>0.05$). (Table 2

**Table 1: Skeletal reference points and planes**

| | DS group (n=30) n(%) | Non-DS group (n=30) n(%) | Total n(%) | χ2 | p-value |
|---|---|---|---|---|---|
| **Age group (Years)** | | | | | |
| 4-6 | 9(30.0) | 8(26.7) | 17(28.3) | 0.466 | 0.451 |
| 7-9 | 16(53.3) | 13(43.3) | 29(48.3) | | |
| 10-12 | 5(16.7) | 9(30.0) | 14(23.3) | | |
| **Mean±SD** | 7.70±2.2 | 8.27±2.2 | 7.98±2.2 | -0.682 | 0.320 |
| **Gender** | | | | | |
| Male | 16(53.3) | 16(53.3) | 32(53.3) | 0.000 | 1.000 |
| Female | 14(46.7) | 14(46.7) | 28(46.7) | | |

†Fisher's Exact test

Most of the subjects (25;83.3%) sucked while asleep while 14 (46.6%) subjects sucked at other times during the day (excluding school time). Four (13.3%) subjects sucked across all three-time periods; while at school, during the day, and while asleep. The majority of the subjects (60.0%) had a moderate digit-sucking habit while 16.7% and 23.3% had mild and severe sucking habits respectively (Figure 2).

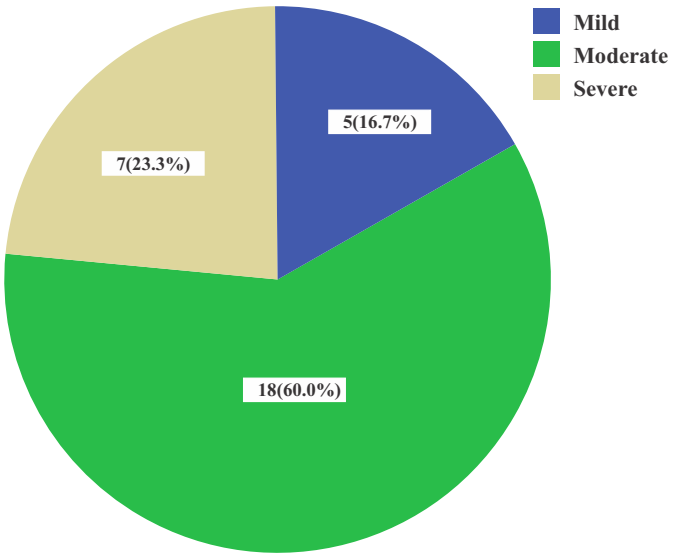



**Figure 2: Pie chart showing classification of habit severity in the study population.**

Table 3 shows the comparison of the mean hyoid bone position in the DS and non-DS groups. The mean vertical linear distance between the hyoid and mandibular plane (H-ML) and the horizontal position (HC3ai) were significantly increased in the DS group respectively when compared with the non-DS group ($p<0.05$). However, the mean horizontal linear distance between the hyoid and the retrognathion (H-Rgn) was reduced in the DS group compared to the non-DS group, although the difference was not significant ($p>0.05$).

**Table 3. Comparison of the mean hyoid bone position in the DS and non-DS groups**

| | Hyoid bone position | DS group Mean±SD (mm) | t-value | p-value |
|---|---|---|---|---|
| H-ML | 11.23±3.6 | 9.43±2.8 | 2.205 | 0.031* |
| H-C3ai | 34.83±4.0 | 31.93±4.9 | 2.509 | 0.015* |
| H-Rgn | 31.93±6.9 | 34.57±5.0 | -1.703 | 0.094 |

## Discussion

In this study the hyoid bone was significantly lower (H-ML) and more anteriorly positioned (H-C3ai) in the DS group compared to the non-DS group. This supports the evidence from the literature that the hyoid position changes in response to mandibular movement.[10, 11, 24] When the mandible moves posteriorly, as a compensatory functional mechanism, the hyoid bone is guided to an inferior position to avoid compromising the airway space.[25] During digit sucking, the tongue moves downward and forward to allow for passage of air and the mandible assumes an inferior and posterior habitual position.[26] The anterior tongue displacement and tongue thrusting associated with digit-sucking habit[17, 18] may also influence the position of the hyoid bone due to the attachment of the muscles of the tongue to the hyoid.[9] This may be responsible for the more anterior position of the hyoid bone as observed among the digit-sucking group in this study.

Salazar-Arboleda *et al*[26] reported a significant increase in the mean values of the vertical (H-ML) and horizontal positions (H-C3ai) of the hyoid bone among a population of children with a digit-sucking habit, similar to the finding in this study. An inferiorly positioned hyoid bone in respect to the mandible has

been reported in patients with reduced airway dimensions.[27,28] Genta *et al*[28] and Sforza *et al*[29] reported that a more inferiorly positioned hyoid bone is strongly associated with the presence and severity of obstructive sleep apnea syndrome (OSA) which is a sleep disorder characterized by a repetitive collapse of the upper airway during sleep. Their findings were in agreement with other reported studies.[30]

This could possibly suggest that digit suckers are at risk of developing OSA, which has been associated with significantly impaired quality of life, poor cognitive and social functioning, and high morbidity.[31,32] The possible association between digit-sucking habits and OSA validates the need for proper upper airway assessment in children with a history of prolonged digit-sucking habit. Further research in children with digit-sucking habits, which may entail sleep studies are needed to explore any defined relationship between the presence of digit sucking and obstructive sleep apnea.

Although the intensity of the digit-sucking habit was not assessed in the subjects of this study, the majority of subjects sucked their digits mostly when asleep, which could have influenced the intensity of digit sucking.

One of the limitations of this study is the fact that lateral cephalograms are limited by inherent errors accompanying the two dimensional representation of a three dimensional structure, including distortion, differences in magnification, and superimposition of bilateral craniofacial structures. Therefore, the use of cone beam computed tomography in the evaluation of the upper airway would further enhance understanding of the upper airway changes seen in patients with digit-sucking habits . However, in our environment, lateral cephalometric radiographs is still a cost effective means for assessing craniofacial morphology. In this study, the use of the same machine in taking the lateral cephalometric radiographs ensured minimal problems with magnification errors.

## Conclusion.

In conclusion, the authors of this study found that digit-sucking habits influenced the vertical and horizontal position of the hyoid bone (more inferiorly and anteriorly positioned hyoid bone in relation to the mandible and the cervical vertebrae respectively) as seen among the DS group. Further studies would be welcome to determine the effects of the hyoid position, especially in relation to Obstructive sleep apnea.

## Contributors

All the authors contributed to the design, data collection, analysis and write-up of the manuscript.

## Funding/Grants

Self-funded

## Conflict of Interest

Nil

## References

1. Shahraki N, Yassaei S, Moghadam MG. Abnormal oral habits: A review. J Dent Oral Hyg 2012;4(2):12-15.
2. Bishara SE, Warren JJ, Broffitt B, Levy SM. Changes in the prevalence of nonnutritive sucking patterns in the first 8 years of life. Am J Orthod Dentofac Orthop 2006;130(1):31-36.
3. Quashie-Williams R, daCosta OO, Isiekwe MC. Oral habits, prevalence and effects on occlusion of 4–15-year-old school children in Lagos, Nigeria. Niger Postgrad Med J 2010;17(2):113-7.
4. Schneider PE, Peterson J. Oral habits: considerations in management. Pediatr Clin North Am 1982;29(3):523-46.
5. Kamdar RJ, Al-Shahrani I. Damaging oral habits. J Int Oral Health: 2015;7(4):85.
6. Shimizu Y, Kanetaka H, Kim Y-H, et al. Age-related morphological changes in the human hyoid bone. Cells Tissues Organs 2005;180(3):185-92.
7. Bordoni B, Morabito B, Mitrano R, Simonelli M, Toccafondi A. The anatomical relationships of the tongue with the body system. Cureus 2018;10(12).

8. Grant L. A radiographic study of hyoid bone position in Angles Class I, II, and III malocclusions [Masters thesis]. Kansas: University of Kansas City; 1959;43-44.
9. Gray H. Henry Gray's Anatomy of the Human Body. Lea and Febiger, Philadelphia 1954:194-95.
10. Tsai H-H. The positional changes of hyoid bone in children. J Clin Pediatr Dent 2003;27(1):29-34.
11. Adamidis IP, Spyropoulos MN. Hyoid bone position and orientation in Class I and Class III malocclusions. Am J Orthod Dentofac Orthop. 1992;101(4):308-12.
12. Fink DF, Smith RJ. The duration of orthodontic treatment. Am J Orthod Dentofac Orthop. 1992;102(1):45-51.
13. Sahoo NK, Jayan B, Ramakrishna N, Chopra SS, Kochar G. Evaluation of upper airway dimensional changes and hyoid position following mandibular advancement in patients with skeletal class II malocclusion. J Craniofac Surg 2012;23(6):e623-7.
14. Winnberg A, Pancherz H, Westesson P-L. Head posture and hyo-mandibular function in man: A synchronized electromyographic and video fluorographic study of the open-close-clench cycle. Am J Orthod Dentofac Orthop. 1988;94(5):393-404.
15. Adeyemi TE, Otuyemi OD, Bamgbose BO, Muhammad SA. The impact of playing wind musical instruments on the masseter muscles in a West African population. West Afr J Rad 2020;27(2):114.
16. Gale EN, Ayer WA. Thumb-sucking revisited. Am J Orthod 1969;55(2):167-70.
17. Subtelny JD, Subtelny JD. Oral habits--studies in form, function, and therapy. Angle Orthod 1973;43(4):347-83.
18. Warren JJ, Bishara se, Steinbock Kl, Yonezu T, Nowak AJ. Effects of oral habits' duration on dental characteristics in the primary dentition. J Am Dent Assoc 2001;132(12):1685-93.
19. Waligora M, Dranseika V, Piasecki J. Child's assent in research: age threshold or personalisation? BMC Med Ethics 2014;15(1):44.
20. John Eng M. Sample size estimation: how many individuals should be studied? Radiology 2003; 2003: 227:309-13.
21. Ogden CL, Kuczmarski RJ, Flegal KM, et al. Centers for Disease Control and Prevention 2000 growth charts for the United States: improvements to the 1977 National Center for Health Statistics version. Pediatr 2002;109(1):45-60.
22. Dahlberg G. Statistical methods for medical and biological students. Int J Stats. Med & Bio. Res. 1940.
23. Ajayi EO. Cephalometric norms of Nigerian children. Am J Orthod Dentofac Orthop. 2005;128(5):653-56.
24. Graber LW. Hyoid changes following orthopedic treatment of mandibular prognathism. Angle Orthod 1978;48(1):33-38.
25. Amayeri M, Saleh F, Saleh M. The position of hyoid bone in different facial patterns: A lateral cephalometric study. Eur Sci J 2014;10(15).
26. Salaza-Arboleda. Comparison of the upper airways from cephalometric radiographs of children with and without digit sucking habit. Eur J Paediatr Dent 2014;15(3):326-31.
27. Bacon WH, Turlot JC, Krieger J, Stierle J-L. Cephalometric evaluation of pharyngeal obstructive factors in patients with sleep apneas syndrome. Angle Orthod. 1990;60(2):115-22.
28. Genta PR, Schorr F, Eckert DJ, et al. Upper airway collapsibility is associated with obesity and hyoid position. Sleep 2014;37(10):1673-8.
29. Sforza E, Bacon W, Weiss T, et al. Upper airway collapsibility and cephalometric variables in patients with obstructive sleep apnea. Am J Respir Crit Care Med 2000;161(2):347-52.
30. Maltais F, Carrier G, Cormier Y, Series F. Cephalometric measurements in snorers, non-snorers, and patients with sleep apnoea. Thorax 1991;46(6):419-23.
31. Engelmann H, Douglas N. Sleep· 4: Sleepiness, cognitive function, and quality of life in obstructive sleep apnoea/hypopnoea syndrome. Thorax 2004;59(7):618-22.
32. Lacasse Y, Godbout C, Series F. Health-related quality of life in obstructive sleep apnoea. Eur Respir J 2002;19(3):499-503.

# An Evaluation of Dentofacial Changes in Angle's Class II division 1 Patients using Advansync 2

Sanshavi PAR, Sunil M, Goutham B, Sanju S, Shetty BK

## Abstract

*Background:* The purpose of the study was to evaluate the dental, skeletal, and soft tissue changes of Advansync 2 appliance using photometric analysis.

*Methods:* The sample size consisted of 15 patients who reported to the department of orthodontics, seeking fixed orthodontic treatment. The effects of the Advansync 2 appliance were measured at two intervals.

*Results:* After the nine months, p-values were observed to be less than 0.5, therefore statistically significant for parameters such as SNA, CO-A, WITZ, C0-Gn, ANB, UI-A (degree), LI-B (mm), LL-E plane, Nasolabial angle, Mentolabial angle, Facial angle, and L lip to chin. P-values were however observed to be greater than 0.5, therefore statistically insignificant for parameters such as SNB, C0-Go, UI A(mm), LI B(mm), UL-EPL, H LINE, FMA, Nose Tip angle, Nasofrontal angle, Nasomental angle, Upper-lip angle and U lip to chin.

