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Evaluation of dento-skeletal and soft tissue changes in class II individuals using advansync 2 fixed functional class II corrector– A clinical study

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Abstract
Aim: The purpose of this study was to evaluate the dento-skeletal and soft tissue changes with AdvanSync 2 appliance in Class II patients.
Material and methods: A sample of 30 subjects (15 males and 15 females) were selected after satisfying the inclusion criteria. Patient age ranged between 14-18 years (mean age 15.6 years). The hard and soft tissue measurements were recorded at three different stages of treatment, T1 - before the start of the Orthodontic treatment, T2 - before AdvanSync installation, T3 - after removal of AdvanSync. The data collection included lateral cephalograms, digital photographs (frontal, lateral, and Oblique view), and study models at T1, T2, and T3. All the measurements were analyzed for any significance.
Results: Comparison of T1, T2, and T3 periods for SNA, Go-Gn and saddle angle was statistically non-significant (P>0.05). Comparison of T1, T2 and T3 periods for SNB, ANB, Basal Plane Angle, Co-Gn, Na-Me, S-Go, LAFH, Co-A, IMPA, U1-Sn, L1-APog, U6-Sv, L6-Sv, G-Sn-Pog, Nasolabial Angle, Upper lip to E line, lower sulcus depth, overjet, and overbite were all statistically significant (P<0.05).
Conclusion: The AdvanSync 2 appliance showed statistically significant skeletal, dental and soft tissue changes. The AdvanSync 2 appliance is an efficient appliance for correcting class II malocclusion successfully, with measures taken for the prevention of proclination of lower anteriors.

Keywords: class II corrector, advansync 2, fixed functional appliance

Introduction

Class II malocclusion is commonly observed in orthodontic practice, it affects the majority of the patients seeking orthodontic therapy. Class II malocclusion is characterized by an incorrect relationship between maxillary and mandibular arches because of skeletal problems, dental problems, or a combination of both [1]. The most common characteristic of Class II malocclusion is mandibular retrusion rather than maxillary prognathism. Thus, among the various orthodontic appliances introduced to treat Class II malocclusion, functional orthopedic appliances are widely used [2]. The term functional appliance refers to a variety of removable or fixed appliances designed to alter the mandibular position both sagittally and vertically, resulting in orthodontic and orthopedic changes [3]. Contrary to removable functional appliances, fixed functional appliances do not require the patient's cooperation and can be worn in association with multibracket therapy so that Class II malocclusion can be corrected in a single-phase treatment [4].

The ideal functional appliance should be comfortable for the patient, allow jaw movements, leave room for the tongue, provide skeletal rather than dental effects, and should be comfortable to be used in subjects with nasal obstruction [5]. The fact that functional appliances are not successful is generally attributed to the lack of patient compliance in the use of the appliances and also to the severity of the malocclusion. Therefore to be effective in treating Angle's Class II div 1 malocclusion an appliance should generate skeletal and dental effects necessary to correct the discrepancy between the basal bones while reducing the overjet thus eliminating the need for patient compliance. Such appliance would also ideally allow the simultaneous (orthopedic and orthodontic) placement of a fixed orthodontic appliance in one single step, thereby speeding up treatment [6].

Several studies on the effects of fixed functional appliances have documented their shortcomings: - Pancherz [7] reported that the profile changes exhibited by patients who were treated with Herbst therapy were variable and unpredictable. The Herbst and Mara appliances significantly restricted the maxillary growth and produced a steeper occlusal plane [8]. Protrusion of mandibular incisors was also reported to be a common finding that limits skeletal effects of the appliance used [9].

Fixed functional appliances can be grouped into rigid or flexible and hybrid devices. AdvanSync 2 is the latest innovation in Class II correction by ORMCO Orthodontics. This fixed functional appliance consists of crowns cemented to the maxillary and mandibular permanent first molars, which are connected by

telescoping rods. The advansync 2 was designed to allow for simultaneous use of conventional edgewise appliances since the crowns have 0.022 x 0.028-in slots. The telescoping mechanism acts to constantly posture the mandible forward upon closure, to enhance mandibular growth to correct the Class II malocclusion [10].

