

## Evaluation of Root Resorption and Tooth Inclination in Class II Malocclusion Patients Treated with Advansync2 Appliance – A CBCT Study

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### Abstract

The Advansync2 appliance is known as a tooth-borne fixed functional appliance consisting of bands cemented on permanent first molars in the upper and lower arches, to dissipate orthodontic forces. These fixed functional appliances could cause excessive proclination of the lower incisors, which could lead to inflammatory root resorption. Therefore, the purpose of this study was to evaluate the degree of root resorption and incisor tooth inclination changes in subjects with class II malocclusion who were treated with the Advansync2 appliance. 10 patients (6 males and 4 females) between the age group of 13-20 years with class II malocclusion treated with Advansync2 appliance were included. A CBCT of each of these patients was taken before and after the treatment with the Advansync2 appliance and evaluated for the amount of root resorption and tooth inclination in the mandibular incisor tooth region. The measurement of root resorption was made using the axial navigation method. Statistical analysis was done using SPSS software (version 22.0). A paired t-test was used to detect changes in the root length before and after the use of the Advansync2 appliance. Wilcoxon signed-rank test was used to compare the parameters of the angle of inclination as the data was not normally distributed. There was a statistically significant reduction of the mandibular anterior tooth roots by 0.52mm ( $p = 0.01$ ). The angle of inclination for the mandibular incisor region was reduced by 5.73° indicative of proclined incisors ( $p = 0.005$ ).

**Keywords:** Fixed Functional Therapy, Root Resorption, Tooth Inclination.

### Introduction

Class II malocclusion is defined as a condition resulting due to a prognathic maxilla, a retrognathic mandible or a combination of both. Orthodontic correction of class II malocclusion involves the use of various types of appliances which are either removable or fixed. The primary disadvantage of the former category of appliances is their high dependency on patient participation [1,2]. Due to noncompliance of the patient, alternate treatment strategies of functional appliances had been devised, broadly grouped as fixed functional appliances [3]. This maintains the mandible in a more forward position 24 hours a

day, thereby providing more stimulus for growth [4].

Taking advantage of pubertal growth is the optimal period for treatment with fixed functional appliances. Being a 24-h wear appliance, it produces rapid sagittal correction utilizing the short span of remaining growth to maximum advantage [5,6]. Among the many fixed functional appliances, Advansync appliance is a recent modification of the Herbst appliance, also known as Molar-to-Molar appliance. In 2008, Terry and Bill Dischinger designed the Advansync in collaboration with Ormco TM to treat skeletal class II malocclusion. The appliance was designed to advance the mandible to class I occlusion

within 6–9 months, while allowing simultaneous use of fixed orthodontic appliances. It is known as a fixed tooth-borne functional appliance, which consists of bands attached to permanent mandibular and maxillary first molars [7].

Fixed functional appliances have been associated with desired skeletal and such as mandibular growth stimulation, minor restriction of growth in the maxillary region along with major changes in the dentition and soft tissue [8]. Among these, the changes on the skeletal tissues were minor and clinically less significant [9,10].

Even though the appliance has been known to cause desired changes, it has its own limitations. Besides the common desired effects of functional appliance therapy like mandibular growth advancement, maxillary growth restriction and retroclination of maxillary incisors, there also occurs unwanted proclination of lower incisors [11]. Previous studies have stated that an excessive increase in the type and direction of orthodontic forces could lead to inflammatory root resorption

[12,13]. Hence the aim of this study was to assess the amount of root resorption and changes in incisor tooth inclination in class II malocclusion patients treated with Advansync2 appliance.

## Materials and Methods

### Study Population

This retrospective study was approved by the institutional review board of Saveetha Institute of Medical and Technical Sciences (SIMATS University), Chennai (Ethical clearance number: **IHEC/SDC/ORTHO-2101/23/035**). The G\*power software (version 3.1, Heinrich Heine University, Düsseldorf) was used to calculate the sample size. The study by Rekhawat et al. [14] served as a guide for determining the appropriate sample size. The estimated sample size was 10. The alpha level and power were set at 0.05 and 80%, respectively. Thus 10 patients (6 males, 4 females) between the age of 13 to 20 years with class II malocclusion were selected for the study (figure 1).



**Figure 1.** Advansync2 Appliance Therapy

## CBCT Procedure

CBCT of the 10 selected patients were taken before and after treatment with Advansync2 appliance and evaluated for the amount of root resorption and tooth inclination in the mandibular anterior teeth region. The CBCT data was exported in DICOM format to the Dolphin imaging software (version 11.95) and all the measurements were made digitally using the same.