*Conclusion:* AdvanSync 2 appliance brought about a change in Class II malocclusions through Co-Gn, Co-Go, ANB, FMA, UI-A (degree), UI A (linear) LI B (linear), UL-E plane, LL-E plane, H LINE, Nose tip angle, Nasolabial angle, Mentolabial angle, Nasofrontal angle, Nasomental angle, Facial angle, Upper lip angle, U lip to chin, and L lip to chin after nine months of appliance delivery.

*Keywords:* 3D Cephalometrics, Functional, Class II, Compliance

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ORIGINAL ARTICLE

## Introduction

For decades, orthodontic researchers have focused on the treatment of class II malocclusions. Several appliances, such as the Calibrated Force Module, Alpern Class II Closers, Saif Spring, and CS 2000 Class II Springs have been used as alternatives for intermaxillary Class II elastics, with coil springs put distal to the mandibular molars and mesial or distal to the maxillary canines. Another intermaxillary therapy option for growing patients with skeletal Class II division 1 malocclusion due to a retruded mandible is functional appliances. They include a range of removable and fixed devices that are designed to alter the position of the mandible, thus resulting in orthopaedic and orthodontic changes.[1,2,3]

The Herbst appliance is a regularly used rigid fixed functional appliance that has been studied and compared to the effects of other functional appliances in various researches. Herbst appliance has been modified into the Advansync appliance. Since the Advansync appliance only uses the first permanent molars, it may cure dental malocclusion and class II orthopaedic correction at the same time, saving time.[1] (Figure 1)

The goals and objectives of this research were to evaluate the dental and skeletal changes of Advansync 2 appliance as well as the soft tissue changes of Advansync 2 appliance using

PATIENT 1: COLOR PLATES

**Figure 1: Pre treatment extraoral photographs**

photometric analysis. Furthermore, the study assessed the efficacy of Advansync 2 appliance in Angle's class II division 1 Patients.

## Materials and Methods

This study was approved by the Institutional review board (IRB/CIDS/294/2019). The proposed study was explained to each of the selected patients and his/her written consent was obtained prior to the commencement of the study. The demographic characteristics of each patient (age and sex) and clinical parameters were recorded initially (Figure 2).

The sample size consisted of 15 patients who reported to the Department of Orthodontics and Dentofacial Orthopaedics with the chief complaints of backwardly placed lower jaw and seeking orthodontic treatment.

Pre-treatment and Post-functional lateral cephalograms were taken. All the digital radiographs were taken using SIRONA (ORTHOPHOS XG 5) with the same operator. To make the radiographs more uniform, all magnifications were set to 0%. One investigator drew all the tracings and measurements. Fixed orthodontic treatment started simultaneously along with the fixed functional appliance. Following the active phase of the treatment, the fixed functional appliance was removed only after the minimum of a three-month retention period. (Figure3)

Measurements were taken at two intervals

T0 – Beginning of treatment phase

T1 – Completion of fixed functional phase (Figure 4)

A tripod supported a digital camera in the photographic set-up. Adjustment of the tripod height allowed the optical axis of the lens to be maintained in a horizontal position during the recording, which was adapted to each subject's body height. Each patient was asked to relax in a standing stance, with both arms swinging freely beside the trunk. The subject was positioned on a line marked on the floor

**Figure 2: Pretreatment intraoral photographs**

**Figure 3: Pre-treatment lateral cephalograph**

and a vertical measurement scale divided into millimeters was placed behind the subject, allowing measurements at life size. (Figure 5)

A distance of 1.75 meters was always maintained from the marking on the floor where the tripod was placed to another marking where the subject was made to stand. Before each recording, the operator checked that the subject's neck and ear were all visible, and their lips relaxed. A mirror was placed 3.5 metre in front of the subject, so the subjects can look into the mirror with their lips relaxed to record the right side profile in Normal Head Position (NHP) (Figure 6). The photographic records were analyzed using the Photo shoot Adobe cc 2015, Standard Edition. A mill metric paper gauge was attached to the computer monitor, thereby producing a universal background. Using the above-mentioned method, all photographic records were scaled to life size and 12 landmarks located on the digitized image were used to obtain all angular measurements. The same operator undertook all procedures (Figure 7).

**Figure 4: Advansync 2 fixed functional appliance**

**Figure 5: Advan sync 2 appliance delivery intraoral photographs**

**Inclusion criteria:**

1. Patients who were willing for orthodontic treatment (cooperative and gave consent).
2. Angle's Class II Division 1 malocclusion patients
3. Patients with Skeletal Class II malocclusion indicated by an ANB angle greater than $4^{o}$

**Figure 6: Post functional intra oral photograph**

**Exclusion criteria:**

1. Patients with missing teeth (excluding third molars).
2. Patients with syndromic or craniofacial anomalies that affect craniofacial growth.
3. Patients with skeletal class I malocclusion.
4. Patients with Angle's Class Angle's Class II Division 2, Angle's Class III malocclusion.
5. Patients who were not willing to participate {who did not give consent}.

**Figure 6: Post functional occlusal photograph**

### Sample size estimation

All the data were analyzed with MINITAB VERSION 13.1 & SPSS Software .The result data was provided as a mean ± sd. For intra-group comparisons (i.e. pre- and post-changes), a paired t test with a utilized value of 0.05 or less was considered for the result to be statistically significant.

Sample size was calculated based on a study conducted by Esen Ali Gunay et al titled: Evaluation of the Immediate Dentofacial Changes in Late Adolescent Patients Treated with the Forsus FRD. Based on the comparison of required parameters, the sample size was calculated using formula:

$Z_{\alpha} = 1.96$

$\sigma^2 = 0.0081$

e = margin of error=0.0025

**N=12.446 = 13**

## Results

For patients with Advansync 2 fixed functional appliances, the mean of the cephalometric readings, such as SNA, SNB, WITZ, Co-A, Co-GN, Co-Go, ANB, FMA, UI-A (degree), UI A (linear), LI-B (degree), LI B (linear), UL-E plane, LL-E plane and H LINE at the beginning of the treatment was 81.5333 ± 4.37308, 84.8667 ± 4.17247, 77.0000 ± 5.18239, 105.1333 ± 5.62985, 59.7333 ± 7.56370, 5.5333 ± 2.99682, 4.6000 ± 2.16465, 26.8667 ± 6.40164, 31.4000 ± 8.58404, 31.8667 ± 7.81817, 7.3333 ± 3.84831, 6.1333 ± 2.87518, -.4667 ± 2.23180, -1.7333 ± .79881 and -.7333 ± 2.15362 respectively (TABLE 1).

**Table 1. Comparison of effects of Advansync 2 fixed functional appliance between the beginning of the treatment and nine months after appliance delivery using lateral cephalogram.**

| | | Mean | Standard deviation | t | Sig. |
|---|---|---|---|---|---|
| SNA | Pre | 81.5333 | 4.37308 | 2.977 | **0.010** |
| (degree) | Post | 78.2667 | 5.71298 | | **(S)** |
| Co-Pt A | Pre | 84.8667 | 4.17247 | 5.196 | **0.000** |
| (mm) | Post | 81.9333 | 4.09646 | | **(HS)** |
| SNB | Pre | 77.0000 | 5.18239 | 0.840 | 0.415 |
| (degree) | Post | 76.1333 | 5.84156 | | (NS) |
| Co-Gn | Pre | 105.1333 | 5.62985 | - | **0.000** |
| (mm) | Post | 110.3333 | 3.15474 | 6.925 | **(HS)** |
| Co-Go | Pre | 59.7333 | 7.56370 | - | 0.096 |
| (mm) | Post | 60.0667 | 7.24536 | 1.784 | (NS) |
| ANB | Pre | 5.5333 | 2.99682 | 4.289 | **0.001** |
| (degree) | Post | 3.4000 | 2.72029 | | **(HS)** |
| WITZ | Pre | 4.6000 | 2.16465 | 5.449 | **0.000** |
| (mm) | Post | .7333 | 1.62422 | | **(HS)** |
| FMA | Pre | 26.8667 | 6.40164 | 0.862 | 0.403 |
| (degree) | Post | 25.4667 | 2.13363 | | (NS) |
| U1-Pt-A | Pre | 31.4000 | 8.58404 | 3.658 | **0.003** |
| (degree) | Post | 26.2000 | 6.87854 | | **(HS)** |
| L1-Pt-B | Pre | 31.8667 | 7.81817 | - | **0.032** |
| (degree) | Post | 36.2667 | 5.68792 | 2.384 | **(S)** |
| U1-Pt-A | Pre | 7.3333 | 3.84831 | 1.871 | 0.082 |
| (mm) | Post | 6.7333 | 3.34806 | | (NS) |
| L1-Pt-B | Pre | 6.1333 | 2.87518 | 0.960 | 0.353 |
| (mm) | Post | 5.8000 | 2.30527 | | (NS) |
| U lip to E | Pre | -.4667 | 2.23180 | 1.848 | 0.086 |
| plane(mm) | Post | -1.1333 | 2.55976 | | (NS) |
| L lip to E | Pre | -1.7333 | .79881. | - | **0.002** |
| plane(mm) | Post | -.2667 | 703732. | 3.898 | **(HS)** |
| H line | Pre | -.7333 | 153621. | 0.673 | 0.512 |
| (mm) | Post | -1.0000 | 36277 | | (NS) |

*p value= 0.05; p value < 0.05 =significant; p value > 0.05 = non significant;

**Figure 8: Post functional extra oral photograph**

**Figure 9: Post-functional cephalograph**


**Figure 10: Pre and post functional photometric analysis**

After nine months of treatment with the Advansync 2 fixed functional appliance, the mean of the cephalometric readings in the patients, for such parameters as SNA, SNB, WITZ, Co- A, Co-GN, Co-Go, ANB, FMA, UI-A (degree), UI A (linear), LI-B (degree), LI B (linear), UL-E plane, LL-E plane and H LINE, was found to be 78.2667 ± 5.71298, 81.9333 ± 4.09646, 76.1333 ± 5.84156, 110.3333 ± 3.15474, 60.0667 ± 7.24536, 3.4000 ± 2.72029, .7333 ± 1.62422, 25.4667 ± 2.13363, 26.2000 ± 6.87854, 36.2667 ± 5.68792, 6.7333 ± 3.34806, 5.8000 ± 2.30527, -1.1333 ± 2.55976, -.2667 ± .70373 and -1.0000 ± 1.36277respectively.

C0-Gn, C0-Go, ANB, WITZ, UI-A (degree and mm), LI-B (mm) UL-E plane, LL-E plane, H LINE and FMA were found to have improved after nine months of the Advansync 2 fixed functional appliance delivery. On the contrary, SNA, SNB, CO-A and LI-B (degree) were reduced after nine months of the Advansync 2 fixed functional appliance delivery.

P-values were observed to be less than 0.05 for parameters such as SNA, WITZ, CO-A, C0-Gn, ANB, UI-A (degree), LI-B (degree) and LL-E plane. Consequently, the parameters SNA and LI-B (degree) were observed to be statistically significant, while the remaining parameters were highly significant.

The p-values for SNB, C0-Go, UI-A (mm), UI A, LI B (mm), UL-EPL, H LINE and FMA were however observed to be greater than 0.05. Therefore, the above-mentioned parameters were statistically non-significant .

For patients with Advansync 2 fixed functional appliances, the mean of the photometric analysis readings, such as Nose tip angle, Nasolabial angle, Mentolabial angle, Nasofrontal angle, Nasomental angle, Facial angle, Upper lip angle, U lip to chin and L lip to chin at the beginning of the treatment were 81.6000 ± 1.35225, 96.9333 ± 3.97252, 84.7333 ± 5.39135, 132.8000 ± 9.84305, 129.4000 ± 2.32379, 88.2667 ±. 59362, 11.6000 ±.82808, 7.0000 ±. 37796 and 4.0667 ±. 25820 respectively.

After nine months of the Advansync fixed functional appliance treatment, the mean of the cephalometric readings in the patients for such parameters as Nose tip angle, Nasolabial angle, Mentolabial angle, Nasofrontal angle, Nasomental angle, Facial angle, Upper lip angle, U lip to chin and L lip to chin were found to be 81.7333 ± 1.22280, 103.3333 ± 3.53890, 114.0000 ± 4.14039, 133.4000 ± 7.06905, 129.3333 ± 1.91485, 89.8000 ±. 86189, 12.4667 ± 1.72654, 7.3333 ±. 81650 and 4.4000 ±.50709 respectively (Table 2)

All the parameters were found to have improved after nine months of the Advansync fixed functional appliance delivery. P-values were observed to be less than 0.5 for parameters such as Nasolabial angle, Mentolabial angle, Facial angle and L lip to chin. Therefore, the above-mentioned parameters L lip to chin were statistically significant while the remaining were highly significant.

The p-values for Nose tip angle, Nasofrontal angle, Nasomental angle, Upper lip angle and U lip to chin were however observed to be greater than 0.5. Therefore, the above-mentioned parameters were observed to be statistically insignificant.

