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Comparative evaluation of the skeletal effects of Advansync2 and Advansync2 used with Miniscrew anchorage

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ABSTRACT

Objectives: To assess and compare the skeletal effects of the fixedfunctional appliance AdvanSync2, when used alone & when used along with miniscrews.
Methods: Pre-treatment and Post-functional treatment lateral cephalograms of
30 patients with skeletal Class II division 1 malocclusion, who had undergone treatment using AdvanSync2 appliance were assigned into 2groups. Group I was with advansync2 without miniscrew and Group II was with advansync2 with miniscrew placed between mandibular premolar & canine 1 week before Advansync2 activation In both groups lateral cephalograms taken at the beginning and at the end of post functional treatment were analyzed by using few parameters from modified Pancherz analysis.
Result: Mandibular growth and improvement in the sagittal skeletal relationship werestatistically significant in both groups. An increase in lower anterior facial height was there in both groups.
Conclusion: The present study concluded that both groups were effective in correcting the Class II malocclusion due to mandibular retrognathism. AdvanSync2 is the best option for correcting Class II malocclusion in patients at the extreme end of growing period.

Keywords: AdvanSync2, miniscrew, Fixed functional appliance, Skeletal changes

Introduction

Class II malocclusion occurs in about one third of the population, thus one of the most common malocclusion[1,2,3] The malocclusion can have familial tendency or due to environmental factors or the combination of both and in order to treat them a clinician must recognize them at an early age.
Class II malocclusions can be treated by growth modification, camouflage treatment or surgical correction. Treatment strategy are classified mainly based on whether the patient is growing or non growing. There are many studies in literature proving that mandibular retrognathia[4] is the main cause of Class II malocclusion. A treatment that would enhance mandibular growth like functional appliances are indicated in such patients[5,6].
The ideal timing for fixed orthopaedic treatment for mandibular deficiency is after onset of pubertal growth spurt[7]. The orthopaedic phase and orthodontic treatment phase should be combined in one single treatment, as studies have demonstrated that very early treatment involving two separate phases of therapy does not provide any benefits[8,9,10,11] other than an improvement in self-esteem. During the period of active growth, myofunctionalappliances can be used as Class II correctors[12]. While during the deceleration stages of growth, fixed functional appliances are commonly being advised to the patient.[13]
The fixed functional appliances has been gaining immense popularity as "noncompliant class II correctors" Hence, the orthodontist would have a better control. Fixed Functional Appliance was first initiated into dentistry by Dr. Emil Herbstwith the Herbst appliance; which was later rediscovered by Pancherz.[14] Some of the fixed functional appliance shown in literature are Japer Jumper, MARS (Mandibular Advancing Repositioning Splint), Ritto appliance, Mandibular protraction appliance, Functional orthopedic magnetic appliance (FOMA), Rick-A-Nator Appliance, Churro Jumper, Eureka spring, developed Forsus Fatigue Resistant Device, PowerScope, etc

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AdvanSync2 is a new addition into the group of Herbst appliances. AdvanSync2 appliance is almost half the size of MiniScopeHerbst appliance with a molar-to-molar attachment.[14] The AdvanSync appliance was developed by Dr Terry Dischinger and his son Bill M Dischinger in association with Ormco in 2008[15] which was later subjected to some modifications leading to the emergence of the AdvanSync2. There is no need to level and align both arches and use heavy stainless steel stabilizing wires prior to placement of the Class II corrector like in other conventional fixed functional appliances.[14]
Flaring of the lower incisors from the beginning of Class II correction to the end of active treatment has been shown in patients treated with functional appliances, is generally regarded as an undesirable side effect. It is to mitigate this problem miniscrews, which claim to produce absolute anchorage has been used along with functional appliances. Ease of use of the AdvanSync2 with ability to place fixed appliances at the beginning of treatment to reduce overall treatment time was the determining factor in selection of this appliance for the study.
Thus, in the present study we are comparing the mandibular advancement achieved using AdvanSync2 and AdvanSync2 with miniscrew anchorage.

