An evaluation of dentofacial changes in Angle's class II division 1 patients using AdvanSync 2

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Abstract

OBJECTIVES: The purpose of the study is as follows:
• To evaluate the dental and skeletal changes of the AdvanSync 2 appliance.
• To evaluate the soft tissue changes of the 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 Sella-Nasion-Point A (SNA), Condylion-Point A (CO-A), University of Witwatersrand, Condylion-Gnathion (C0-Gn), point A-Nasion-Point B (ANB), Upper incisor-Point A (UI-A) (degree), LI-B (mm), Lower lip to Esthetic plane (LL-E plane), nasolabial angle, mentolabial angle, facial angle, and L lip to the chin. *P* values were however observed to be greater than 0.5, therefore statistically insignificant for parameters such as sella-Nasion-Point B (SNB), Condylion –gonion (C0-Go), UI A (mm), LI B (mm), UL-EPL, H LINE, Frankfurt mandibular plane (FMA), nose tip angle, nasofrontal angle, nasomental angle, upper lip angle, and U lip to the chin.

CONCLUSIONS: 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), Upper lip to Esthetic plane, LL-E plane, Holdaway LINE, nose tip angle, nasolabial angle, mentolabial angle, nasofrontal angle, nasomental angle, facial angle, upper lip angle, U lip to chin, L lip to the chin after nine months of appliance delivery.

MAIN POINTS:
1. AdvanSync 2 normalized class II by an increase in the length and body of the mandible.
2. AdvanSync 2 has a restraining effect on the growth of the maxilla.
3. AdvanSync 2 brings about positive soft tissue changes.
4. The major disadvantage is the proclination of the lower incisors.

Keywords:
3D Cephalometrics, class II, compliance, functional

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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, are 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 resulting in orthopedic and orthodontic changes.[1-3]

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

The following were the goals and objectives of this research:
*   To evaluate the dental changes of the AdvanSync 2 appliance.
*   To evaluate the skeletal changes of the AdvanSync 2 appliance.
*   To evaluate the soft tissue changes of the AdvanSync 2 appliance using photometric analysis.
*   To assess the efficacy of AdvanSync 2 appliance in Angle's class II division 1 patients.

Materials and Methods

The ethical committee has approved the study (IRB/CIDS/294/2019). The proposed study was explained to each of the selected patients and his/her written consent was obtained before the commencement of the study. The demographic characteristics of the 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 Orthopedics with 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, ORMCO Corporation, Orange, CA) 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 a minimum of a three-month retention period [Figure 3].

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 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 m 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, as well as that their lips were relaxed. A mirror was placed 3.5 m in front of the subject so that the subjects can look into the mirror with their lips relaxed to record the right side profile in normal head position (NHP) [Figure 6].

Figure 1: Pre-treatment intraoral

Figure 2: Pre-treatment lateral cephalogram

Figure 3: Appliance placement

Figure 4: AdvanSync 2

Figure 5: Post-treatment

Figure 6: Post-treatment lateral cephalogram

The photographic records were analyzed using the software Photo shoot Adobe cc 2015, Standard Edition (ORMCO Corporation, Orange, CA). A mill metric paper gauge was attached on 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].

Inclusion criteria
1. Patients who were willing for orthodontic treatment (cooperative and who 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°.

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 II division 2, Angle's class III malocclusion.
5. Patients who are not willing to participate {who do not give consent}.

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

The sample size was calculated based on a study conducted by Esen Ali Gunay *et al.*[4] titled: Evaluation

Figure 7: Pre and post extraoral oral photometric analysis

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 (degree)				
Pre	81.5333	4.37308	2.977	0.010
Post	78.2667	5.71298		(S)
Co-Pt A (mm)				
Pre	84.8667	4.17247	5.196	0.000
Post	81.9333	4.09646		(HS)
SNB (degree)				
Pre	77.0000	5.18239	0.840	0.415
Post	76.1333	5.84156		(NS)
Co-Gn (mm)				
Pre	105.1333	5.62985	-6.925	0.000
Post	110.3333	3.15474		(HS)
Co-Go (mm)				
Pre	59.7333	7.56370	-1.784	0.096
Post	60.0667	7.24536		(NS)
ANB (degree)				
Pre	5.5333	2.99682	4.289	0.001
Post	3.4000	2.72029		(HS)
WITS (mm)				
Pre	4.6000	2.16465	5.449	0.000
Post	0.7333	1.62422		(HS)
FMA (degree)				
Pre	26.8667	6.40164	0.862	0.403
Post	25.4667	2.13363		(NS)
U1-Pt-A (degree)				
Pre	31.4000	8.58404	3.658	0.003
Post	26.2000	6.87854		(HS)
L1-Pt-B (degree)				
Pre	31.8667	7.81817	-2.384	0.032
Post	36.2667	5.68792		(S)
U1-Pt-A (mm)				
Pre	7.3333	3.84831	1.871	0.082
Post	6.7333	3.34806		(NS)
L1-Pt-B (mm)				
Pre	6.1333	2.87518	0.960	0.353
Post	5.8000	2.30527		(NS)
U lip to E plane (mm)				
Pre	-0.4667	2.23180	1.848	0.086
Post	-1.1333	2.55976		(NS)
L lip to E plane (mm)				
Pre	-1.7333	0.79881	-3.898	0.002
Post	-0.2667	0.70373		(HS)
H line (mm)				
Pre	-0.7333	2.15362	0.673	0.512
Post	-1.0000	1.36277		(NS)