**Table 2. Comparison of effects of Advansync II fixed functional appliance between the beginning of the treatment and nine months after appliance delivery using photometric analysis.**

| | | Mean | Standard deviation | t | Sig. |
|---|---|---|---|---|---|
| Nose tip angle (degree) | Pre | 81.6000 | 1.35225 | - 0.315 | 0.758 (NS) |
| | Post | 81.7333 | 1.22280 | | |
| Nasolabial angle (degree) | Pre | 96.9333 | 3.97252 | - 4.932 | **0.000 (HS)** |
| | Post | 103.3333 | 3.53890 | | |
| Mentolabial angle (degree) | Pre | 84.7333 | 5.39135 | - 19.29 | **0.000 (HS)** |
| | Post | 114.0000 | 4.14039 | | |
| Nasofrontal angle (degree) | Pre | 132.8000 | 9.84305 | 9 - | 0.664 (NS) |
| | Post | 133.4000 | 7.06905 | | |
| Nasomental angle (degree) | Pre | 129.4000 | 2.32379 | 0.444 0.095 | 0.925 (NS) |
| | Post | 129.3333 | 1.91485 | | |
| Facial angle (degree) | Pre | 88.2667 | .59362 | - 5.996 | **0.000 (HS)** |
| | Post | 89.8000 | .86189 | | |
| Upper lip angle (degree) | Pre | 11.6000 | .82808 | - 1.857 | 0.084 (NS) |
| | Post | 12.4667 | 1.72654 | | |
| U lip to chin (mm) | Pre | 7.0000 | .37796 | - 1.581 | 0.136 (NS) |
| | Post | 7.3333 | .81650 | | |
| L lip to chin (mm) | Pre | 4.0667 | .25820 | - 2.646 | **0.019 (S)** |
| | Post | 4.4000 | .50709 | | |

*p value= 0.05; p value < 0.05 =significant; p value > 0.05 = non significant

## Discussion

This was a cephalometric and photometric study of the dental, skeletal, and soft tissue treatment impacts of the AdvanSync 2 fixed functional appliance in treating Class II malocclusions. As a result of these dentoalveolar alterations, the occlusal plane was rotated clockwise. All of the patients' overbite and overjet were minimised and the soft tissue profile was slightly improved. [4,5,6]

The Advansync 2 appliance produced its effect through maxillary growth restriction and dentoalveolar changes. This concurs with another research by May H. EL Mofty et al. testing the equivalent appliance. The purpose of this study was to compare the skeletal, dentoalveolar, and soft tissue impacts of the Advansync functional appliance to intermaxillary NiTi coil springs in the treatment of growing people with Class II division 1 malocclusion.[1,7,8,9]

The maxillary restriction was the major skeletal impact of the AdvanSync 2 appliance. This concurs with another research by Al-Jewair et al. testing the equivalent appliance. **Al-Jewair et al.** showed a 3.3° decrease in SNA, a 3.3 mm decrease in A-Na perp, and a 1.8 mm rise in maxillary length (Co-A) (from natural growth). Maxillary dentoalveolar changes with the AdvanSync 2 in our investigation were like the past examination, with no critical changes contrasted with the untreated controls (except for a slight incisor extrusion, undoubtedly because of fixed appliance mechanics)[10,11,12]. Mandibular dentoalveolar changes were additionally reliable with the past investigation, with the AdvanSync patients displaying incisor protrusion and proclination and molar mesialization contrasted with their separate control groups. However, Al-Jewair et al. revealed huge mandibular molar extrusion with AdvanSync contrasted with the controls; this was not found in our examination. This might be due to the advances in biomechanics of AdvanSync 2 over AdvanSync. The noticed dentoalveolar changes with the AdvanSync 2 were predictable generally with those detailed in investigations including the Herbst and the MARA.[13,14] Chitra et al, [15] derived similar conclusions from another research**.** They also stated that pre and post pubertal patients showed similar results, which most likely are a combination of skeletal and dentoalveolar changes. [15,16]

According to Celikoglu et al,[17] skeletal Class II malocclusions due to mandibular retrusion can be treated with removable or fixed functional orthodontic appliances. However, all those appliances cause protrusion of the mandibular incisors, thus limiting the skeletal contribution to overjet correction compared to the Advansync 2.[17,18,19]

The results of the present study showed that patients treated with the Advansync 2 fixed functional appliances had better C0-Gn, C0-GO, ANB, FMA, UI-A (degree), UI A (linear) LI B (linear), UL-E plane, LL-E plane, H LINE , Nose tip angle, Nasolabial angle , Mentolabial angle , Nasofrontal angle , Nasomental angle, Facial angle , Upper lip angle , U lip to chin , L lip to chin after the nine months of appliance delivery.

A limitation of this study is that only two time points before the treatment phase and nine months after functional appliance removal was included. A time point at fixed orthodontic treatment should have been recorded. The lower incisor proclination has increased drastically and has not been recorded in the database as of date and was one major finding in this study.

We restricted our study to AdvanSync 2 fixed functional appliance while numerous different modalities are accessible. Usually, appliances should be chosen for their probability of satisfying the individual patient necessities dependent on sound evidence.

## Conclusion

AdvanSync 2 appliance was effective in normalizing Class II malocclusions.

AdvanSync 2 corrected Class II malocclusions through changes in Co-Gn, Co-Go, ANB, FMA, UI-A (degree), UI A (linear) LI B (linear), UL-E plane, LL-E plane, H LINE, Nose tip angle, Nasolabial angle, Mentolabial angle, Nasofrontal angle, Nasomental angle, Facial angle, Upper lip angle, U lip to chin, L lip to chin.

**Contribution**-Contributions equally by the authors
**Funding** - Self Funding
**Conflict of interest:** Nil

## References:


1. EL Mofty, M., Ibrahim, S., EL-Shall, O., Tawfik, W. Evaluation of Dentoskeletal Changes Accompanying the Treatment of Class II Malocclusion by Advansync Appliance versus Intermaxillary Coil Spring Mechanics. Al-Azhar Dental Journal for Girls, 2018; 5(4): 373-383.
2. Jayachandran S, Wiltshire WA, Hayasaki SM, Pinheiro FHSL. Comparison of AdvanSync and intermaxillary elastics in the correction of Class II malocclusions: A retrospective clinical study. Am J Orthod Dentofac Orthop. 2016;150(6):979-988.
3. Anić-Milošević S, Lapter-Varga M, Laj M. Analysis of the soft tissue facial profile by means of angular measurements. Eur J Orthod. 2008;30(2):135-140. doi:10.1093/ejo/cjm116
4. Gunay EA, Arun T, Nalbantgil D. Evaluation of the immediate dentofacial changes in late adolescent patients treated with the ForsusTM FRD. European journal of dentistry. 2011 Oct;5(04):423-32.
5. Lai M, McNamara JA. An evaluation of two-phase treatment with the Herbst appliance and preadjusted edgewise therapy. Semin Orthod. 1998;4(1):46-58.
6. Koay WL, Yang Y, Tse CSK, Gu M. Effects of Two-Phase Treatment with the Herbst and Preadjusted Edgewise Appliances on the Upper Airway Dimensions. Sci World J. 2016;2016.
7. Negi G, Ponnada S, Aravind NKS, Chitra P. Photogrammetric correlation of face with frontal radiographs and direct measurements. J Clin Diagnostic Res. 2017;11(5):ZC79-ZC83. doi:10.7860/JCDR/2017/28249.9924
8. Bozkurt AP, Aras I, Othman E, Aras A. Comparison of 2 treatment protocols using fixed functional appliances in Class II malocclusion: Treatment results and stability. Am J Orthod Dentofac Orthop. 2020;157(4):474-480.
9. Abdalla Y, Brown L, Sonnesen L. Effects of a fixed functional appliance on upper airway volume: A 3-dimensional cone-beam computed tomography study. Am J Orthod Dentofac Orthop. 2020;158(1):40-49.
10. Arici S, Akan H, Yakubov K, Arici N. Effects of fixed functional appliance treatment on the temporomandibular joint. Am J Orthod Dentofac Orthop. 2008;133(6):809-814.
11. Yin K, Han E, Guo J, Yasumura T, Grauer D, Sameshima G. Evaluating the treatment effectiveness and efficiency of Carriere Distalizer: a cephalometric and study model comparison of Class II appliances. Prog Orthod. 2019;20(1). doi:10.1186/s40510-019-0280-2
12. Akan B, Veli İ. Evaluation of soft-tissue changes in young adults treated with the Forsus fatigue-resistant device. Am J Orthod Dentofac Orthop. 2020;157(4):481-489.e2.
13. Al-Jewair TS, Preston CB, Moll EM, Dischinger T. A comparison of the MARA and the AdvanSync functional appliances in the treatment of Class II malocclusion. Angle Orthod. 2012;82(5):907-914.
14. Wigal TG, Dischinger T, Martin C, Razmus T, Gunel E, Ngan P. Stability of Class II treatment with an edgewise crowned Herbst appliance in the early mixed dentition: Skeletal and dental changes. Am J Orthod Dentofac Orthop. 2011;140(2):210-223.
15. Chitra P, Negi G, Thushar BK. Treatment Outcomes in the Sagittal and Vertical

Dimensions with the AdvanSync2 Class II Corrector — A Case Series. Published online 2018:38-50.

16. Aras I, Pasaoglu A, Olmez S, Unal I, Tuncer AV, Aras A. Comparison of stepwise vs single-step advancement with the Functional Mandibular Advancer in Class II division 1 treatment. Angle Orthod. 2017;87(1):82-87. doi:10.2319/032416-241.1
17. Celikoglu M, Buyuk SK, Ekizer A, Unal T. Treatment effects of skeletally anchored Forsus FRD EZ and Herbst appliances: A retrospective clinical study. Angle Orthod. 2016;86(2):306-314. doi:10.2319/040315-225.1
18. Shendy M, Ibrahim S, Salama A. Evaluation of the Treatment Outcomes for Class II Malocclusion by Using PowerScope Appliance. Al-Azhar Dent J Girls. 2017;4(4):409-416. doi:10.21608/adjg.2017.5288
19. Cacciatore G, Alvetro L, Defraia E, Ghislanzoni LTH, Franchi L. Active-treatment effects of the Forsus fatigue resistant device during comprehensive Class II correction in growing patients. Korean J Orthod. 2014;44(3):136-142.

# Orthodontic Treatment and Temporo-mandibular Disorders - A Tale of Two Paradoxes .

Otuyemi OD, Olabintan AA

*Abstract*

The controversy on the causal or curative relationship between orthodontic treatment and Temporo-Mandibular Disorders (TMD) has been reported for several decades. This review highlighted the associations between orthodontic treatment of malocclusion and TMDs. It also provided empirical evidence on the relationship between malocclusion, orthodontic treatment mechanics and extraction of teeth protocols on TMDs. Thus far, there is no concrete evidence that demonstrates an elevated risk of developing TMD through orthodontic treatment as well as evidence that TMD can be permanently cured by orthodontic treatment

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## Introduction

The controversy on the causal or curative relationship between orthodontic treatment and Temporo-Mandibular Disorders (TMD) is still rife.[1, 2] The association between Orthodontics and TMDs have been widely reported in the literature for many years through observations and experts' opinions.[3,4] Orthodontists have also been implicated for causing TMD following orthodontic treatment and similarly complimented for curing the disease. A paradox of the time! The phrase "Orthodontics plays an important role as both a cause and treatment for TMD" is made repeatedly by some groups within the orthodontic profession, whereas others believe in the contrary. [3,4]

TMD is a collective term that involves a number of clinical conditions that affect the masticatory muscles, the temporomandibular joint (TMJ) and the associated structures.[5] It sometimes present with signs and symptoms such as pain from the temporomandibular joints and muscles, pain on joint movement, joint sounds, locking or luxation of joints as well as restricted mandibular movement.[6] The aetiology and pathophysiology of TMD is poorly understood, but it is believed to be multifactorial.[6-10] Unstable occlusion, psychosocial factors, parafunctional activity, trauma, individual predisposition and structural conditions have been considered as possible aetiologic factors.[6-10] TMDs, especially TMJ sounds, are often reported in children and adolescents with increase in prevalence between ages 15 and 25 years.[1] Prevalence of patients with at least one sign or symptom of TMD was reported to be 63% for sign and 41% for symptom by Jagger et al,[11] while Otuyemi et al[10] reported 62.8% for signs and 29.2% for symptoms of TMDs among Nigerian medical and dental students from Obafemi Awolowo University, Ile-Ife.

The purpose of this review was to highlight the associations between orthodontic treatment of

malocclusion and TMDs. This relationship remains an important but complex existential issue in orthodontics as a profession.

The attention of the orthodontic profession and the public was heightened in the late 1980s following a litigation instituted by a patient who allegedly developed TMD symptoms following orthodontic treatment. In the Michigan case of Brimm vs Malloy, Susan Brimm, a 16 year-old female patient, with Class II Division 1 malocclusion complicated by 7mm anterior open bite was treated by an experienced board certified orthodontist in Michigan, United States of America[12, 13]. Her treatment included the removal of her upper first premolars; use of a headgear, banding, and bonding of her upper and lower teeth. She exhibited no TMD at the onset of orthodontic treatment but symptoms (joint pain and headache) of TMD started after debanding/debonding and this was aggravated with wearing of a retainer. With increased discomfort she was referred to an Oral Surgeon who removed her lower third molars. Her TMD symptoms markedly increased with complaints of severe pain, clicking and locking of the joints.

A complaint was filed against the Oral Surgeon by Susan's attorney, with the allegation that the force of extractions caused trauma to the joints and that the Surgeon breached his duty to diagnose TMJ dysfunction and failed to make an appropriate referral for care. The trial took place between July 6-15, 1987 under Honorable James S. Thorburn, the case against the Oral surgeon was settled out of court for $2,500.