## Measurement of Root Resorption

The measurement of root resorption was made using the axial navigation method as mentioned previously by Rekhawat et. al. The root length and tooth inclination were measured before and after treatment with Advansync2 appliance, for all the mandibular anteriors. The

measurements were standardised by measuring the height of each crown and the width of the cemento-enamel junction (CEJ) in the sagittal section (figure 2). The root length was measured from the apical point till the CEJ. Any reduction in the measurements after the therapy quantified the amount of resorption occurred.

## Measurement of Changes in Tooth Inclination

An angle generated between a tooth's long axis and the horizontal symphyseal baseline was used to quantify tooth inclination [15]. A line was drawn from the most convex surface of the symphysis connecting the outer and inner margins in the sagittal section. The angle between the long axis of the crown to this constructed line was used for measurement of tooth inclination.

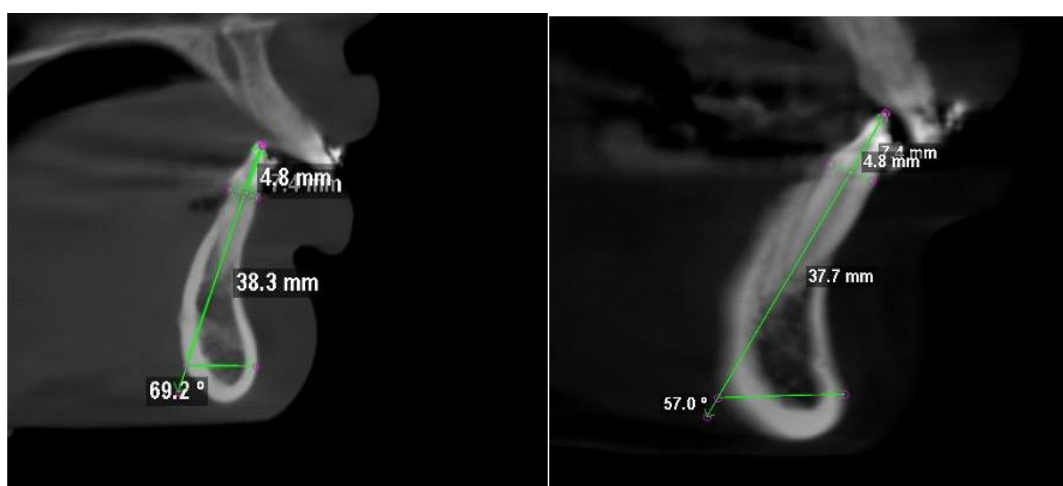


Figure 2. Root length and tooth inclination measurements using Dolphin software.

## Statistical Analysis

Statistical analysis was done using SPSS software (version 22.0). Paired t test was used to detect changes in the root length before and after the use of advansync2 appliance (Table 1). Wilcoxon signed-rank test was used to compare the changes of angle of inclination as the data was not normally distributed (Table 2).

## Results

There was a statistically significant reduction of the mandibular anterior teeth roots by 0.52mm. The angle of inclination for the mandibular incisor region was reduced by 5.73° indicative of proclined incisors. The results were statistically significant in relation to the changes in root length ( $p=0.01$ ) and angle of inclination ( $p=0.005$ ) (Table 1 and 2).

**Table 1.** Paired t-test

Paired t-test (Root length)	t	df	Sig. (2 tailed)
Before and after advansync2	4.894	9	0.001*

**Table 2.** Wilcoxon Signed-rank test

Angle of inclination of mandibular incisors	Before and after advansync
Z	-2.805
Asymp Sig. ( 2 tailed )	0.005*

## Discussion

Fixed functional appliance therapy is used for the treatment of class II patients, especially in their post adolescent phase, where the growth is mostly completed. Hence dentoalveolar changes take place predominantly rather than skeletal changes [16]. Despite the desired dentoalveolar effects caused by these appliances, there has been a major disadvantage of excessive proclination of the lower incisors. According to a systematic evaluation, most incisors with treated Class II division 1 malocclusions had mild to moderate OIIR [17]. Previous research has also demonstrated that there could be alveolar bone loss and successive loss of tooth in case of severe inclination of incisors buccally or lingually [18]. Rekhawat et. al found that use of forsus appliance led to decrease in root thickness especially in the apical region. Resorption was found to be more extensive when the root surface approximated the cortical bone [14]. Thus, in the current study, an effort was made to assess the changes in the root length and