Various studies have been done on fixed functional appliances (like Eureka Spring, Jasper Jumper, Forsus, etc) to evaluate their effects on dento-skeletal and soft tissue changes. AdvanSync2 newly invented Class II corrector. Due to its recent emergence in clinical orthodontics studies have not been undertaken on advansync 2 to evaluate its effects in Class II corrections. So, the present study helps to evaluate the dento-skeletal and soft tissue effects of AdvanSync2 application in Class II cases.

Material and methods

This study was designed to evaluate dento-skeletal and soft tissue effects of the fixed functional appliance advansync (manufactured by ORMCO) in Class II patients. Before the study, approval was granted by the Ethical Committee of Maharashtra University of Health Sciences, Nashik. A sample of 30 subjects was selected satisfying the inclusion and criterion.

The inclusion and exclusion criteria were as follows:

Inclusion Criteria

- Class II cases with mandibular retrusion
- Patient age ranges between 14-18 years
- Patients with reduced lower anterior facial height
- Well-aligned lower arch
- Landmarks identifiable on cephalograms

Exclusion Criteria

- Patients with mixed/missing dentition
- Patient age above 19 years
- Patients previously treated with any functional appliance
- Patients with increased lower anterior facial height
- Landmarks not identifiable on cephalograms

The patients were explained about the treatment procedure and signed consent forms were taken from individual patients. All patients were treated with 0.022 slot appliance brackets (American Orthodontics AO, Master Series, USA) with a standard MBT prescription. After the initial alignment of the upper and lower arch, the AdvanSync 2 was installed. It was a molar-to-molar installation delivered in conjunction with 0.019 x 0.025inch stainless steel wire in the maxillary and mandibular arch and cinched back properly. In the maxillary arch, the crown was cemented on the upper first molar and in the mandibular arch crown was cemented on the lower first molar with glass ionomer cement.

Activations were done with the help of crimpable shims (size- 2 & 3 mm) in the lower arm of the mini-scope which act as stops for the middle tube. The period with AdvanSync 2 installed was undertaken until Class II canine and molar was corrected to Class I canine and molar relationship. After the completion of the advancement, unscrewing of the mini-scope was done and the crowns were removed. Thereafter, fixed appliances were maintained for finishing and detailing. Date of AdvanSync 2 placement and removal were noted to evaluate the time duration required for corrections.

Data Collection

The data were collected at three different stages of treatment:

T1: Before the start of the Orthodontic treatment

T2: Before AdvanSync 2 installation

T3: After removal of AdvanSync 2

The data collection included Lateral cephalograms, digital photographs (frontal, lateral, and Oblique view), and study models at T1, T2, and T3.

Cephalometric Records

All the cephalometric radiographs were hand-traced on single matted acetate paper and included the cranial base, maxilla, mandible, orbit, pterygomaxillary fissure, dentition (upper and lower central incisors and first molars), and the entire soft tissue profile from glabella to cervicale. The different points and planes used in the cephalometric analysis were seen in Figures 1 and 2.

Cephalometric Analysis for dento-skeletal and soft tissue measurements

T1 radiographs were traced and used to obtain patients' pre-treatment skeletally and dental characteristics. A total of 22 dental, skeletal and soft tissue measurements were made (11 angular, 11 linear). Similarly, cephalograms were traced at stages T2 and T3 using the same parameters. Horizontal dental movements in the maxilla and mandible were measured using a sella vertical (Sv) line. This Sv line was constructed by drawing a constructed plane (-7 degrees to SN plane) and drawing a perpendicular line to this plane passing through sella point. These tracings were done by a single evaluator and at the same time to minimize the errors.

Measurement of Dental changes on Study Models

The impressions were taken at the T1, T2, and T3 stage with the help of alginate impression material and were poured by Orthokal (Dental plaster Class II) as early as possible to avoid impression distortion. After the model's recovery the changes in molar relation, canine relation, overjet, and overbite were evaluated at T1, T2, and T3.