Another complaint was filed against the Orthodontist, that the plaintiff's teeth migrated in various directions causing an improper occlusion and deformity of the jaws/ surrounding mouth area as a result of the Orthodontist's substandard treatment. The Orthodontist was also alleged to have inflicted severe clicking in the joint, severe pain/crepitus in TMJ and limited mouth opening following treatment. Two experts for the plaintiff who were not licensed dentists in Michigan testified against the defendant orthodontist, stating that his treatment should not have involved the extraction of maxillary premolar teeth which led to distal placement of her mandible thus resulting in TMD due to excessive retraction of her maxillary incisors. Notwithstanding what the expert Michigan board certified specialist witnesses had to say on behalf of the defendant, the six jurors selected by the court to hear the case between July 6-15, 1987, found the orthodontist guilty (5-1) and awarded the plaintiff $850,000 ($1.3m with added costs).

Post-trial motions were argued in December 1987, but the trial court issued a written opinion denying all the defendant's post-trial motions. The defendant Counsel filed a claim of appeal with the appellate court. The AAO also filed an “Amicus Curiae Brief” on behalf of the defendant in the appellate court.

Some legal lessons from Susan Brimm's case include:

1. Juries don't decide cases and set precedents, decisions not landmark, but Appellate courts.
2. Precedents are established on legal principles, not on whether bicuspids should or should not be extracted.
3. The outcome of jury trials were not “recorded” in the manor as appellate court cases.
4. Should precedent be established in one geographic jurisdiction, it is not binding in another.
5. It is difficult, if not impossible, to discover on what basis a jury decides in favour of a litigant in this case.

**Implications of litigation**

This litigious climate resulted in an increased need for risk management as well as methodologically-sound clinical research works. Many clinicians avoided extraction protocols during orthodontic treatment at that critical period. Between 1988 and 1989, there was a flurry of clinical, experimental research works embarked on and sponsored by various research grant agencies across the US. Research works were published in subsequent editions of AJODO between 1991-1992[13,14].

**The following key questions seem pivotal:**

Does malocclusion lead to TMD?

Does orthodontic treatment with fixed or removable appliances lead to a greater incidence of TMD?

Does extraction of premolars as part of an orthodontic treatment plan result in a greater incidence of TMD?

Does orthodontic treatment prevent or cure TMD?

How should Orthodontic patients be managed if they present with TMDs before or during treatment?

**Does malocclusion lead to TMD?**

The role of occlusion in the aetiology of TMD is highly controversial.[15] Costen posited in 1934 that TMJ problems were as a result of nerve impingement from overclosure of occlusal bites, missing posterior teeth, and malocclusion.[16]

Malocclusion was reported to cause displacement of the condyle postero-superiorly, thus implying that correcting dental malocclusion would favourably affect the TMD symptoms.[17] McNamara[18] however, showed no difference in the occurrence of TMD symptoms in orthodontically treated and untreated patients.

Consistently, the only occlusal condition that may be of significant interest when exploring the role of malocclusion and onset of TMD symptoms is Unilateral Posterior Crossbite (UPC). Pullinger et al[19, 20]suggested that uncorrected UPC in childhood may NOT always result in sufficient condylar adaptation to avoid TMD symptoms.

Thilander[4] advocated that UPC should be corrected to avoid condylar displacement. Egermark et al[15] in a 20 year follow-up study, also found occlusal wear and deep bite as predictors of TMDs. However, Iodice et al[21] in a 2013 review, reported that no conclusion could be drawn of a causal relationship between posterior crossbites and TMDs.

A systematic review (1966-2005) of the association between different malocclusions and TMD by Mohlin et al[6] using Medline and Cochrane databases, reported that associations between certain malocclusions and TMD were discernible in some studies, whereas majority of the articles failed to identify significant and clinically important associations. They concluded that association between specific types of malocclusion traits and development of signs and symptoms of TMD could not be verified. Manfredini et al[22] in a 2017 systematic review also concluded that there was no clinically relevant association between occlusion and TMD. They further stated that there was no basis to consider dental occlusion as a major player in the pathophysiology of TMDs and thus encouraged practitioners to discard the old-fashioned gnathological ideology.

**Does orthodontic treatment with fixed or removable appliances lead to a greater incidence of TMD?**

In a review of literature (1966-1988) on Orthodontics and TMDs by Reynders,[3] 285 publications were provided by Medline, however, only 91 discussed the subject matter. The analyses were categorized into viewpoint publications, case reports and sample studies. (Tables I-III).

Viewpoint publications (VPs) and case reports (CRs) were over-represented compared with sample studies (SSs). VPs and CRs described a wide variety of conflicting opinions with little or no value in assessment of the relationship between treatment and TMDs.

Twenty viewpoint publications cited specific treatment mechanics as the cause of TMDs i.e. class II and cross-bite elastics, headgear, chin-cups and first premolar extraction.[3] Eight viewpoint publications claimed that TMDs were as a result of treatment not finished according to gnathologic standards.[3]

Sample studies indicated that orthodontic treatment was not responsible for creating TMDs regardless of orthodontic technique.[3] Also, Rinchuse et al[23] in their review of 2004 and 2017 systematic reviews on TMDs which assessed the 8 relevant systematic reviews in 2004 and the 110 relevant systematic reviews in 2017, following two PubMed searches, stated that traditional orthodontic treatment does not cause TMD. They identified an increased role of genetics and psychosocial factors in the aetiology of TMDs.

**Table 1: Viewpoint publications on the relationship between Orthodontics and TMDs**

| Author | Journal | Year | Relationship between Orthodontics and TMDs | Origin viewpoint |
|---|---|---|---|---|
| Ricketts | Am J Orthod | 1966 | ± | PVA |
| Mathews | Angle Orthod | 1967 | + | PVA |
| Silverman | Am J Orthod | 1968 | ± | PVA |
| Wilson | Orthodontist | 1971 | - | PVA |
| Marbach | Am J Orthod | 1972 | - | PVA |
| Perry HT | Am J Orthod | 1973 | ± | PVA |
| Perry HT | Am J Orthod | 1975 | - | PVA |
| Freer | Aust Orthod J | 1975 | 0 | PVA |
| Spyropoulos et al | Am J Orthod | 1976 | - | CRO |
| Williamson | Angle Orthod | 1976 | ± | PVA/CRA |
| Lewis | Am J Orthod | 1976 | ± | CRO |
| Timm and Ash | J Clin Orthod | 1977 | ± | PVA |
| Bench et al | J Clin Orthod | 1978 | ± | PVA |
| Aubrey | Am J Orthod | 1978 | ± | PVA/PVO/CRA/CRO |
| Levy | Int J Orthod | 1979 | ± | PVA |
| Roth | J Clin Orthod | 1981 | ± | PVA |
| Roth et al | J Clin Orthod | 1981 | ± | PVA |
| Roth | J Clin Orthod | 1981 | ± | PVA |
| Roth et al | J Clin Orthod | 1981 | ± | PVA |
| Williamson | J Clin Orthod | 1981 | ± | PVA |
| Williamson | J Clin Orthod | 1981 | ± | PVA |
| Libin | Int J Orthod | 1981 | - | PVA |
| Greene | Angle Orthod | 1982 | 0 | CSSO |
| Haden | J Craniomandibular Prac | 1982 | + | PVA |
| Williamson | J Clin Orthod | 1982 | + | PVA |
| Bellavia | J Craniomandibular Prac | 1983 | + | PVA |

| Author | Journal | Year | Relationship between Orthodontics and TMDs | Origin viewpoint |
|---|---|---|---|---|
| Bell | J Clin Orthod | 1984 | 0 | PVA |
| Bean | Funct Orthod | 1984 | ± | PVA |
| Mehta | Funct Orthod | 1984 | + | PVA |
| Witzig | Funct Orthod | 1984 | ± | PVA |
| Stack | Funct Orthod | 1985 | + | PVA |
| Kussick | Funct Orthod | 1985 | ± | PVA |
| Bowbeer | Funct Orthod | 1985 | ± | PVA/CRA |
| Bean | Funct Orthod | 1985 | ± | PVA |
| Grummons | Funct Orthod | 1985 | + | PVA |
| Bowbeer | Funct Orthod | 1986 | ± | PVA |
| Perry SS | Funct Orthod | 1986 | ± | PVA/CRA |
| Broadbent | Funct Orthod | 1986 | - | PVA |
| Broadbent | Funct Orthod | 1986 | + | PVA |
| Broadbent | Funct Orthod | 1986 | + | PVA |
| Broadbent | Funct Orthod | 1986 | ± | PVA |
| Gerber | Funct Orthod | 1986 | + | PVA |
| Bowbeer | Funct Orthod | 1986 | ± | PVA |
| Thompson | Angle Orthod | 1986 | ± | PVA |
| Gelb | Funct Orthod | 1987 | - | PVA |
| Gelb | Funct Orthod | 1987 | - | PVA |
| Wyatt | Am J Orthod Dentofac Orthop | 1987 | ± | PVA |
| Rinchuse | Am J Orthod Dentofac Orthop | 1987 | 0 | CSSO |
| Bowbeer | Funct Orthod | 1987 | ± | PVA/PVO/CRA |
| Bowbeer | Funct Orthod | 1987 | ± | PVA |
| McLaughlin | Angle Orthod | 1988 | - | PVO |
| Alpern et al | Angle Orthod | 1988 | ± | PVA |
| Spahl | Funct Orthod | 1988 | ± | PVA |
| Bowbeer | Funct Orthod | 1988 | ± | PVA/CRA |
| Livingston | Funct Orthod | 1988 | ± | PVO |

--, Orthodontics causes TMDs; +, orthodontics cures TMDs; 0, orthodontics does not influence TMDs; ±, orthodontics can both cause and cure TMDs. PVA, Personal viewpoint, author(s); PVO, personal viewpoint, other author(s); CRA, case report, author(s); CRO, case report, other author(s); CSSA, controlled sample study, author(s); CSSO, controlled sample study, other author(s); USSA, uncontrolled sample study, author(s); USSO uncontrolled sample study, other author(s). (Reynders RM. American Journal of Orthodontics and Dentofacial Orthopedics 1990;97(6):463-471.)

**Table 2: Viewpoint publications on the relationship between Orthodontics and TMDs**

| Author | Journal | Year | Relationship between Orthodontics and TMDs | No of cases |
|---|---|---|---|---|
| Roth | Angle OrthodAm | 1973 | ± | 7 |
| Ingervall | J Orthod | 1978 | + | 6 |
| Parker | Am J Orthod | 1978 | ± | 5 |
| Owen | J Craniomandibular Pract | 1984 | + | 4 |
| Callender | J Clin Orthod | 1984 | + | 2 |
| Bronson | Funct Orthod | 1984 | + | 1 |
| Owen | J Craniomandibular Pract | 1984 | ± | 6 |
| Bandeen | Am J Orthod | 1985 | ± | 1 |
| Bronson | Funct Orthod | 1985 | ± | 1 |
| Williamson | Facial Orthop Temporomandibular Arthrol | 1985 | + | 1 |
| Williamson | Facial Orthop Temporomandibular Arthrol | 1986 | + | 1 |
| Thompson | Angle Orthod | 1986 | ± | 3 |
| Williamson | Facial Orthop Temporomandibular Arthrol | 1987 | + | 1 |
| Bledsoe | Funct Orthod | 1987 | + | 6 |
| David | Funct Orthod | 1988 | + | 1 |
| Lynn | Funct Orthod | 1988 | + | 1 |
| Mintz | Funct Orthod | 1988 | + | 1 |
| Owen | Am. J. Orthod Dentofac Orthop | 1988 | ± | 3 |

- orthodontics causes TMDs +, orthodontics cures TMDs 0, orthodontics does not influence TMDs ±, orthodontics can both cause and cure TMDs (Reynders RM. American Journal of Orthodontics and Dentofacial Orthopedics 1990;97(6):463-471.)

**Table 3: Sample studies on the relationship between Orthodontics and TMDs**

| Author | Journal | Year | Relationship between Orthodontics and TMDs | Number of cases | Appliance | Control | Design |
|---|---|---|---|---|---|---|---|
| Larsson and Ronnerman | Eur J Orthod | 1981 | + | 23 Experimental | Fixed Functional | No | Retrospective |
| Janson and Hasund | Eur J Orthod | 1981 | + | 60 Experimental 30 control | Fixed Functional | Yes | Retrospective |
| Sadowsky and Begole | Am J Orthod | 1980 | 0 | **75 Experimental** 75 control | Fixed | Yes | Cross sectional |
| Sadowsky and Begole | Am J Orthod | 1984 | 0 | 207 Experimental 214 control | Fixed | Yes | Cross sectional |
| Pancherz | Am J Orthod | 1985 | 0 | 20 Experimental | Herbst | Yes | Before-After |
| Dibbetts and van der Weele | Am J Orthod Dentofac Orthop | 1987 | 0 | 63 Functional 72 Fixed | Fixed Functional | Yes | Longitudinal |

- orthodontics causes TMDs + orthodontics cures TMDs, 0 orthodontics does not influence TMDs,
± orthodontics can both cause and cure TMDs (Reynders RM. American Journal of Orthodontics and Dentofacial Orthopedics 1990;97(6):463-471.)

**Does extraction of premolars as part of an orthodontic treatment plan result in a higher incidence of TMD?**

Prentiss,[24] in 1918 suggested that TMJ problems were a result of teeth extraction, since it would result in upward movement of the condyle because of the musculature, leading to atrophy of the meniscus.