*P=0.05, P<0.05=significant, P>0.05=non-significant

of the immediate dentofacial changes in late adolescent patients treated with the forsus Fatigue Resistant Device (FRD). Based on the comparison of required parameters, the sample size was calculated using:

$Z_\alpha = 1.96$

$\sigma^2 = 0.0081$

e = margin of error = 0.0025

$N = 12.446 = 13$

Results

In the patients with AdvanSync 2 fixed functional appliances, the mean of the cephalometric readings, such as Sella - nasion -point A, (SNA), Sella-Nasion-Point B (SNB), University of Witwatersrand (WITS), Condylion-Point A (Co- A), Condylion -Gnathion (Co-GN), Condylion-Gonion (Co-Go), Point A-Nasion-Point B (ANB), Frankfurt mandibular plane (FMA), UI-A (degree), Upper incisor-Point A (UI A) (linear), Lower incisor-Point B (LI-B) (degree), LI B (linear), Upper lip to Esthetic plane (UL-E plane), Lower lip to Esthetic plane (LL-E plane), and Holdaway LINE (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 ±0.79881, and -.7333 ± 2.15362, respectively [Table 1].

After nine months of treatment with the AdvanSync 2 fixed functional appliance, the mean of the cephalometric readings in the patients for parameters, such as SNA, SNB, WITS, 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 ±0.70373, and -1.0000 ± 1.36277, respectively.

C0-Gn, C0-Go, ANB, WITS, UI-A (degree and mm), LI-B (mm) UL-E plane, LL-E plane, H LINE, and FMA were found to be 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, WITS, CO-A, C0-Gn, ANB, UI-A (degree), LI-B (degree), and LL-E plane. Therefore, the above-mentioned parameters SNA and LI-B (degree) were observed to be statistically significant and the remaining parameters were highly significant.

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

In the 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 during the beginning of the treatment was 81.6000 ± 1.35225, 96.9333 ± 3.97252, 84.7333 ± 5.39135, 132.8000 ± 9.84305, 129.4000 ± 2.32379, 88.2667 ±0.59362, 11.6000 ±0.82808, 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 parameters, 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 was 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 ±0.86189, 12.4667 ± 1.72654, 7.3333 ±0.81650, and 4.4000 ±.50709, respectively [Table 2].

All the parameters were found to be 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 the chin. Therefore, the above-mentioned parameter L lip to chin was observed to be statistically significant and the remaining parameters were highly significant.

The *P* value for nose tip angle, nasofrontal angle, nasomental angle, upper lip angle, and U lip to chin was 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	-19.299	0.000 (HS)
Post	114.0000	4.14039		
Nasofrontal angle (degree)				
Pre	132.8000	9.84305	-0.444	0.664 (NS)
Post	133.4000	7.06905		
Nasomental angle (degree)				
Pre	129.4000	2.32379	0.095	0.925 (NS)
Post	129.3333	1.91485		
Facial angle (degree)				
Pre	88.2667	0.59362	-5.996	0.000 (HS)
Post	89.8000	0.86189		
Upper lip angle (degree)				
Pre	11.6000	0.82808	-1.857	0.084 (NS)
Post	12.4667	1.72654		
U lip to chin (mm)				
Pre	7.0000	0.37796	-1.581	0.136 (NS)
Post	7.3333	0.81650		
L lip to chin (mm)				
Pre	4.0667	0.25820	-2.646	0.019 (S)
Post	4.4000	0.50709		

*P=0.05, $P<0.05$=significant, $P>0.05$=non-significant

Discussion

This was a cephalometric and photometric study looking at 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' overbites and overjet were minimized. Soft tissue profile slightly improved.[4-6]

The Advansync 2 appliance produced its effect through maxillary growth restriction and dentoalveolar changes. This concurs with another research by 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.[1,7-9]

The maxillary restriction was the major skeletal impact of the AdvanSync 2 appliance. This concurs with another

research by Al-Jewair *et al*.[13] 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).[10-12] 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 the 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 mandibular anterior repositioning appliance Mandibular anterior repositioning appliance (MARA).[13,14]

Chitra *et al*. 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*., 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.[17-19]

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 the 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 were 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 the date and this 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

The following footprints were laid out within the bounds of this study:
1. AdvanSync 2 appliance was effective in normalizing Class II malocclusions.
2. AdvanSync 2 corrected Class II malocclusions through changes in 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 the chin.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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