DENTOSKELETAL, SOFT TISSUE AND AIRWAY EFFECTS OF THE ADVANSYNC2 IN PATIENTS WITH CLASS II DIV 1 MANDIBULAR RETROGNATHISM: A RETROSPECTIVE STUDY

Orthodontics

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ABSTRACT

Objective: To evaluate dentoskeletal, soft tissue and airway changes in Class II malocclusion patients treated with AdvanSync2 Class II corrector in conjunction with fixed appliances.

Methods: Forty-five subjects with skeletal and dental Class II malocclusion requiring fixed functional therapy were included. Pre-treatment cephalograms served as control group (Group 1), post treatment cephalograms of patients treated using AdvanSync2, as experimental group (Group 2). Changes in skeletal, dental, soft tissue profile and airway were analyzed on lateral cephalograms using 21 variables from multiple cephalometric analysis. Results were tabulated and data was analyzed using Wilcoxon signed rank test for linear parameters and paired student t test for angular parameters.

Results: Maxillary skeletal and dental effects included restriction of growth, upper incisor retrusion and retroclination at $p < 0.001$. Mandibular incisors proclined during treatment. Forward mandibular relocation was noted, though not statistically significant. Upper and lower lip repositioning was achieved, establishing lip competency. Changes in Z angle and nasolabial angle were positive, reducing facial convexity. Significant airway dimensional improvements were noted.

Conclusion: AdvanSync2 Class II corrector was effective in treating skeletal Class II malocclusions with mandibular retrognathism. It produced its effects mainly through maxillary restriction and mandibular dentoalveolar changes which furthermore helped in achieving good soft tissue profiles in patients. Positive airway changes were also noted.

KEYWORDS

Angle Class II, AdvanSync2, Airway, Fixed functional appliance

INTRODUCTION

Class II malocclusion is a common disharmony in all age groups with a prevalence between 13%-23% (Jayachandran et al., 2016). Treatment methods vary from growth modification appliances like headgear and functional appliances, distalization appliances or fixed appliances with or without extractions depending on the nature of the problem. The treatment modality chosen is based on various factors including growth and soft tissue considerations. Patients with Class II div 1 malocclusion usually present with an unappealing facial profile. Hence, improving the patient's facial esthetics is an important aim of orthodontic treatment in such cases. The pharyngeal airway along with its surrounding structures has a major role in physiological processes like vocalisation, swallowing and respiration. These patients are at a higher risk of respiratory dysfunction and may present with problems like mouth breathing, upper airway resistance syndrome and obstructive sleep apnoea (OSA). Therefore, detailed assessment of the upper airway is essential for routine orthodontic planning, in patients presenting with a retrusive mandible. Functional appliances have been advocated since 1900's to relocate a retrognathic mandible. Modern orthodontics has seen major advancements in functional appliance therapy with a stronger emphasis on Class II non-compliant patients. This has in turn, led to introduction of fixed functional appliances.

The AdvanSync2 (Ormco, Glendora, Calif) is one such recently introduced fixed functional appliance. The appliance is smaller in size, more comfortable and can be used immediately from day one, which is a great advantage. In orthodontic literature, only a few have focused on their effect on the soft tissue profile and airway dimensions. Studies on AdvanSync2 appliance are even fewer. Thus, the aim of this study was to compare the dentoskeletal, soft tissue facial profile and airway changes (pre and post treatment), in patients presenting with Class II div 1 malocclusion due to a retruded mandible treated with the AdvanSync2 fixed Class II corrector.

MATERIAL AND METHODS

This retrospective study was conducted using orthodontic records (2017-2019) of 45 patients (17 males, 28 females with mean age 14.4 ± 1.2 years) with Class II skeleton treated with AdvanSync2 in department of Orthodontics at 2 time points: (T1) pre-treatment-control, (T2) at post treatment. The inclusion criteria were: girls and boys presenting with $\frac{1}{2}$ to full cusp Class II molar relation, presenting later than the peak growth spurt (CVMI-4/5), retrognathic mandible with positive VTO, ANB angle > 4 , overjet > 5 mm and non-extraction

therapy. All patients were treated by a single practitioner using Damon 3MX self ligating (Ormco Corp, California, USA) fixed orthodontic appliances. Class II corrector was placed to allow simultaneous fixed orthodontic appliance treatment in all patients from start of treatment (Figure 1).