Methodology

Patients of age 12 to 16 years having Class II division 1 malocclusion with mandibular deficiency and reported to Dept. of Orthodontics and Dentofacial Orthopedics for correction of their malocclusion was included in this study.the sample was divided into 2 groups. Group I consists of Lateral cephalograms of 15 patients (7 boys & 8 girls) categorized by Class II pattern with mandibular deficiency and had undergone treatment with AdvanSync2 alone – AdvanSync2 group and Group II consists of 15 patients (6 boys & 9 girls) categorized by Class II pattern with mandibular deficiency and were to be treated with AdvanSync2 and miniscrew-AdvanSync2 with miniscrew anchorage group.
Inclusion criteria were skeletal class II division 1 malocclusion with orthognathic maxilla &retrognathic mandible at an age range of 12- 16 years, overjet exceeding 5 mm and horizontal or normal growth pattern. Exclusion criteria were skeletal class 1 & III malocclusion, overjet less than 5mm, severely periodontally compromised patient, patients allergic to nickel & chromium, patients with vertical growth pattern. Ethical clearance was obtained from the Institutional Ethical Committee as well as Informed consents were obtained from individual participants before the functional appliance therapy.

After giving a verbal explanation about the study, a signed informed consent & a detailed case study was obtained. Photographs & lateral cephalograms under standardized conditions at natural head position with a cephalostat is taken for the selected class II patients. These 15 patients were treated by non-extraction treatment plan with MBT fixed appliance (0.022 inch slot).

In group 1 which is AdvanSync2 alone group, appliance was inserted in the following manner-
After adequate separation of first molars proper crowns (bands) were selected according to the tooth size. Lower bands were cemented first. Telescopic rods (right and left) were attached with the screw to the distal holes of upper crowns extra orally and then cemented to upper first molars. Guide the patient to guide the mandible forward, to align the lower telescopic mechanism in the mesial casing and then place the screw. Activation was done on the day of placement, telescopic mechanism was placed in distal casing of upper crown and mesial casing of lower crown. This gives approximately 4mm activation. After around 6-8 weeks patient recalled for next activation. The screw from the lower mesial casing was shifted to the distal casing, thus producing around 2mm activation. Patients are recalled after 6 to 8weeks to check the correction of mandibular advancement. If required the spacers (1mm, 2mm) was added for further activation.
In the AdvanSync2 with miniscrew group the miniscrews are inserted at the mucogingival junction in the inter-radicular region between mandibular canine & first premolar root area bilaterally at least 1 week before AdvanSync2 telescope tube application. Initially Intra oral periapical radiographs were taken to confirm adequate space for miniscrew placement & to analayse the proximity from vital structures. Even though brackets were bonded before or after placement of miniscrews, the telescopes for activation were only placed after 1 week.
Topical anaesthesia was given to reduce the prick of the needle for infiltration anesthesia. AbsoAnchor mini implants (SH 1514- 08; DentosInc, Korea) were inserted using a long hand driver with micro dual ball grip system (LHD-OB-S) after applying local anesthesia (0.3mml). The TADs were tied tightly to the canine brackets with .012" stainless steel ligatures (indirect anchorage is established). Chlorhexidine rinse was prescribed daily after brushing

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twice for one week. Patients were recalled after 1 week to assess the healing of the tissues & placing the telescope connection of AdvanSync2, thereby activating it. Patients are observed at 6-8 week intervals. The occlusion is overcorrected to an edge to edge incisor relationship. After overcorrection of the sagittal discrepancy, the appliance was removed, Lateral cephalograms are taken before the treatment (T1) & at the end of fixed functional treatment (T2) for comparison. The average length of the AdvanSync treatment was 7.2 months.

Measurements
All cephalometric radiographs were traced on matt acetate tracing paper in a random order by a single investigator using 0.3mm 3HB lead pencil. Cephalometric landmarks used in modified Pancherz analysis were identified on a lateral cephalograms.
Modified Pancherz Cephalometric Analysis comprised of two parts: The sagittal occlusal analysis and the vertical occlusal analysis. The sagittal analysis includes 4 linear variables and the vertical analysis has 1 linear and 2 angular variables. The angular measurements were recorded to a nearest of 0.5 degrees.

