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

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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

Figure 5: Advan sync 2 appliance delivery intraoral photographs

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

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.

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