Figure 1. Bonding of Damon 3MX brackets with simultaneous placement of AdvanSync2: a) Intraoral right lateral; b) Intraoral frontal; c) Intraoral left lateral; d) Upper occlusal; e) Intraoral Lower occlusal

Initial 0.013" Copper-Nickel- Titanium (CuNiTi) archwires were placed followed by 0.018" CuNiTi wires, 14 x 25" CuNiTi wires respectively. The appliances were activated 2 to 4 mm every 3 months and were in place for 6 to 12 months. Post functional therapy, the Class II corrector was removed, lateral cephalograms were taken with a Planmeca Proline EC (PM 2002 EC) X-ray apparatus. Patients were positioned in natural head position with the mid sagittal plane perpendicular to X-rays and Frankfurt plane. Second molars tubes were bonded at this time and 18 x 25" CuNiTi archwires were placed followed by 19 x 25" stainless steel wires. Cephalograms obtained were imported into Nemotec orthodontic software [Nemotec Dental Studio1.0, Madrid, Spain]. Radiographs were digitally traced after calibration following study protocols by Jayachandran et al., 2016; Janson et al., 2018 and Wen et al., 2017 (Table II).

Figure 2. (a,b) Cephalometric landmarks and reference plane; (c,d) Airway division into 3 compartments: nasopharynx (NP), velopharynx (VP) and glossopharynx (GP) using 3 planes: A; plane passing through PNS, B; plane passing through uvula top and C; plane passing through epiglottis

For standardization purposes, all radiographs were taken using the same machine with magnification corrected to 8%. The reproducibility of measurements was calculated using intra-class correlation statistics between two operators.

Statistical Analysis

Statistical Package for Social Sciences [SPSS] for Windows (Ver 22.0, Armonk, NY: IBM Corp) was used to perform statistical analyses. Wilcoxon signed rank test was used to compare the mean linear distances (in mm) and Student Paired t Test was used to compare (in degrees) angular measurements. Intra-class correlation statistics was used to assess the reproducibility of study measurements between 2 observers for both groups. The level of significance p-value was set at $p < 0.05$.

RESULTS

Eighteen parameters differed significantly between treated and control groups (SNA, ANB, Co-A (mm), IMPA, U1- FH, U1- A Perp (mm), UL- E line, LL- E line, UL- S line, LL- S line, UL-TVL, LL-TVL, Nasolabial angle, Z angle – UL, Z angle – LL, nasopharyngeal width, velopharyngeal width and glossopharyngeal width). The outcomes are reported in Table 1. Compared to pre-treatment controls, the AdvanSync2 produced maxillary skeletal growth restriction (SNA, A-Na perp and Co-A; $p < 0.001$), improvement of the skeletal intermaxillary relationship (ANB; $p < 0.001$) and mandibular incisor proclination (IMPA; $p < 0.001$). The appliance produced significant dentoalveolar effects as demonstrated by retrusion and retroclination of maxillary incisors and mandibular proclination (U1-A perp, U1-FH, and IMPA; $p < 0.001$). A statistically significant decrease in linear measurements of upper lip and lower lip to S line, E line and TVL showed retrusion of the upper lip and lower lips. All three segments of pharyngeal airway demonstrated significant increase in dimensions (Figure 3).