Cephalometric linear measurements used in sagittal occlusal analysis
1. A-OLp: Position of maxillary base where OLp is occlusal line perpendicular and A is Point A
2. Pg- OLp: Position of mandibular base where Pg is pogonion
3. A-OLp minus Pg- OLp: Jaw base relationship.
4. Pg-OLp + Co-OLp: Mandibular length.

Cephalometric linear measurements used in vertical Occlusal analysis:
1.ANS-Me: Lower anterior facial height where ANS is anterior nasalspine and Me is menton

Cephalometric angular measurements used in modified Pancherz analysis
1. NL-NSL-Nasal plane angle: The angle between maxillary plane (ANS-PNS) and N-S plane (NasionSella line).
2. ML-NSL-Mandibular plane angle: The angle between mandibular plane (Me-Go) and N-S plane angle.

Statistical analysis
All statistical analysis was performed using the Statistical Package for theSocial Sciences for Windows software package (SPSS for Windows, version 19.0,SPSS Inc). The mean and standard deviation calculated for each cephalometricvariable. Statistical analysis was done using inferential statistics such as independent t-test or man whitney U test for intergroup evaluation; and Paired t-test or Wilcoxonsigned rank test was done for intragroup evaluation.
The following statistical methods were employed in the present study

- Descriptive statistics including mean, standard deviation.
- Paired t-test or Wilcoxon signed rank test
- Independent sample t-test or Man-whitney U test
- Null Hypothesis: There is no significant difference in the score between the p . . $\eta 1=\eta 2$
- Alternate Hypothesis: There is a significant difference in the score recorded b w p . . $\eta 1\neq\eta 2$
- Level of Significance: $\alpha=0.05$

Results

This study involved comparison of effects of AdvanSync2 and AdvanSync2 with miniscrew used for the correction of Class II division 1 malocclusion due to mandibular retrognathism. Lateral cephalograms of 15 patients who had undergone treatment using AdvanSync2 comprised Group I (AdvanSync2 group) and 15 patients who were to be treated with AdvanSync2 supported by miniscrews were included in Group II: Adv-MS (AdvanSync2 with miniscrew group). Skeletal changes were assessed using lateral cephalograms. The pre-functional and post functional measurements in anteroposterior and vertical planes were anaysed.

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Angular measurement changes

Table 1 and Table 2 show the angular measurements changes by AdvanSync2 appliance and Adv-MS appliance respectively. Comparison between the AdvanSync2 appliance and Adv-MS appliance group is presented in Table 3. When the angular measurements were analysed, they showed an increase in all post treatment values. But they were not statistically significant except for that of palatal plane angle.

The Adv-MS group showed a statistically significant increase in palatal plane angle by 1.67 (P=.009) (Table 2). Inter group comparison did not yield any significant results.

Table 1 -Comparison of angular measurements pre- functional and post- functional in Group I.

Groups	N	Mean	SD	Std. Error Mean	p-value
NL-NSL(T1)	15	8.0000	3.54562	.91548	0.224
NL-NSL(T2)	15	8.9333	3.19523	.82501	
ML-NSL(T1)	15	31.4667	4.42181	1.14171	0.728
ML-NSL(T2)	15	31.6000	3.92428	1.01325	

*****P-value significant at the 0.05 level.

Table 2- Comparison of angular measurements pre- functional and post- functional in Group II.

Groups	N	Mean	SD	Std. Error Mean	p-value
NL-NSL(T1)	15	15.6667	1.29099	.33333	**0.009***
NL-NSL(T2)	15	17.3333	1.75933	.45426	
ML-NSL(T1)	15	35.5333	1.88478	.48665	0.192
ML-NSL(T2)	15	36.6000	1.24212	.32071	

*p-value significant at the 0.05 level.

Table 3- Comparison of angular measurements pre-post functional in Group I&II.

Variable Pre-post	Groups	N	Mean	SD	Std. Error Mean	p-value
NL-NSL	I	15	-.9000	2.84228	.73387	0.410
	II	15	-1.6667	2.12692	.54917	
ML-NSL	I	15	-.1333	1.45733	.37628	0.289
	II	15	-1.0667	3.01109	.77746	

*p-value significant at the 0.05 level.