Statistical Analysis

A master file was created compiling all the data. It was then statistically analyzed using the Statistical Package for Social Sciences software (version 17) (SPSS Inc. Released 2008. Chicago: SPSS Inc). The data were subjected to descriptive analysis for mean, standard deviation, and 95% confidence interval. 'P' value less than 0.05 was considered to denote a statistically significant association. Paired 't-test was performed for intragroup comparison. Wilcoxon matched paired test was done for intragroup comparison.

Results

Comparison of T1, T2, and T3 periods to SNA, Go-Gn and saddle angle was statistically non-significant (P>0.05). Comparison of T1, T2 and T3 periods to SNB, ANB, Basal Plane Angle, Co-Gn, Na-Me, S-Go, LAFH, Co-A, IMPA, U1-Sn, L1-APog, U6-Sv, L6-Sv, G-Sn-Pog, Nasolabial Angle, Upper lip to E line, lower sulcus depth, overjet, and overbite were all statistically

significant (P<0.05). Comparison of T1, T2, and T3 time points for the duration of correction with AdvanSync 2 scores by paired t-test are shown in Table 1.

Discussion

This study was designed to evaluate the dento-skeletal and soft tissue effects of the AdvanSync 2 in Class II patients that will provide the orthodontist's information about the appliance and allow them to use this appliance appropriately. Changes in cephalometric measurements from the T1-T2 leveling phase were not given importance as these changes do not quantify the changes brought about by the AdvanSync 2 as the appliance is installed after the initial leveling and alignment has been completed.

The parameters undertaken in this study will now be compared to the studies performed previously on other fixed functional appliances. AdvanSync 2 had a restraining effect on the maxilla. The finding of our study was in support of previous studies carried out on Jasper Jumper (Kucukkeles, Neves, Henrique, Covell) [11, 1, 12, 13], Herbst (Panchrz) [14], Eureka Spring (Stromeyer) [15], Churro jumper (Jethe) [6], and Forsus (Cacciatore, Turkkahraman, Karacay) [2, 17, 18]. The restraining effect on the maxilla may be due to the advancement with AdvanSync 2 implemented simultaneously with fixed edgewise orthodontic treatment. As the appliance is a molar-to-molar installation there was a distal force on the maxilla hence having the effect of headgear effect and preventing further maxillary growth.

In the present study skeletal effect of AdvanSync 2 on the mandible can be seen by the significant increase in the SNB angle. Our results were as per studies carried out on various fixed functional appliances (Karacay, Celikoglu, Turkkahraman) [18, 6, 17], Churro Jumper (Jethe) [16], Herbst (Panchrz, Alvares) [14, 19], Jasper Jumper (Covell, Kucukkeles) [13, 11]. The anterior mandibular repositioning caused the increase in the SNB. The backward position of the retrognathic mandible was improved to the cranial base

The ANB angle measures the relative position of the maxilla to mandible to the cranial base. The mandibular anterior repositioning along with the restraining effect on the maxilla found in this study was able to decrease the ANB angle. The studies done using other fixed functional appliances showed similar findings [1, 2, 13, 18].

The mandibular plane angle measures the facial growth direction and the basal plane angle checks the rotation of the maxilla-mandibular complex. The basal plane angle and mandibular plane angle had no significant changes in this study. There was a slight increase in the mandibular plane angle but it was not statistically significant. This increase may be due to the increase in the height of the posterior alveolar process and the forward and downward movement of the mandible.

The saddle angle signifies the position of the condyle and the position of the mandible to the cranial base. In the present study, there was a slight decrease in the angle but was not significant. The decrease in the angle accounted for the anterior repositioning of the mandible. In this study, it can also be seen that the upper molar distance from Sella vertical line has decreased due to the distal movement of the molars due which wedging effect has taken place. The Co-Gn is the effective mandibular length fixed functional appliances encourage mandible to grow thus affect it. In our study, the result showed a significant increase in the effective mandibular length. Previous studies on fixed functional appliances showed controversial results as some showed significant changes (Karacay (3.8mm in FRD group and 4.5 mm in JJ group) [18], Celikoglu (4.59 mm) [6], Panchrz (3.4 – 6 mm) [14], Alvares (4.15mm) [19], Jethe (7.42mm) [16] and some with no significant changes (Ghislanzoni, Cacciatore, Henrique) [20, 2, 12] ineffective mandibular length.