incisor tooth inclination in class II malocclusion patients treated with Advansync appliance. Root resorption varied between different types of fixed functional appliances used [19]. A CBCT study on the impact of using Powerscope and Forsus was reported by Narendran et al. Based on the study findings, all maxillary first molars and mandibular anteriors showed a significant reduction in the root length as well as the root surface area in the usage of both the appliances ( $p=0.001$ ). Similarly, Schwartz et. al, in a three-dimensional study, correlated root resorption to the anchoring teeth in patients treated with Herbst appliances, but the results were not statistically significant. The root resorption caused in the above-mentioned research was suspected to be due to continuous forces delivered onto the teeth. Singla et. al also stated that resorption occurred more in the mandibular incisor teeth due to lesser surface area of the roots. The impact on the mandibular laterals were more as the force got dissipated as it passed towards the central incisors [20]. Nasiopoulos et. al demonstrated a significantly

higher degree of root resorption in the 1st premolar region which served as the anchor teeth following Herbst appliance therapy, though there weren't any significant changes in the root surface morphology of the 1st and 2nd premolars [21]. The present study evaluated the changes in root length due to root resorption that occurred in the lower anterior teeth due to the usage of Advansync2 appliance. Based on the changes in root length, there was a statistically significant decrease in the root length post fixed functional appliance therapy. Hence the mandibular anterior teeth were subjected to orthodontic root resorption after the treatment with the Advansync2 appliance. The greatest change was seen in the mandibular lateral incisor teeth with a statistically significant difference ( $p=0.001$ ). These findings were similar to the findings of the previous studies which assessed root resorption. The changes in the tooth inclinations were also measured before and after treatment and the results stated a statistically significant difference thereby depicting an increase in the inclination of the mandibular anterior teeth ( $p=0.005$ ). These findings were in accordance with the previous study by [18]. Hence the use of Advansync2 appliance for correction of class II malocclusions could also lead to root resorption and increased inclination of the mandibular anteriors.

## **Limitations**

Use of a smaller sample size in the present study was one of this research's limitations. The study also could not have a control group as class II patients had to be left untreated and had to be involved in the study.

## **Conclusion**

This study stated that the use of an Advansync2 appliance caused a significant reduction in the length of the roots and an increase in incisor proclination post-treatment. Hence the duration of treatment and direction of force during fixed functional therapy played an indispensable role in determining the extent of root resorption. Confirmatory findings are needed to come from further research with a larger sample size and inclusion of other important skeletal and dental parameters.

## **Conflict of Interest**

None.

## **Acknowledgement**

None.