Members of the National Survey of 814 AAO between November 1989 and January 1990 showed that their extraction rate had dropped significantly. Reasons for this reduction included "medico-legal reason" from 9.8% respondents,[25] while 14.8% respondents believed that a causative association between premolar extraction and TMD may exist.

This attitude is influenced by viewpoints and texts that showed that the removal of premolars increases the risk of TMD. Witzig[26] reported in 1991 that extraction of the 1st premolars caused loss of vertical dimension, leading to "a pathological positioning of the condyle".

However, in 1994, Stagger[27] showed no TMD symptoms in premolar extraction cases despite an increase in lower anterior-facial height, following a pre- and post-treatment cephalogram evaluation of class I malocclusion (45 non-extraction; 38 extraction) cases.

Other studies evaluated the prevalence of signs/symptoms of TMDs of former orthodontic patients, with and without premolar extraction and found no differences in the positive scores on a list of 62 signs and symptoms commonly associated with TMD. Sadowsky[28] concluded that extraction as part of orthodontic treatment strategy does not constitute an increased risk for the development of TMDs. Also, Conti et al[29] in a cross-sectional study which evaluated the prevalence of TMDs before and after orthodontic treatment among 200 participants, reported no association between prevalence or severity of TMDs and the extraction protocol.

**Does orthodontic treatment prevent or cure TMD?**

**Viewpoint** articles and uncontrolled case reports claimed that non-extraction treatment, second molar extraction, facemask, functional or other removable appliances can prevent and cure TMD[3,30-32] Similarly, non-traditional orthodontic treatment protocols, for instance, second or third molar extraction have been reported to prevent/cure TMD.[3]

Janson & Hasund [33] evaluated 3 groups of Class II division 1 malocclusions retrospectively of 30 cases each; treatment with extraction, treatment without extraction, and untreated cases. They concluded that early orthodontic therapy without extraction can be regarded as prophylactic treatment with regards to functional disorders in class II division 1 malocclusion.

Thilander[4] recommended the treatment of posterior cross-bite at a young age to prevent not only asymmetrical facial growth, but also unilateral condylar displacement. Muscular hyperactivity on the crossbite side may influence unfavourable craniofacial cum TMJ growth. On the basis of her longitudinal studies, interceptive orthodontics is recommended in children to selectively equilibrate deflecting supracontacts in the deciduous teeth.

However, the majority of the studies[1,3,34-36] carried out with appropriate study design and relevant outcome measures were unable to show that orthodontic therapy has a preventive or curative effect on the occurrence of TMD.

**How should Orthodontic patients be managed if they present with TMDs before or during treatment?**

Proper TMJ clinical examinations should be done prior to orthodontic treatment (Figure 1) and any findings documented. Informed consent should also be obtained from the patient. If there are signs and symptoms of TMD prior to treatment (Figure 2), proper diagnosis of the condition has to be made and then treated, conservative and reversible treatment approaches are favoured and could require an interdisciplinary approach.[37] Orthodontic treatment can then be commenced after symptoms must have abated. e orthodontic treatment may be resumed.[1,13]

**Figure 1: Temporo-Mandibular Joint examination**

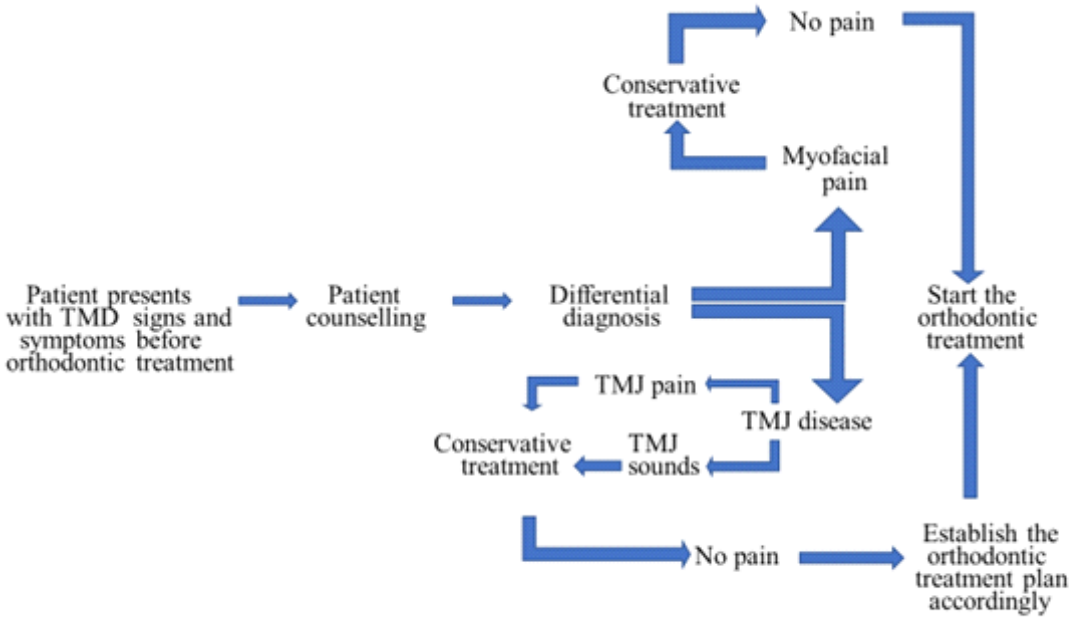


**Figure 2: Management protocol for patients with TMD signs and symptoms before orthodontic treatment.**

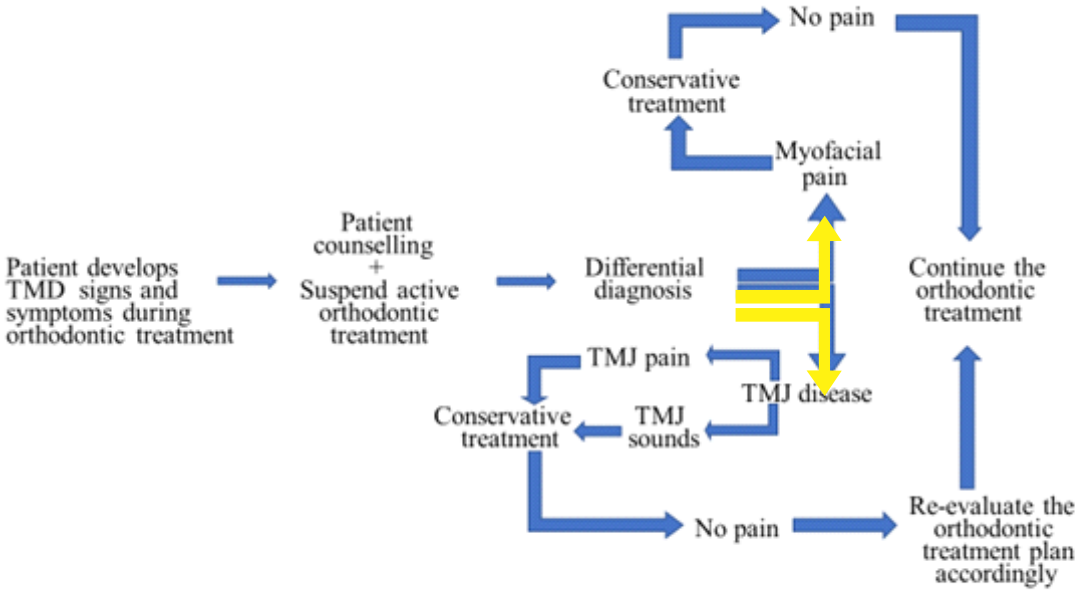


**Figure 3: Management protocol for patients who develop TMD signs and symptoms during orthodontic treatment**

## Conclusions

TMDs signs/symptoms sometimes occur in healthy individuals.

Prevalence of TMD increases with age and could be of sudden onset.

Associations between malocclusion traits and development of TMD could not be verified.

Orthodontic treatment performed during adolescence is equivocal in developing TMD signs/symptoms later in life.

No significant evidence of an elevated risk for TMD

associated with any particular type of orthodontic mechanics.

The extraction of teeth as part of an orthodontic plan does not increase the risk of developing TMD.

Thus far, there is little evidence that orthodontic treatment prevents TMD.

There is no substantiated evidence that TMD can be cured by orthodontic treatment.

Proper patient examination, diagnosis, and management of TMD signs and symptoms should be made prior to, or during orthodontic treatment.

There is a need for more longitudinal studies in a randomized controlled manner on this important subject.

**Funding**: Self

**Conflict of Interest:** Nil

**Contribution of authors**: All authors contributed substantially to the work

## References

1. Michelotti A, Iodice G. The role of orthodontics in temporomandibular disorders. J Oral Rehabil 2010;37(6):411-429.
2. Sim H-Y, Kim H-S, Jung D-U, et al. Investigation of the association between orthodontic treatment and temporomandibular joint pain and dysfunction in the South Korean population. Kor J Orthod 2019;49(3):181-187.
3. Reynders RM. Orthodontics and temporomandibular disorders: a review of the literature (1966–1988). Am J Orthod Dentofacial Orthop 1990;97(6):463-471.
4. Thilander B, Bjerklin K. Posterior crossbite and temporomandibular disorders (TMDs): need for orthodontic treatment? Eur J Orthod 2012;34(6):667-673.
5. De Leeuw R, Klasser GD. Orofacial pain: guidelines for assessment, diagnosis, and management: Quintessence Publishing Company, Incorporated Hanover Park, IL; 2018.
6. Mohlin B, Axelsson S, Paulin G, et al. TMD in relation to malocclusion and orthodontic treatment: a systematic review. Angle Orthod 2007;77(3):542-548.
7. Okeson JP. Evolution of occlusion and temporomandibular disorder in orthodontics: Past, present, and future. Am J Orthod Dentofacial Orthop 2015;147(5):S216-S223.
8. Bair E, Gaynor S, Slade GD, et al. Identification of clusters of individuals relevant to temporomandibular disorders and other chronic pain conditions: the OPPERA study. Pain 2016;157(6):1266.
9. Osiewicz M, Lobbezoo F, Ciapała B, Pytko-Polończyk J, Manfredini D. Pain predictors in a population of temporomandibular disorders patients. J Clin Med 2020;9(2):452.
10. Otuyemi O, Owotade F, Ugboko V, Ndukwe K, Olusile O. Prevalence of signs and symptoms of temporomandibular disorders in young Nigerian adults. J Orthod 2014;27:61-65
11. Jagger R, Woolley S, Savio L. Signs and symptoms of temporomandibular disorders in Ecuadorian Indians. J Oral Rehabil 2004;31(4):293-297.
12. Pollack B. Cases of note: Michigan jury awards $850,000 in ortho case: a tempest in a teapot. J Michigan Dent Assoc 1988;70(11-12):540-542.
13. Kandasamy S, Rinchuse DJ, Greene CS, Johnston Jr LE. Temporomandibular disorders and orthodontics: What have we learned from 1992-2022? Am J Orthod Dentofacial Orthop 2022;161(6):769-774
14. Behrents RG, White RA. TMJ research: responsibility and risk. Am J Orthod Dentofacial Orthop 1992;101(1):1-3.
15. Carlsson GE, Egermark I, Magnusson T. Predictors of signs and symptoms of temporomandibular disorders: a 20-year follow-up study from childhood to adulthood. Acta Odontol Scand 2002;60(3):180-185.

16. Costen JB. I. A syndrome of ear and sinus symptoms dependent upon disturbed function of the temporomandibular joint. Ann Otol Rhinol Laryngol 1934;43(1):1-15.
17. Thompson Jr. The temporomandibular articula-functioning masticatory system. Temporomandibular Joint 1964:146-184.
18. McNamara Jr JA. Orthodontic treatment and temporomandibular disorders. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83(1):107-117.
19. Pullinger AG, Seligman DA. Quantification and validation of predictive values of occlusal variables in temporomandibular disorders using a multifactorial analysis. J Prosthet Dent 2000;83(1):66-75.
20. Pullinger AG, Seligman DA, Solberg WK. Temporomandibular disorders. Part II: Occlusal factors associated with temporomandibular joint tenderness and dysfunction. J Prosthet Dent 1988;59(3):363-367.
21. Iodice G, Danzi G, Cimino R, Paduano S, Michelotti A. Association between posterior crossbite, masticatory muscle pain, and disc displacement: a systematic review. Eur J Orthod 2013;35(6):737-744.
22. Manfredini D, Lombardo L, Siciliani G. Temporomandibular disorders and dental occlusion. A systematic review of association studies: end of an era? J Oral Rehabil 2017;44(11):908-923.
23. Rinchuse DJ, McMinn JT. Summary of evidence-based systematic reviews of temporomandibular disorders. Am J Orthod Dentofacial Orthop 2006;130(6):715-720.
24. Prentiss HJ. A preliminary report upon the temporo-mandibular articulation in the human type. Dent Cosmos 1918;60:505-512.
25. O'Connor BM. Contemporary trends in orthodontic practice: a national survey. Am J Orthod Dentofacial Orthop 1993;103(2):163-170.
26. Witzig J, Spahl T. The clinical management of basic maxilofacial orthopedic appliances, Vol. 3. Temporomandibular Joint: PSG Publishing Company, Boston; 1991.
27. Staggers JA. Vertical changes following first premolar extractions. Am J Orthod Dentofacial Orthop 1994;105(1):19-24.
28. Sadowsky C. The risk of orthodontic treatment for producing temporomandibular mandibular disorders: a literature overview. Am J Orthod Dentofacial Orthop 1992;101(1):79-83.
29. Conti A, Freitas M, Conti P, Henriques J, Janson G. Relationship between signs and symptoms of temporomandibular disorders and orthodontic treatment: a cross-sectional study. Angle Orthod 2003;73(4):411-417.
30. Petersohn I. Use of orthodontic appliances in temporomandibular joint disorders. ZWR 1972;81(13):628-635.
31. Stack B. Orthopedic/orthodontic case finishing techniques on TMJ patients. Funct Orthod 1985;2(2):28-44.
32. Hertrich K. Treatment of myoarthropathies with functional orthodontic devices. Fortschr Kieferorthop 1987;48(6):516-526.
33. Janson M, Hasund A. Functional problems in orthodontic patients out of retention. Eur J Orthod 1981;3(3):173-179.
34. Luther F, Layton S, McDonald F. Orthodontics for treating temporomandibular joint (TMJ) disorders. Cochrane Database Systematic Rev 2010(7).
35. Leite RA, Rodrigues JF, Sakima MT, Sakima T. Relationship between temporomandibular disorders and orthodontic treatment: a literature review. Dent Press J Orthod 2013;18(1):150-157.
36. Shroff B. Malocclusion as a cause for temporomandibular disorders and orthodontics as a treatment. Oral Maxillofac Surg Clin 2018;30(3):299-302.
37. Rinchuse DJ, Greene CS. Scoping review of systematic review abstracts about temporomandibular disorders: Comparison of search years 2004 and 2017. Am J Orthod Dentofacial Orthop 2018;154(1):35-46. e9.