Table 1. Comparison Of Cephalometric Measurements Between Group 1 And Group 2					
Variables	N	Control	Post treatment	MD	p value
		Mean SD	Mean SD		
Skeletal Parameters					

Table 2- Intraclass Correlation Statistics For The Reproducibility Of Measurements Between Two Observers For Both Groups								
Variables	Group 1				Group 2			
	ICC	95% CI		P-Value	ICC	95% CI		P-Value
		Lower	Upper			Lower	Upper	
SNA	0.87	0.33	0.81	0.002*	0.97	0.92	1	<0.001*
SNB	0.82	0.37	0.82	<0.001*	0.96	0.91	0.91	<0.001*
ANB	0.93	0.56	0.89	<0.001*	1	0.9	1	<0.001*
Co- A (mm)	0.91	0.76	0.95	<0.001*	0.92	0.83	0.92	<0.001*
Co-Gn (mm)	0.95	0.84	0.93	<0.001*	0.87	0.65	0.94	<0.001*
Pog- Na Perp (mm)	0.94	0.92	0.96	<0.001*	0.85	0.31	0.95	<0.001*
U1- FH	0.85	0.73	0.95	<0.001*	0.83	0.6	0.96	<0.001*
U1- A Perp (mm)	0.88	0.76	0.97	<0.001*	0.80	0.43	0.92	<0.001*
IMPA	0.87	0.65	0.95	<0.001*	0.97	0.91	1	<0.001*
Nasopharynx	0.83	0.37	0.91	<0.001*	0.94	0.92	0.89	<0.001*

SNA	45	80.25	3.98	77.6	1.37	-2.65	<0.001*
SNB	45	75.2	3.27	75.77	1.22	0.57	0.37
ANB	45	5.05	0.76	2.38	1.18	-2.66	<0.001*
Co- A (mm)	45	80.74	4.23	82.42	2.83	1.68	<0.001*
Co-Gn (mm)	45	105.11	5.32	112.98	4.08	7.87	0.54
Pog- Na Perp (mm)	45	-7.67	5.89	-6.9	1.89	0.77	0.73
Dental parameters							
U1- FH	45	111.25	7.98	105.83	7.89	-5.42	<0.001*
U1- A Perp (mm)	45	3.45	2.87	0.25	2.54	-3.2	<0.001*
IMPA	45	96.23	4.77	103.43	6.78	7.23	<0.001*
Soft tissue parameters							
UL- E line	45	2.09	1.09	0.07	2.17	-2.03	<0.001*
LL- E line	45	1.77	1.27	0.48	1.83	-1.29	0.001*
UL- S line	45	1.43	1.14	0.24	1.4	-1.19	<0.001*
LL- S line	45	1.92	1.61	0.58	1.53	-1.34	<0.001*
UL-TVL	45	2.11	1.5	0.77	1.38	-1.34	<0.001*
LL-TVL	45	1.69	2.58	-0.55	1.89	2.23	<0.001*
Nasolabial angle	45	114.2	10.26	124.7	9.5	10.5	0.001*
Z angle - UL	45	65.6	5.22	72.85	8.2	7.25	<0.001*
Z angle - LL	45	58.5	5.39	67.3	7.71	8.8	<0.001*
Airway parameters							
Nasopharynx	45	7.11	1.14	9.05	1.22	1.95	0.001*
Velopharynx	45	5.75	1.23	9.25	1.67	3.51	<0.001*
Glossopharynx	45	8.8	2.13	10.25	2.21	1.45	<0.001*

Figure 3. Assessment of airway: (a,b) Pretreatment ; (c,d) Post functional; (e,f): Post treatment

The interclass correlation coefficients for measurements obtained for both groups by two observers demonstrated good to excellent reliability ranging between 0.75 to 1.0 and was statistically significant at $p < 0.05$ (Table 2).

DISCUSSION

This was a retrospective cephalometric study evaluating the effects of the AdvanSync2 appliance on the dentoskeletal, soft tissue, and airway changes in treatment of skeletal Class II malocclusions with a retrognathic mandible. The AdvanSync2's foremost skeletal effect was maxillary restriction. This is in agreement with previous studies (Jayachandran et al.,2016; Al-Jewair et al.,2012). These authors reported an overall decrease of (2.1°-3.3°) in SNA and an increase of 1.8 mm in maxillary length (Co-A). However, SNA decreased by 2.65° and Co-A increased by 1.68 mm in this study.