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The sagittal changes

Sagittal changes by the AdvanSync2 appliance and AdvanSync2 with miniscrew appliance are presented in Table 4 and Table 5 respectively. Comparison of sagittal measurements between the AdvanSync2 appliance and AdvanSync2 with miniscrew appliance is presented in Table 6.

In AdvanSync2 group, there was a posterior movement of maxilla (Table 4) (P=.078) by 2.0mm and in Adv-MS, it was 0.5mm (P =.081) (Table 5) which was statistically insignificant. When both the groups were compared the result remained statistically insignificant (Table 6) (P=.4).

According to this study, there was statistically significant change in the position of the pogonion in both groups. Sagittally, the pogonion moved forward by 6.26 mm (P=.001) in AdvanSync2 appliance group (Table 4) and by 4.1mm (P=.019) in Group II (Table 5). When both the groups were compared the result was statistically insignificant (Table 6) (P=.059).

When the change in the skeletal discrepancy value (A-OLp minus Pg-OLp) was assessed, the results showed that mandibular growth was more than the maxillary growth in both groups (P=.003). In AdvanSync2 it was 2.7mm (P=.003) & in Adv-MS group (P=.041) it was 1.02mm (Table 4,5 respectively). It was statistically significant when the two groups were compared (P=.005) with AdvanSync2 group showing greater change. In case of the mean mandibular length (Co-OLp + Pg-OLp), AdvanSyn2 group increased by 2.4 mm (P=.032) (Table 4) and Adv-MS group by 3.03 mm (P=.001) (Table 5). When both groups were compared the result was statistically insignificant (P=.524) (Table 6).

Table 4- Comparison of sagittal measurements pre- functional and post-functional in Group I.

Groups	N	Mean	SD	Std. Error Mean	p-value
A-OLP(T1)	15	78.6000	5.20714	1.34448	**0.078**
A-OLP(T2)	15	76.6000	5.14208	1.48260	
Pg-OLP (T1)	15	71.0000	3.83592	.99043	**0.001***
Pg-OLP (T2)	15	77.2667	4.52717	1.16891	
A-OLP- Pg-Olp(T1)	15	4.5333	4.40562	1.13753	**0.003***
A-OLP- Pg-Olp(T2)	15	1.6667	4.18614	1.08086	
Pg-OLP+Co-OLP(T1)	15	85.8000	4.41103	1.13892	**0.032***
Pg-OLP+Co-OLP(T2)	15	88.2000	4.95984	1.28062	

*****p-value significant at the 0.05 level.

Table 5- Comparison of sagittal measurements pre- functional and post- functional in Group II.

Groups	N	Mean	SD	Std. Error Mean	p-value
A-OLP(T1)	15	81.0333	1.23153	.31798	0.081
A-OLP(T2)	15	80.5333	1.10948	.28647	

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Pg-OLP (T1)	15	77.3333	.97590	.25198	**0.019***
Pg-OLP (T2)	15	77.6667	.48795	.12599	
A-OLP- Pg-Olp(T1)	15	4.931	2.14453	.8119	**0.041***
A-OLP- Pg-Olp(T2)	15	4.1667	2.32737	.60093	
Pg-OLP+Co-OLP(T1)	15	82.3000	4.21646	1.08869	**0.001***
Pg-OLP+Co-OLP(T2)	15	85.3333	4.95215	1.27864	

*****P-value significant at the 0.05 level.

Table 6- Comparison of sagittal measurements pre-post- functional in Group I&II.

Variable Pre-post	**Groups**	**N**	**Mean**	**SD**	**Std. Error Mean**	**p-value**
A-OLP	I	15	-3.0333	2.25568	.58241	0.400
	II	15	-2.5000	.86603	.22361	
Pg-OLP	I	15	-2.3333	3.88985	1.00436	0.504
	II	15	-3.0333	1.58640	.40961	
A-OLP- Pg-Olp	I	15	2.8667	3.04412	.78599	**0.005***
	II	15	-.0667	2.09478	.54087	
Pg-OLP + Co-OLP	I	15	-2.3333	3.88985	1.00436	0.524
	II	15	-3.0333	1.58640	.40961	

*p-value significant at the 0.05 level

Vertical changes

Vertical changes by the AdvanSync2 appliance and Adv-MS appliance are presented in (Table 7) and (Table 8) respectively.