# Orthodontic Treatment of moderate Anterior Crowding of Lower Arch with Bilateral Maxillary Lateral Incisors Microdonts - A Clinical Case Report

Chegwe S[a], Sanu OO[b]

## Abstract

A case of a 17 year-old female who presented to the orthodontic clinic of the department of Child Dental Health Lagos University Teaching Hospital, Lagos with a complaint that "my teeth are scattered and I want to check if it can be corrected". We were to unravel the lower arch crowding, to derotate the rotated teeth and to build up the pegged shaped laterals with composite. A comprehensive Fixed orthodontic therapy of upper and lower arches using pre-adjusted Roth's 022 slot Edgewise brackets was done in conjunction with the paediatric dentistry department for a composite build up of the pegged shape lateral incisors.

After 48 months of active orthodontic treatment, a normal over-jet was achieved with the anterior crowding of the lower arch resolved and the pegged shape lateral incisors built up.

**Keywords:** Peg-shaped Laterals, composite, Fixed Orthodontic appliance

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## Introduction

The Peg-shaped lateral is a tooth with a conical crown size reduction, reducing from the cervical region to the incisal edge.[1] Aberrations in the tooth morphology resulting from late disturbances during the differentiation process most commonly result in the size variation among teeth.[2,3] Maxillary lateral incisors vary in form, second to the third molar.[3]

The overall prevalence of peg-shaped maxillary permanent upper lateral incisors is 1.8%.[4]

The prevalence of peg-shaped laterals was found to be 1% and 2.3% in field and clinic samples respectively in South Western Nigeria.[5]

The management is interdisciplinary when presenting with malocclusion. The purpose of this article is to present a clinical case report.

## Case Report

The patient presented at the Orthodontic unit of Child Dental Health, Lagos University Teaching Hospital, Idi-Araba Lagos.

**Biodata**

Name: LO
Age: 17 years
Sex: Female

**Presenting complaint**: "I want my upper teeth to be normal and my lower teeth look scattered".

**History of Presenting complaint**: Patient complained of not being pleased with her look because she feels her teeth are not well shaped and she wants them arranged to look normal. She became aware it can be corrected from the internet, so she made the decision to visit the Orthodontic clinic with her mother.

She has visited the dental clinic routinely but not

ORIGINAL ARTICLE

eventful and no medical history of any significance.

**Examination:**

Extra-Oral examination

- Frontal: There was no facial asymmetry. She had competent lips. Jackson's 3/1
- Profile: She had a straight profile on Skeletal pattern 1.

**Figure 1: Full frontal and profile views:**

Intra-Oral Examination: Teeth present: 1-7 in all quadrants except upper Right 1-6.DMFT – 0

Mild spacing of 3 mm in the upper anterior segment. She had moderate crowding in the lower anterior segment of about 5mm and Peg-shaped lateral incisors. The upper incisors were retroclined but the lower incisors were of normal inclination. The upper and lower arch widths were normal but there was deviation to the right on the path of closure of the mandible.

In Occlusion: She was on Angles class I malocclusion molar relationship on both sides. Overjet of 2mm for 11 and 21 respectively. Upper midline was coincident with the midline of the face. Shift to the right of about 2mm of the midline of the lower arch, at Rotations of 31,33,35,41,43 and 45. Deep and complete overbite.

**Figure 2: shows the Intraoral views of the patient:**

### Orthodontic Summary

- Angles class I malocclusion on skeletal pattern 1 complicated by:
- Mild spacing of 3 mm in the upper anterior segment
- Moderate crowding in the lower anterior segment 5mm
- Peg-shaped upper lateral incisors
- Deep and complete overbite
- Lower midline shift to the right by 2mm
- Rotations of 31,33,35,41,43 and 45.
- Competent lips. Jackson's lip pattern of 3/1

**Investigation**

**Figure 3: Shows the patient's Pretreatment Radiographs and tracing.**

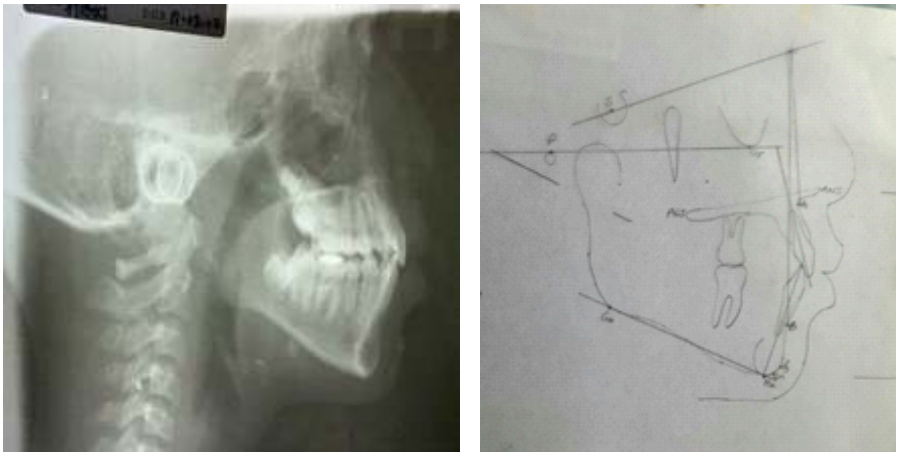


**Table 1:Shows the Pretreatment Cephalometric Values.**

| Measurement | Pretreatment | Range for Nigerian norm |
|---|---|---|
| SNA | 83 | 85.5 ° ±3.5 |
| SNB | 78 | 82.7 ° ±3.0 |
| ANB | 5 | 2-4 ° |
| U1 TO FP | 108 | 119-127 ° |
| L1 TO MP | 88 | 96-104 ° |
| IIA | 140 | 108-116 ° |
| FMA | 26 | 24-26 ° |
| MMA | 34 | 24 ° |
| LFH | 60.5% | 55% |

LEGEND: SNA-Sella/Nasion A-point Angle, SNB-Sella/Nasion B-point Angle, A-point-Nasion-B-point Angle, U1 TO FP- Maxillary Incisor to Frankfort Plane Angle, L1 to MP- Mandibular Incisor to Mandibular Plane Angle, IIA- Interincisal Angle, FMA- Frankfort Maxillary Plane Angle. MMA- Maxillary Mandibular Plane Angle. LFH- Lower Facial Height Percentage

**Figure 4: Shows the Panoramic radiograph of the Patient**

**Figure 5: Shows the Pretreatment Models of the Patient.**

## Treatment Objectives

- To resolve the Moderate crowding in the lower anterior segment
- To build up the peg-shaped lateral incisors
- To correct the deep bite
- To correct the inclination of the incisors
- To correct the lower midline shift
- To derotate the rotated teeth
- To maintain Angles class I molar relationship and canine class I relationship

## Treatment Plan

Non extraction treatment

- Fixed orthodontic appliance in both upper and lower arches. Pre-adjusted Edgewise technique Roth's prescription.
- Composite build up of the Peg-shaped laterals
- Retention with vacuum-form retainers in both arches.

Alternative treatment option: Passive self-ligating of both arches

- Build up of the peg shaped lateral incisors
- Non extraction
- Retention with vacuum-form retainers in both arches.

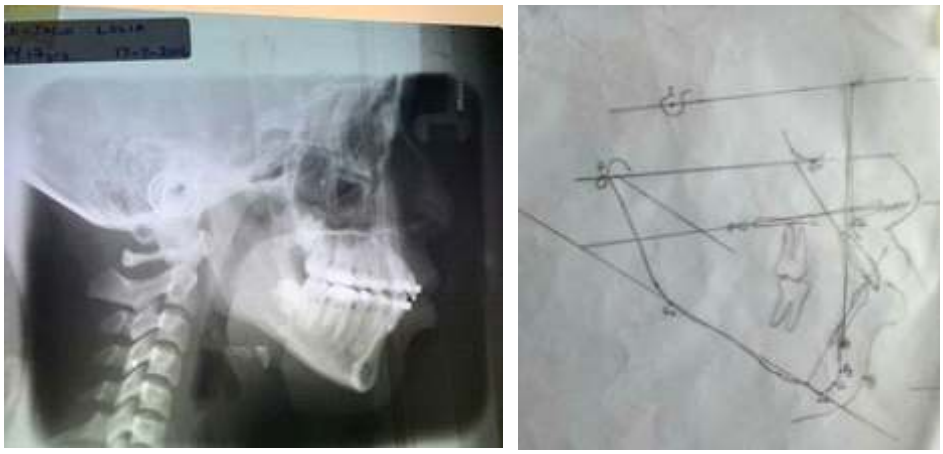
## Treatment Progress

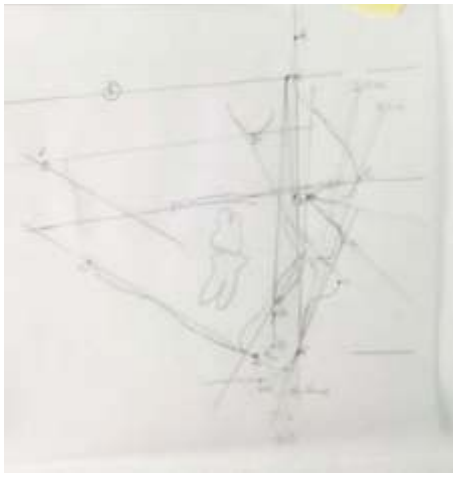
Full arch- upper and lower arches were set up using preadjusted Edgewise Roth's brackets 022 slot prescription.

Treatment sequence was as follows:
014" Nickel titanium (Niti)wires ligated in upper and lower (U/L) arches
016" Niti ligated U/L arches
016" SS ligated U/L arches
018" SS ligated U arch and L arch 016 Niti
Interproximal reduction done from 6 to 6 in the lower arch
016" Niti ligated U/L arches
018" Niti Ligated U/L arches
020" SS ligated U/L arches
019"x025" SS ligated U/L arches
019x025 SS maintained U/L arches
Crimpable hooks placed U/L archwires for cross elastics
Open coil springs placed 11-13,21-23
019x025 SS maintained U/L arches
Patient referred for restoration of peg shaped laterals

**Figure 6A: Shows the Intra operative Photographs**

**Figure 7: Shows the Post Treatment Models**





Soft Tissue Tracing

**Figure 8: Shows the patient's Posttreatment Radiographs and tracing.**

**Table 2:Shows the Post-treatment Cephalometric Values.**

| Measurement | Post treatment values | Range for Nigerian norm |
|---|---|---|
| SNA | 84° | 85.5 ° ±3.5 |
| SNB | 82° | 82.7 ° ±3.0 |
| ANB | 2° | 2-4 ° |
| U1 TO FP | 120° | 119-127 ° |
| L1 TO MP | 92° | 96-104 ° |
| IIA | 118° | 108-116 ° |
| FMA | 35° | 24-26 ° |
| MMA | 35° | 24 ° |
| LFH | 60% | 55%S |
| | | |