The effective length of the maxilla is measured as Co-A showed a significant decrease. This may be due to the restraining effect or the orthopedic effect which the appliance has on the maxillary dentition.

The lower anterior facial height (ANS-Me) was slightly increased but was not significant. The increase may be due to the downward and forward movement of the mandible and wedging effect. Studies done by Karacay [18], Henrique [12], Covell [13], Neves [1], Sari [21] showed similar findings. However, Jethe *et al* [16] on Churro Jumper and Stucki [22] on JJ showed contrary results, as there was a significant decrease in the anterior facial height due to remodeling changes in the glenoid fossa. There was a slight increase in the total anterior facial height (N-Me). This increase was not that significant. This increase is due to the forward and downward movement of the mandible. There was a significant increase in the posterior facial height. The increase in the posterior facial height (S-Go) also supported the increase in the vertical dimensions [18, 14, 23].

The maxillary incisor to SN plane is an angular measurement that determines the inclination of the central incisor relative to the anterior cranial base. It is measured as the inner angle between the SN plane and the long axis of the incisor. The increase in this measurement suggests the proclined maxillary incisors relative to the anterior cranial base and vice versa. There was a decrease in the UI-SN value which was not significant. This change was due to the reduction in proclination during the initial leveling and aligning phase and due to the restrictive effect of the appliance on the maxilla.

Incisor mandibular plane angle (IMPA) defines the axial inclination between the mandibular incisor and the inferior border of the mandible. The more the incisor is labially inclined, the greater the angle. AdvanSync 2 is molar to molar installation and along with the distal force on the maxilla, there is a mesial thrust on the mandibular dentition which causes the mandibular incisors to procline. In the present study, there was a significant increase in the IMPA. There was an increase in the interincisal angle after AdvanSync 2 placement. This increase may be due to the reduction of proclination of maxillary anteriors in the initial leveling and alignment phase and more skeletal effects of the appliance. The position of the lower incisors to the denture base is given by the Li-Apog. There was a significant forward positioning of the lower incisors after AdvanSync 2. placement. Concurrent findings observed in different FFA studies [1, 6, 11, 13, 18, 24, 25, 26]. There was slight decrease in the U6-Sv. The decrease was not statistically significant. This decrease may be due to the distal movement of the maxillary molars. There was a significant increase in the L6-Sv. The increase is due to the mesial movement of the mandibular molar along with the anterior positioning of the mandible. Class II division 1 malocclusion caused by mandibular deficiency is associated with soft tissue characteristics that involve a high degree of facial convexity with a normal nasolabial angle, decreased mento-labial angle, recessed chin, and lower lip, lip incompetence, and a short chin-to-neck

length.[27]This study hence evaluates various soft tissue parameters to assess the soft tissue changes after appliance removal. Rickett's Esthetic plane was used as a reference to evaluate the changes in upper and lower lip position. In the present study, there was a significant retraction of the upper lip and the forward movement of the lower lip. The retraction of the upper lip position was due to the restraining of AdvanSync 2 on the maxilla and as a result of initial leveling and aligning. The forward lower lip to E-line and decrease in the lower sulcus depth might be because of an increase in effective mandibular length and the dentoalveolar proclination of lower incisors [16, 28]. There was a significant decrease in the labialis superior distance and lip strength showed the retrusion of the upper lip. When parameters related to the lower lip were evaluated, the decrease in the E line labialis inferior distance showed that the lower lip moved forward as the lower incisors proclined [24]. Nasolabial angle is the angle that gives an account of the aesthetics of the individual hence it has gained prime importance in treatment planning. The angle is measured by drawing a line tangent to the base of the nose and a line tangent to the upper lip. There was a significant increase in this angle. The evaluation of the changes in overjet and overbite were evaluated by measuring dental cast models. In the present study, there was a significant decrease in the overjet and overbite this was due to the restraining effect on the maxilla and the increase in length of the mandible.