In AdvanSync2 group, there was an increase in lower anterior facial height by 4.27 mm (P=.001) (Table 7) and in Adv-MS group by 6.56 mm (P=.001) (Table 8). When both the groups were compared the result was not statistically significant (Table 9) (P=.135).

Table 7- Comparison of vertical measurements pre- functional and post- functional in Group I.

Groups	**N**	**Mean**	**SD**	**Std. Error Mean**	**p-value**
ANS-Me-T1	15	58.93	4.096	1.058	**0.001***

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ANS-Me-T2	15	63.20	4.346	1.122	

*p-value significant at the 0.05 level.

Table 8- Comparison of vertical measurements pre- functional and post-functional in Group II.

Groups	N	Mean	SD	Std. Error Mean	p-value
ANS-Me-T1	15	65.7000	1.75051	.45198	**0.001***
ANS-Me-T2	15	72.2667	4.21675	1.08876	

*p-value significant at the 0.05 level.

Table 9= Comparison of vertical measurements pre-post- functional in Group I&II.

Variable Pre-post	Groups	N	Mean	SD	Std. Error Mean	p-value
ANS-Me	I	15	-4.2000	1.83030	.47258	0.135
	II	15	-6.5667	5.66590	1.46293	

*p-value significant at the 0.05 level.

Discussion

There are many studies in literature proving that mandibular retrognathia is the main cause of Class II malocclusion.[4] These malocclusions can be treated by several methods which include extraoral appliances, functional appliances, fixed appliances associated with Class II intermaxillary elastics, extraction of premolars, distalization of maxillary arch in growing patients or surgical correction in case of adult patients. The use of functional appliances has been recommended for adolescent patients to enhance mandibular growth. Removable functional appliances like Frankel, Activator, Bionatoretc are generally used in younger individuals who are yet to reach the pubertal growth spurt.

Since the reintroduction of the Herbst appliance into modern orthodontics by Pancherz in 1979, the most popular tool for non-surgical Class II treatment has become fixed functional appliances. Over the years many Herbst appliance derivatives, which all use the bite-jumping method but differ in the appliance and/or anchorage design, have been developed.[13]Fixed functional appliances are available in rigid, flexible, and hybridcategories.[16] A number of fixed appliances have been introduced over the years to helpachieve better result in noncompliant patients. One of such innovations isAdvanSync2 which was presented by Terry Dischinger, few years back.[14]
Though thereare innumerable articles on most fixed functional appliances, very few studies have been done on AdvanSync2 per se.

AdvanSync2 appliance consisted of four first molar crowns designated to cement on first molars in each quadrant. The size of this rod is 50% shorter than those in traditional Herbst appliances.
Like all class II correctors AdvanSync2 push lower anteriors forward. Such proclination can partially reduce the overjet through dentoalveolar compensation, potentially diminishing the skeletal effect of the appliance by impeding forward movement of the mandible.In order to find a remedy for this solution absolute anchorage was included along with AdvanSync2 in this study.

To avoid unwanted reciprocal tooth movement anchorage is of paramount importance.

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This study was done to compare the treatment effects of one of the latest compliance free fixed functional appliances for correction of Angle's Class II division 1malocclusion, viz. AdvanSync2 and to AdvanSync2 combined with mini screw to increase anchorage. The change in skeletal is collated.

Changes in Sagittal relationship

The findings in this study showed that both groups are effective in improving the profile of patients by advancing mandible forward. At the completion of the functional appliance treatment, all patients showed increase in the total mandibular length (Pg-OLp+Co-OLp). All patients showed retrusion of maxillary incisors within the maxilla (Is-OLp minus AOLp) and more or less mandibular proclination in both groups. Similar effects were reported in previous studies by Lorenzo Franchi[17], Al Jewair[15] along with their coworkers.