**Figure 9: shows her full frontal and profile views post treatment.**

**Figure 10: shows Post treatment Intra oral photographs.**

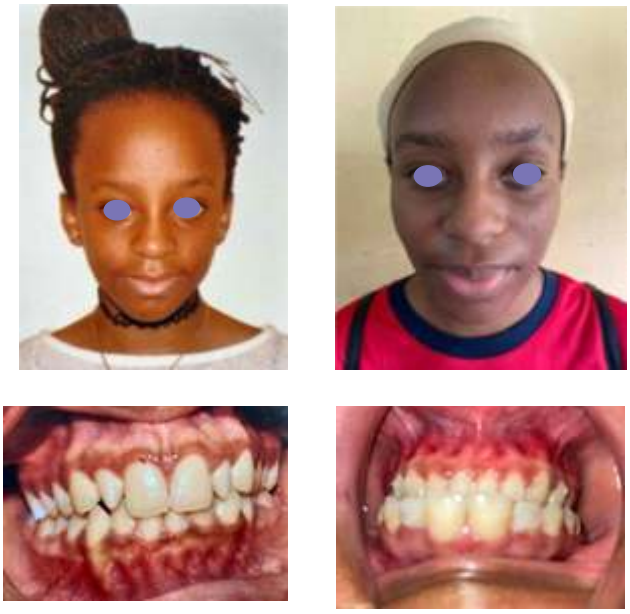


**Figure 11: shows Pretreatment and Post treatment photographs.**

**Table 3: Shows the Pre-treatment and Post-treatment Cephalometric Values.**

| Measurement | Pre treatment | Post treatment | Differences |
|---|---|---|---|
| SNA | 83 | 84° | $1^0$ |
| SNB | 78 | 82° | $4^0$ |
| ANB | 5 | 2° | $3^0$ |
| U1 TO FP | 108 | 120° | $12^0$ |
| L1 TO MP | 88 | 92° | $4^0$ |
| IIA | 140 | 118° | $22^0$ |
| FMA | 26 | 35° | $9^0$ |
| MMA | 34 | 35° | $1^0$ |
| LFH | 60.5% | 60% | 0.5% |

**Table 4: Shows the Pretreatment and Posttreatment soft tissues cephalometric analysis**

| SOFT TISSUE MEASUREMENTS | NIGERIAN NORMS | PRE-TREATMENT | POST-TREATMENT | DIFFERENCES |
|---|---|---|---|---|
| UL TO E-LINE | 3.21 ±2.69mm | 2mm | 4mm | 2mm |
| LL TO E-LINE | 6.76 ±2.83mm | 7mm | 7mm | 0mm |
| UL TO S-LINE | 5.89±2.23mm | 5mm | 9mm | 4mm |
| LL TO S-LINE | 8.19±2.6mm | 10mm | 11mm | 1mm |
| UL TO B-LINE | 9.84±2.02mm | 6mm | 16mm | 10mm |
| LL TO B-LINE | 10.53±2.40mm | 12mm | 16mm | 4mm |
| H-ANGLE | $20.77^0$±3.57 | $16^0$ | $22^0$ | $6^0$ |
| NASOLABIAL ANGLE | $84.35^0$ ±13.71 | $92^0$ | $82^0$ | $10^0$ |

## Treatment Outcome

- After about 48 months of fixed appliance therapy, the following were achieved:
- The moderate crowding in the lower anterior segment was resolved
- The Peg-shaped lateral incisors were built up with composite
- The deep overbite was corrected
- The inclination of the incisors became normal
- The lower midline shift slightly improved, though the patient defaulted in wearing her cross elastics.
- The rotated teeth were derotated
- The buccal segment was maintained - Angles class I molar relationship and canine class I relationship
- The Patient was satisfied

## Discussion

Microdontia is a condition in which teeth are smaller than the normal size. A common form of microdontia that affects the maxillary lateral incisor is known as Peg lateral.[7]

Peg-shaped lateral is a tooth with a conical crown size reduction, reducing from the cervical region to the incisal edge.[1] Aberrations in the tooth morphology resulting from late disturbances during the differentiation process, most commonly result in the size variation among teeth.[2,3] Peg- shaped laterals are dental anomalies that are likely to be connected to various defects in certain genes.[6] There is probably a strong component of heredity, and peg-shaped lateral incisors have been linked genetically with tooth agencies.[6] In our case report, there was a little resemblance because the mother of the patient affirmed to it "running in the family with a little apathy for correction in the course of treatment.

A study[5] carried out in South Western Nigeria indicated that prevalence of peg-shaped laterals was found to be 1% and 2.3% in the field and clinic samples respectively. A total of one thousand and seventy individuals were assessed by intra-oral examination and case files respectively for the presence of peg-shaped laterals and other dental anomalies. This case report is also from the South Western region, the Lagos University Teaching Hospital.

The goal of Orthodontic treatment is the aesthetic value it renders to the patient, so the management was interdisciplinary when presenting with malocclusion. The prevalence has been reported to be higher than the prevalence of other developmental malformations. The treatment options of peg laterals include extraction of the peg- shaped tooth and orthodontic movement of canine into the space of lateral incisor, which can then be re-contoured to resemble lateral incisors. Replacement with a single-tooth implant/FPD supported restoration; Direct resin-composite bonding or indirect restoration of the peg laterals with Porcelain laminate veneers, metal-ceramic restorations or all-ceramic crowns, to develop normal tooth morphology.[7,8]

A conservative veneer technique involves the application of resin composite without a reduction of the tooth structure. Resin composite can be altered and re-polished in situ, and a direct resin composites are not as expensive as porcelain laminate veneers.[9] Saatwika et al[7] described a simple direct technique for restoring the aesthetic appearance of the peg – shaped lateral. This case report, in conjunction with the Paediatric dental unit, a direct composite resin build up was done on the bilateral peg-shaped laterals of the patient. In this case, Preadjusted Edgewise appliance was used in both aches. In the course of treatment with a sequence of archwires, the crowing in the mandibular arch was resolved. At the rectangular arch wires 0.019x 0.025 stainless steel arch wires, auxiliary open coiled springs were used to create enough space for the composite build-up of the pegged-shaped laterals.

## Conclusion

After 48 months of not too regular appointments but active orthodontic treatment, a normal over-jet was achieved with the anterior crowding of the lower arch resolved

## Contributors

All the authors contributed to the design, data collection, analysis and write-up of the manuscript.

## Funding/Grants

Self-funded

## Conflict of Interest

Nil

and build –up done with composite of the pegged shaped lateral incisors.

## References


1. Becker A, Smith PR. Incidence of anomalous maxillary lateral incisors in relation to palatally displaced cuspids. Angle Orthod. 1981;51: 24-29.
2. Kook YA, Park S, Sameshima GT. Peg shaped and small lateral incisors not at higher risk for root resorption. Am J Orthod Dentofac Orthop 2003;123:253-258.
3. Jameel K, Saqib A, Fazal S, Imran F, Shifat A, Mohammed A, Mohammad K. The Prevalence of Peg Shaped and Missing Permanent Maxillary Lateral Incisors in Non-Syndromic Orthodontic Patients. Journal of International Dental and Medical Research · 2019; 12:1416-1420.
4. Fang Hua 1, Hong He, Peter Ngan, Wassim Bouzid. Prevalence of peg-shaped maxillary permanent lateral incisors: A meta-analysis**.** Am J Orthod Dentofacial Orthop . 2013 Jul;144(1):97-109
5. I Ucheonye, A Tokunbo. Prevalence of Peg-Shaped Laterals in South Western Nigeria: A Comparison of Field and Clinic Findings. The Internet Journal of Dental Science. 2009 Volume 8 Number 2.
6. Peck S, Peck L, Kataja M. Prevalence of tooth agenesis and peg-shaped maxillary lateral incisor associated with palatally displaced canine (PDC) anomaly. Am J Orthod Dentofac Orthop 1996;110:441-3.
7. Saatwika L, Anuradha B, Selvakumar GM, Arunajetasan S. Esthetic correction of peg laterals – a case report . Eur J Mol Clin Med 2020;7:663-666.
8. Kulshrestha R. Interdisciplinary approach in the treatment of peg lateral incisors. J Orthod Endod. 2016;2(1) 11.
9. Sultana A, Karim FA, Quader SA, Tasnim T, Hossain M, Nasrin KF. Composite facing of peg shaped lateral incisor-a case report. Update Dental College Journal. 2016;6(2):31-33.

# Orthodontic Treatment of Anterior Open Bite with Drawbridge Effect in an Adult Patient: A Clinical Case Report

Akeredolu MO[a], Umeh OD [b], Sanu OO[c]

*Abstract*

This case report presents the successful treatment of a patient with an anterior open bite.A 28 year old female presented at the orthodontic clinic with the chief complaint of protruding teeth and a gap between her teeth. The clinical examination showed a convex profile with Angle's Class I molar relationship on Skeletal Pattern II complicated by an anterior open bite extending from canine – canine measuring 4mm and increased overjet of 6mm.
The malocclusion was treated with preadjusted edgewise fixed appliance using .022" slot Roth prescription with extractions of the upper first premolars and lower second premolars and the drawbridge effect. At the end of treatment, her occlusion was restored to function and aesthetics and then retained with an upper Hawley's removable retainer and lower Essix removable retainer.

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ORIGINAL ARTICLE

## Introduction

Anterior open bite (AOB) malocclusion is defined as lack of contact and vertical overlap between the maxillary and mandibular incisors when the mandible is brought into habitual and centric occlusion.[1,2] The incidence of anterior open bite ranges from 1.5% to 11% and this varies between races and with dental age. In Britain, the reported prevalence is 0.4 – 3.0%.[3] AOB is more common in Africans and Afro-Caribbeans (5 – 10%).[4] In Nigeria, Otuyemi and Abidoye reported a prevalence of 7.0 – 10.2% in suburban and rural children.[5]

AOB may be as a result of many aetiological factors includingskeletal, dental, and soft-tissue factors. It may also occur as an interaction between hereditary and environmental factors.[6,7] It is considered one of the most challenging malocclusion to treat, and its correction is prone to relapse.[8,9]

The treatment of anterior open bite is dependent on the aetiology of malocclusion, age, and the expectation of the patient. Mizrahi[7] described four modalities of treatment: growth modulation; orthodontic mechanotherapy; orthognathic surgery and the combination of two or more of the above. In the case of dental anterior open bite in adult patients, extraction and retraction have been recommended because of the drawbridge effect of reducing the inclination of the upper & lower incisors to close the anterior open-bite.[10]

A case report is presented where the management of AOB malocclusion was carried out by extraction and drawbridge effect.

## Case report

A 28-year-old female presented at the Orthodontic Clinic at the Lagos University Teaching Hospital (LUTH), Lagos with the chief complaint of protruding upper teeth and upper and lower front teeth not touching. Facial analysis showed a symmetric face with an average smile line, a convex profile with incompetent and protrusive lips.

The intraoral clinical evaluation showed a moderate AOB malocclusion, measuring 4mm, extending from canine to canine, anterior resting position of the tongue, increased overjet of 6mm, Angles' Class I molar and canine relationship. Also shown is the bimaxillary proclination of the maxillary and mandibular incisors, mild maxillary and mandibular arch crowding as well as disto labial rotation of tooth

32 and tooth 42 and mesiopalatal rotation of tooth 22. Cephalometric analysis revealed a skeletal pattern 2 profile and an acute interincisal angle, suggestive of bimaxillary proclination, increased FMA angle and increased lower facial height. The soft tissue analysis revealed the patient had a convex profile and protrusive lips.

***Informed consent was obtained from the patient***

**Figure 1: Pre-treatment photographs**

**Figure 2 : Pre-treatment casts**

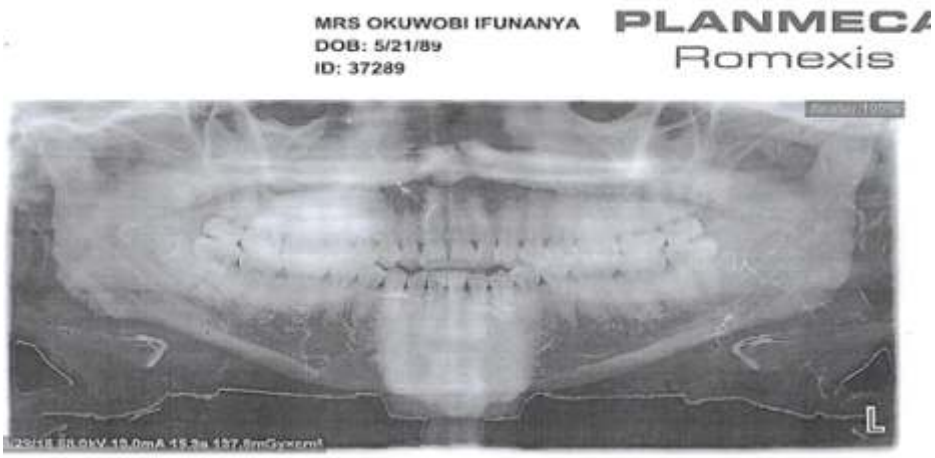


**Figure 3 : Pre-treatment orthopantomogram**

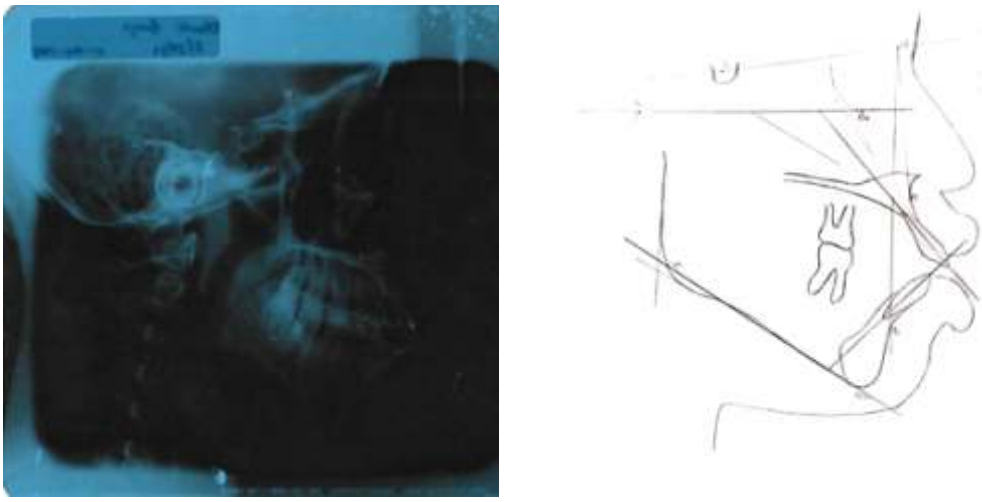

**Figure 4 : Pre-treatment cephalometric & tracing**

**Table 1 : Pre-treatment cephalometric values**

| Parameter | Pre-treatment | Normal | Comment |
|---|---|---|---|
| SNA | 86 | 85.5 +/- 3.5 | Normal |
| SNB | 79 | 82.7 +/- 3.0 | Normal |
| ANB | 7 | 2 – 4 | Increased |
| U1 TO FP | 129 | 119 – 127 | Increased |
| L1 TO MP | 106 | 96 – 104 | Increased |
| IIA | 97 | 108 – 116 | Reduced |
| FMA | 34 | 24 – 26 | Increased |
| LFH | 58.3% | 55% | Increased |