Velopharynx	0.92	0.83	0.97	<0.001*	0.95	0.91	0.94	<0.001*
Glossopharynx	0.94	0.85	0.92	<0.001*	0.88	0.95	0.96	<0.001*
UL-E line	0.77	0.43	0.91	0.002*	0.85	0.78	0.99	<0.001*
UL-S line	0.8	0.47	0.92	<0.001*	0.99	0.94	0.94	<0.001*
UL-TVL	0.97	0.87	0.99	<0.001*	0.98	0.93	0.99	<0.001*
LL-E plane	0.96	0.86	0.99	<0.001*	1	0.99	1	<0.001*
LL-S line	0.98	0.94	0.99	<0.001*	0.96	0.86	0.99	<0.001*
LL-TVL	0.98	0.94	0.99	<0.001*	0.88	0.69	0.97	<0.001*
Z angle- UL	0.88	0.7	0.98	<0.001*	0.84	0.33	0.97	<0.001*
Z angle- LL	0.85	0.73	0.98	<0.001*	0.81	0.7	0.98	<0.001*
Nasolabial angle	0.89	0.7	0.97	<0.001*	0.79	0.46	0.98	0.001*

In previous studies, overall skeletal changes in the mandible with AdvanSync2 were not statistically different from the control group (Jayachandran et al.,2016; Al-Jewair et al.,2012). In contrast to our study where significant retrusion and retroclination of the upper incisors were noted, Jayachandran et al.,2016 reported no significant maxillary dentoalveolar changes with the AdvanSync2. This could be attributed to variation in mechanics of fixed orthodontic appliances used. Mandibular dentoalveolar changes were consistent with previous studies, with AdvanSync2 patients exhibiting proclination of lower incisors (Al-Jewair et al.,2012). Previous studies on the Herbst and Jasper Jumper have shown similar results (Ruf et al.,1998, Schweitzer et al.,2001). Bavbek et al.,2016 showed that removable and fixed functional appliances increased oropharyngeal airway dimensions in patients. The airway dimensions were measured on a lateral cephalogram, an established tool in evaluation of the airway (Hanggi et al.,2008). A significant mean increase of airway dimensions was noted in the all the 3 parts of the airway. Relation of soft tissues and dentoalveolar structures to the lips and face are the main determinants of facial aesthetics. The AdvanSync2 favorably improved soft-tissue parameters. A reduction of 1.34mm upper lip length to TVL was noted in the study which could be attributed to retrusion of upper incisors, thus also correcting lip trap. Lower incisor proclination helped support the lower lip. Other studies also showed similar soft-tissue changes (Weiland et al.,1996). A study by Malta et al.,2010 discussed the importance of sagittal repositioning of the upper lip, in accordance with a linear change in position of soft tissue point A and soft tissue chin greater than 2.5mm when compared to control groups. On the contrary, Siara-Olds et al.,2010 in their study using Bionator, observed no significant difference in the soft tissues. Post-treatment ANB angle decreased favorably indicating a harmonious relationship of skeletal structures with soft tissues. This provided a well-balanced look in the nasomaxillary complex, in accordance with reduction in facial convexity. Our results were in line with the above-mentioned studies are comparable with a study conducted by Mofty et al.,2018 who found significant improvement in the profile of patients treated with AdvanSync2. Though the effects of the AdvanSync2 appliance are similar to other fixed functional appliances (Janson et al.,2018, Mofty et al.,2018) the greatest advantage is the ability to use the appliance from start of treatment without prior preparation of arches. This is beneficial in cases with minimal residual growth, where one can utilize the remaining growth potential could be tapped quickly. The AdvanSync2 Class II corrector could be a good alternative to conventional fixed appliance therapy with extractions in Class II patients with airway constriction.

CONCLUSION

The AdvanSync2 Class II corrector helped correct skeletal and dental Class II malocclusions to Class I efficiently. It is also important for orthodontists to assess airway dimensions in all patients prior to making treatment decisions, especially those involving extractions. The forward repositioning of the mandible improves airway dimensions in most cases.

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