Conclusion

The AdvanSync 2 appliance showed many skeletal, dental and soft tissue changes which are: -

1. Significant increase in effective mandibular length.
2. Mesialization of the lower molar.
3. Increase in lower anterior facial height.
4. Improvement of maxillo-mandibular relationship thus reduction of the skeletal discrepancy.
5. Reduction in the overjet and overbite
6. Significant soft tissue profile improvement following dento-skeletal changes.
7. The AdvanSync 2 appliance is an efficient appliance for correcting class II malocclusion successfully, with measures taken for the prevention of proclination of lower anteriors.

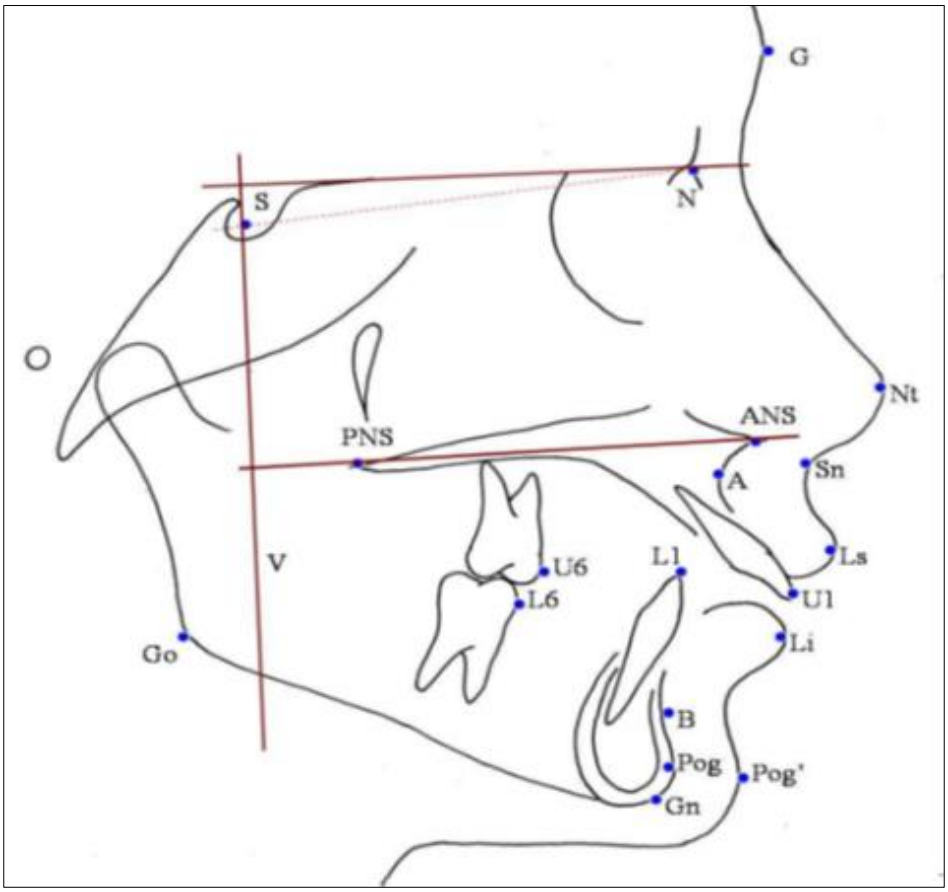

Fig 1: Cephalometric Landmarks used, S (Sella): Geometric centre of the pituitary fossa, N (Nasion): The most anterior point on the fronto-nasal suture on the mid sagittal plane, A (A point): The most posterior midline in the concavity between the anterior nasal spine and the alveolar bone covering the maxillary incisors, B (B point): The most posterior midline point in the concavity of the mandible between the most superior point on the alveolar bone covering the mandibular incisors and pogonion, Go (Gonion): A point on the curvature of the angle of the mandible located by bisecting the angle formed by the lines tangent to the posterior ramus and the inferior border of the mandible, Gn (Gnathion): A point located by taking the midpoint between the anterior and inferior points of the bony chin, ANS (Anterior Nasal Spine): The anterior tip of the sharp bony process of the maxilla at the lower margin of the anterior nasal opening, PNS (Posterior Nasal Spine): The posterior spine of the palatine bone constituting the hard palate, Me (Menton): The lowest