**Table 2: Pre-treatment soft tissue cephalometric values**

| Parameter | Pre-treatment | Normal | Comment |
|---|---|---|---|
| UL to S Line | -9.5mm | -5.89 SD 2.23mm | Increased |
| LL to S Line | -13.5mm | -8.19 SD 2.60mm | Increased |
| UL to E Line | -6.5mm | -3.21 SD 2.69mm | Increased |
| LL to E Line | -12.0mm | -6.76 SD 2.83mm | Increased |
| UL to B Line | -15mm | -9.84 SD 2.02mm | Increased |
| LL to B Line | -16mm | -10.53 SD 2.40mm | Increased |
| H angle | 23° | 21.77 SD 3.65° | Normal |
| Nasolabial | 49° | 84.35 SD 13.71° | Reduced |

## Treatment Objectives

The treatment objectives were:

- To maintain bilateral molar and canine Class I relationship
- Completely resolve the anterior open-bite malocclusion
- Obtain a proper overjet and overbite relationship
- Relieve the crowding in the maxillary and dental arches
- Improve lip incompetence
- Correct the maxillary and mandibular midlines
- Align the rotated teeth
- Correct the tongue posture

## Treatment plan

The treatment plan involved the use of pre-adjusted edgewise fixed appliance in the maxillary and mandibular arches, with the 4-unit extraction of the maxillary first premolars and mandibular second premolars. A tongue-rake appliance was also included.

## Treatment alternatives

The alternative treatment plan consisted of a non-extraction pre-adjusted edgewise fixed appliance in maxillary and mandibular arches, incorporating a tongue-rake appliance.

Other alternative treatment plans consisted of a non-extraction pre-adjusted edgewise fixed appliance in the maxillary and mandibular arches and the use of a temporary anchorage device (TADS) to cause molar intrusion, thereby correcting the anterior open bite.

## Treatment progress

After all prescribed extractions were completed, 0.022" Roth prescription pre-adjusted edgewise fixed appliance (Dentaurum, Ispringen, Germany) were bonded to the maxillary and mandibular arches, engaged with 0.014"nickel-titanium archwire ligated to maxillary and mandibular teeth. A Tongue-rake appliance was also incorporated.

The alignment and levelling stages were performed with the archwire sequence progressing up to 0.019" x 0.025" stainless steel archwires.

Once the levelling phase was completed, en-masse retraction of the anterior teeth was initiated with 0.019" x 0.025" stainless steel archwires, using active tie-backs to close up the extraction spaces.

The total active orthodontic treatment time was 23 months.

Retainers prescribed were Hawley's retainer in the maxillary arch and a thermoplastic retainer in the mandibular arch.

**Figure 5 : Intra-treatment photographs**

## Treatment result

The anterior open bite was resolved. The post-treatment photographs and dental casts (Fig 6 and 7) which demonstrated molar and canine Class I relationships were maintained on both left and right sides, and appropriate overbite and overjet were obtained. The maxillary and mandibular arch crowding were relieved, lip incompetence was improved, maxillary and mandibular midlines were corrected, and the rotated teeth were aligned.

After orthodontic treatment, a stable occlusal relationship and harmonious face were obtained.

**Figure 6 : Post-treatment photographs**

**Figure 7: Post-treatment dental casts**

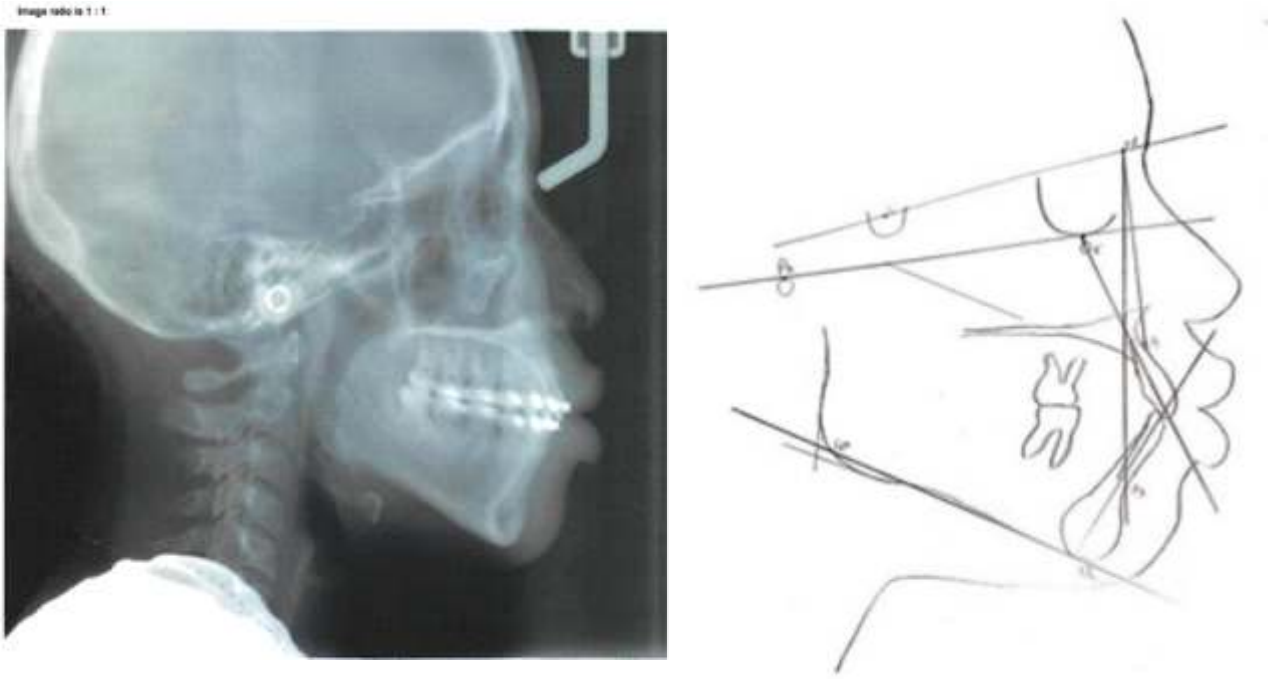

**Figure 8: Post-treatment cephalometric & tracing**

**Table 3 : Post-treatment cephalometric values**

| Parameter | Pre-treatment | Normal | Comment |
|---|---|---|---|
| SNA | 83 | 85.5 +/- 3.5 | Normal |
| SNB | 78 | 82.7 +/- 3.0 | Normal |
| ANB | 4 | 2 – 4 | Normal |
| U1 TO FP | 107 | 119 – 127 | Reduced |
| L1 TO MP | 90 | 96 – 104 | Reduced |
| IIA | 130 | 108 – 116 | Increased |
| FMA | 33 | 24 – 26 | Increased |
| LFH | 56.8% | 55% | Increased |

**Table 4: Post-treatment soft tissue cephalometric values**

| Parameter | Post-treatment | Normal | Comment |
|---|---|---|---|
| UL to S Line | -5mm | -5.89 SD 2.23mm | Normal |
| LL to S Line | -8mm | -8.19 SD 2.60mm | Normal |
| UL to E Line | -3.5mm | -3.21 SD 2.69mm | Normal |
| LL to E Line | -6.5mm | -6.76 SD 2.83mm | Normal |
| UL to B Line | -10mm | -9.84 SD 2.02mm | Normal |
| LL to B Line | -10.5mm | -10.53 SD 2.40mm | Normal |
| H angle | 22° | 21.77 SD 3.65° | Normal |
| Nasolabial | 58° | 84.35 SD 13.71° | Decreased |

## Discussion

Anterior open-bite malocclusion treatment in adult patients is one of the most challenging in orthodontic practice because it often needs an interdisciplinary approach. It generally involves an orthodontist and sometimes a speech therapist and, in most complex cases, an oral & maxillofacial surgeon.

It is currently known that the most important factor for achieving post-orthodontic treatment stability, in cases with and without tooth extractions, is the quality of occlusion at the end of treatment.[11] Therefore, one should seek an excellent occlusion, with simultaneous bilateral contacts in harmony with the centric relation and immediate disocclusion of the posterior teeth by the anterior teeth in excursive mandibular movements.

Sarver and Weissman[12] proposed some useful guidelines for the nonsurgical treatment of adult patients with open bites who have no potential for growth modification. They discussed clinical results using extraction for better incisor retraction and uprighting to close the anterior open bite malocclusion through what is often referred to as the "drawbridge" effect. The drawbridge effect is used in the treatment of anterior open bite in which the first premolars are extracted to deepen the bite by retraction of the incisors resulting in uprighting and relative extrusion of the incisors. It is emphasized that there are a limited number of open bite conditions amenable to this type of treatment. Patients who are candidates for this type of therapy should meet the following criteria: (1) proclined or procumbent maxillary or mandibular incisors, (2) little or no gingival display on a smile, (3) normal craniofacial pattern, and (4) no more than 2 to 3mm of upper incisor exposure at rest.

Studies have investigated the stability of non-extraction and extraction treatment of anterior open bite malocclusion, and the outcomes have shown greater stability with extraction treatment.[13–15]

In this clinical case, the option was taken for treatment with extractions, because the patient presented with bimaxillary incisal proclination that interfered with facial aesthetics. The patient was satisfied with the occlusion at the end of treatment.

## Conclusion

Drawbridge effect in the treatment of anterior open bite malocclusion is an accepted treatment modality. Satisfactory facial aesthetics and a functional and stable occlusion were achieved.

## References


1. Proffit WR, Fields HW, Sarver DM. Contemporary orthodontics. 4th edition . St. Louis, Mo.: Elsevier/Mosby; 2007. 11–12 p.
2. Al-Emran S. Extraction of first permanent molars in the management of anterior open bite malocclusion. Saudi Dent J. 2001;13:155–60.
3. Haynes S. The distribution of overjet and overbite in English children 11-12 years. Dent Pract Dent Rec. 1972 Jun;22(10):380–3.
4. Noar J, Portnoy S. Dental status of children in a primary and secondary school in rural Zambia. Int Dent J [Internet]. 1991;41:142–8. Available from: http://europepmc.org/abstract/MED/1860720
5. Otuyemi OD, Abidoye RO. Malocclusion in 12-year-old suburban and rural Nigerian children. Community Dent Health. 1993 Dec;10:375–80.
6. Sassouni V. A classification of skeletal facial types. Am J Orthod. 1969;55:109–23.
7. Mizrahi E. A review of anterior open bite. Br J Orthod. 1978;5:21–7.
8. Burford D, Noar JH. The causes, diagnosis and treatment of anterior open bite. Dent Update. 2003;30:235–41.
9. De Menezes LME, Ritter DE, Locks A. Combining traditional techniques to correct anterior open bite and posterior crossbite. Am J Orthod Dentofac Orthop [Internet]. 2013;143:412–20. Available from: http://dx.doi.org/10.1016/j.ajodo.2011.10.029
10. Shrestha BK. Orthodontic Treatment of Anterior Dental Open Bite with Drawbridge Effect: A Case Report. Orthod J Nepal. 2013;3:69–72.
11. Teittinen M, Tuovinen V, Tammela L, Schätzle M, Peltomäki T. Long-term stability of anterior open bite closure corrected by surgical-orthodontic treatment. Eur J Orthod. 2012;34:238–43.
12. Sarver DM, Weissman SM. Nonsurgical treatment of open bite in nongrowing patients. Am J Orthod Dentofac Orthop. 1995;108:651–9.
13. De Freitas MR, Beltrão RTS, Janson G, Henriques JFC, Cançado RH. Long-term stability of anterior open bite extraction treatment in the permanent dentition. Am J Orthod Dentofac Orthop. 2004;125:78–87.
14. Janson G, Valarelli FP, Beltrão RTS, de Freitas MR, Henriques JFC. Stability of anterior open-bite extraction and non-extraction treatment in the permanent dentition. Am J Orthod Dentofac Orthop. 2006;129:768–74.

15. Foosiri P, Changsiripun C. Stability of anterior open bite in permanent dentition treated using extraction or non-extraction methods: A systematic review and meta-analysis of each method. Orthod Waves [Internet]. 2019;78:1–10. Available from: https://doi.org/10.1016/j.odw.2018.10.003Orthod Dentofacial Orthop 2006. 129:29-35

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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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- 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
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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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**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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