One of the controversies in functional appliance therapy is restriction of maxillary growth. Clark WJ found that the maxilla continued to grow during the period of Twin Block therapy.[18] There was statistically significant redirection of growth of maxilla in both these groups. So there was a restraining effects on the growth of maxilla in both the groups which was statistically insignificant.

A-OLp minus Pg-OLp shows skeletal jaw discrepancy. A negative value represents mandible outgrew maxilla and a positive value indicates maxilla outgrew the mandible. In this study, growth of mandible was significantly greater than that of maxilla in both groups. So this observation was in agreement with many previous studies like that of Pancherz H et al[19] and PoalaCozza et al [20] .So both groups are effective in correcting maxilloandibular relationship in Class II division1 patients.

Changes in vertical relationship:

There was statistically significant increase in Lower Anterior Facial Height in both groups. This finding is in accordance with studies done by Clark[18], Aras A[21], Gandedkar[22]& so on.

Changes in angular parameters:

All the angular parameters increased in both groups even though they were not statistically significant.

Advantages of AdvanSync2 (as stated by the manufacturer)

1. Very easy to insert the appliance.
2. It does not require any fixed appliance in the mouth before its delivery.
3. Arms are 50% shorter than traditional Herbst appliances.
4. Skeletal correction is more in AdvanSync2.
5. Increase in lower anterior facial height was more in AdvanSyn2, which was very advantageous in Class II malocclusion.
6. Molar correction was also more in AdvanSync 2 patients.
7. Placed more distal than any other type of Herbst appliance so better esthetics.
8. Lateral jaw movement not affected.
9. No need for an initial activation as it has a built in activation.
10. Reactivation is also easy.
11. Patient at the extreme end of growth period are most benefitted as it can be used simultaneously with levelling and aligning.
12. No frequent bracket debonding occurs with this appliance.
13. Patient compliance is not required.
14. As patient profile changes drastically in the initial appointment itself, patient satisfaction is better.
15. Easy to clean, so it is useful in oral hygiene maintenance.
16. Helps to open the overbite during initial appointment itself due to thickness of occlusal part of the crown and forward poisoning of mandible.
17. No need of any lab set up.
18. Fixed orthodontic therapy and functional correction are progressing simultaneously, treatment duration is less.
19. Activation is easy.
20. No special instruments needed for its activation.

Disadvantages of AdvanSync2

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1. Crowns have to be selected before appliance insertion. As any selection guide is not available patient model need to be sent to the suppliers for purchasing proper size crowns of this appliance.
2. Due to the thickness of the occlusal part of molar crowns, there form an open bite in the posterior region when the crown is removed after the completion of mandibular advancement.
3. Only up to 017×025" wire can be engaged though the molar tube of these crowns.
4. Need to change the crown and bond or band first molars after required advancement achieved.
5. There are no hooks for lower molar crowns, so difficult to give lace backs if required.
6. If bonding is delayed in the lower arch, mesial movement of lower first molars occur, so that crowding will occur mesial to it, which may even tip lower second premolars lingually.
7. Lower anteriorsproclination noticed in most of the cases if bonding is done simultaneously with this appliance.
8. Loosening of screw connecting the rod to the crown also noticed.
9. Cost of the AdvanSync2 is more than that of most fixed functional appliances.
10. A lateral open bite was created invariably with the use of AdvanSync2 which needed to be corrected later on using settling elastics, gingivally positioning the premolar brackets etc.
Miniscrews were placed more anteriorly as hindrance was feared from the telescope of AdvanSync2 appliance. Also many articles had shown placement in similar area without any difficulties.[23,24,25]

Conclusion

- AdvanSync2 is found to be less bulky and more esthetic in the mouth than other fixed functional appliances.
- When the patent who needs class II correction has crossed the growth spurt - AdvanSync2 will be the best option than any of the other functional appliances.
- Both methods in this study are acceptable for correction Class II malocclusion due to mandibular retrognathism.
- Both appliances caused an increase in the lower anterior facial height.
- Studies in the long term are required to evaluate the stability of the changes in the skeletal &dentoalveolar structures obtained by using AdvanSync2.

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