point on the symphyseal shadow of the mandible seen on a lateral cephalogram, Pog (Pogonion): The most anterior point on the chin, U1 (Upper Central Incisor): Incisal tip of the maxillary central incisor, L1 (Lower Central Incisor): Incisal tip of the mandibular central incisor, U6 (Upper 1st Molar): The anterior most point on the mesial outline of the crown of the maxillary 1st molar, L6 (Lower 1st Molar): The anterior most point on the mesial outline of the crown of the mandibular 1st molar, G (Glabella): The most prominent anterior point in the midsagital plane of the forehead, Sn. (Subnasale): Point at the junction of the columella and the upper lip, Pog' (Soft tissue pogonion): The most anterior point on the soft tissue chin, Ls (LabraleSuperius): The most anterior point on the convexity of the upper lip, Li (LabraleInferius): The most anterior point on the convexity of the lower lip.

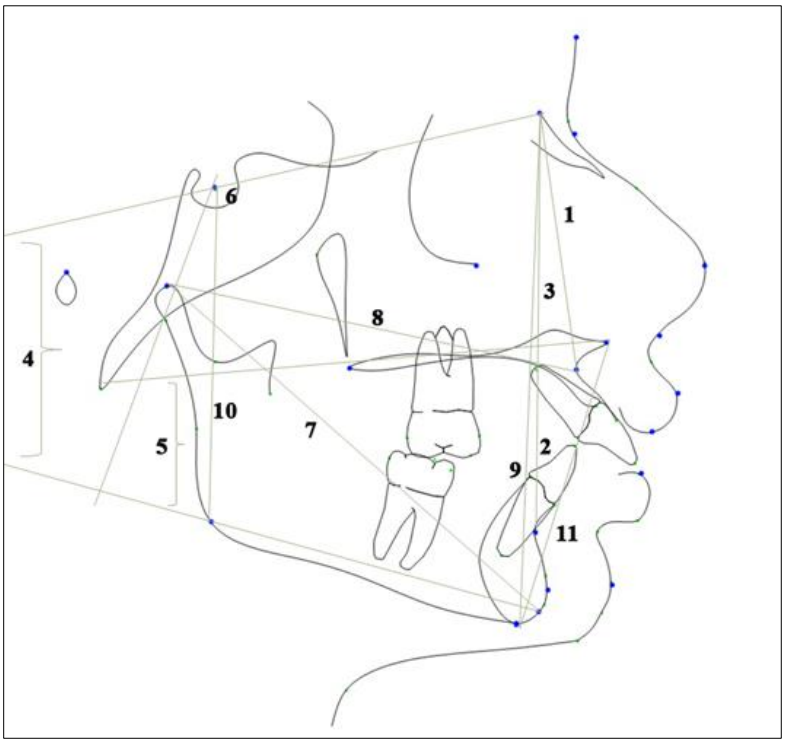

Fig 2: Cephalometric measurements used. A) Angular Measurements:1. SNA,2. SNB,3. ANB,4. Go-Gn-SN,5. PP-MP,6. Saddle angle, B) Linear Measurements (in mm),7. Effective mandibular length (Co-Gn),8. Effective maxillary length (Co-A),9. Total anterior facial height (N- Me), 10. Posterior facial height (S- Go), 11. Lower anterior facial height (ANS- Me)

Table 1: Comparison of T1, T2, and T3 time points to the duration of correction with AdvanSync 2 scores by paired t-test.

Time points	Mean	Std.Dv.	Mean Diff.	SD Diff.	% of change	Paired t	p-value
T1	0.00	0.00					
T2	6.40	1.51	-6.40	1.51	100.00	-13.4427	0.0001*
T1	0.00	0.00					
T3	13.50	1.27	-13.50	1.27	100.00	-33.6334	0.0001*
T2	6.40	1.51					
T3	13.50	1.27	-7.10	0.74	-110.94	-30.4286	0.0001*

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