## References

1. Vaid NR, Doshi VM, Vandekar MJ. Class II treatment with functional appliances: A meta-analysis of short-term treatment effects. *Seminars in Orthodontics* [Internet]. 2014 Dec;20(4):324–38. Available from: <http://dx.doi.org/10.1053/j.sodo.2014.09.008>
2. Functional Appliances in The Treatment and Management of Mandibular Retrognathism - A Literature Review. *International Journal of Pharmaceutical Research* [Internet]. 2020 Nov 2;12(02). Available from: <http://dx.doi.org/10.31838/ijpr/2020.12.02.375>.
3. Weiland, F. J., & Bantleon, H.-P., 1995, Treatment of Class II malocclusions with the Jasper Jumper appliance—a preliminary report, *American Journal of Orthodontics and Dentofacial Orthopedics*, 108(4), 341–350. [https://doi.org/10.1016/s0889-5406\(95\)70031-5](https://doi.org/10.1016/s0889-5406(95)70031-5)
4. Moro, A., Borges, S. W., Spada, P. P., Morais, N. D., Correr, G. M., Chaves Jr., C. M., & Cevidanes, L. H. S., 2018, Twenty-year clinical experience with fixed functional appliances, *Dental Press Journal of Orthodontics*, 23(2), 87–109. <https://doi.org/10.1590/2177-6709.23.2.087-109.sar>.
5. Ritto, A. K., & Ferreira, A. P., 2000, Fixed functional appliances—a classification. *The Functional orthodontist*, 17(2), 12–32.
6. Akriti Tiwari, Ravindra Kumar Jain, Remmiya Mary Varghese. A Survey To Evaluate Patients' Acceptance To Various Fixed Functional Appliance. *International Journal of Research in Pharmaceutical Sciences* [Internet]. 2020 Dec 25;11(SPL4):876–80. Available from: <http://dx.doi.org/10.26452/ijrps.v11ispl4.4100>
7. Chitra, P., Negi, G., Thushar, B. K., & Verma, S., 2023, Treatment Outcomes in the Sagittal and Vertical Dimensions with the AdvanSync2 Class II Corrector—A Case Series, *Journal of Contemporary Orthodontics*, 2(3), 38–50, CLOCKSS, <https://doi.org/10.18231/j.jco.2018.028>.
8. Subramanian A, Varghese R, Sreenivasagan S. Comparison of dentoskeletal changes in skeletal class II cases using two different fixed functional appliances: Forsus fatigue resistant device and powerscope class II corrector—A clinical study. *Journal of International Oral Health* [Internet]. 2021;13(3):234. [http://dx.doi.org/10.4103/jioh.jioh\\_246\\_20](http://dx.doi.org/10.4103/jioh.jioh_246_20).
9. Rajamanickam P, Sundari KKS. Fixed Functional Appliance Therapy With and Without Skeletal Anchorage in Class II Malocclusion: A Systematic Review of Randomized Controlled Trials. *Journal of Advanced Oral Research* [Internet]. 2023 Aug 13;14(2):101–9. Available from: <http://dx.doi.org/10.1177/23202068231190199>
10. Zymperdikas, V. F., Koretsi, V., Papageorgiou, S. N., & Papadopoulos, M. A., 2015, Treatment effects of fixed functional appliances in patients with Class II malocclusion: a systematic review and meta-analysis, *The European Journal of Orthodontics*, 38(2), 113–126. <https://doi.org/10.1093/ejo/cjv034>.
11. Ponnamma, S., Reddy, G., Muddaiah, S., Somaiah, S., & Shetty, B., 2023, An evaluation of dentofacial changes in Angle's class II division 1 patients using AdvanSync 2, *Journal of Orthodontic Science*, 12(1), 17. [https://doi.org/10.4103/jos.jos\\_44\\_22](https://doi.org/10.4103/jos.jos_44_22).
12. Dindaroglu, F., & Dogan, S., 2017, Root Resorption in Orthodontics, *Turkish Journal of Orthodontics*, 29(4), 103–108. <https://doi.org/10.5152/turkjorthod.2016.16021>.
13. Parker, R. J., & Harris, E. F., 1998, Directions of orthodontic tooth movements associated with external apical root resorption of the maxillary central incisor, *American journal of orthodontics and dentofacial orthopedics: official publication of the American Association of Orthodontists, its constituent societies, and the American Board of Orthodontics*, 114(6), 677–683. [https://doi.org/10.1016/s0889-5406\(98\)70200-8](https://doi.org/10.1016/s0889-5406(98)70200-8).
14. Rekhawat, A., Durgekar, S. G., & Reddy, S., 2020, Evaluation of Root Resorption, Tooth Inclination and Changes in Supporting Bone in Class II Malocclusion Patients Treated with Forsus Appliance, *Turkish journal of orthodontics*, 33(1), 21–30. <https://doi.org/10.5152/TurkJOrthod.2020.19037>.

15. Nguyen, T., Cevidanes, L., Franchi, L., Ruellas, A., & Jackson, T., 2018, Three-dimensional mandibular regional superimposition in growing patients, *American Journal of Orthodontics and Dentofacial Orthopedics*, 153(5), 747–754. <https://doi.org/10.1016/j.ajodo.2017.07.026>.
16. Basavaraddi, S., Gandedkar, N. H., Belludi, A., & Patil, A., 2016, Correction of an adult Class II division 2 individual using fixed functional appliance: A noncompliance approach, *Contemporary clinical dentistry*, 7(1), 82–86. <https://doi.org/10.4103/0976-237X.177114>.
17. Tieu, L. D., Saltaji, H., Normando, D., & Flores-Mir, C., 2014, Radiologically determined orthodontically induced external apical root resorption in incisors after non-surgical orthodontic treatment of class II division 1 malocclusion: a systematic review, *Progress in orthodontics*, 15(1), 48. <https://doi.org/10.1186/s40510-014-0048-7>.
18. Wainwright W. M., 1973, Faciolingual tooth movement: its influence on the root and cortical plate, *American journal of orthodontics*, 64(3), 278–302. [https://doi.org/10.1016/0002-9416\(73\)90021-3](https://doi.org/10.1016/0002-9416(73)90021-3).
19. Priyanka, & Yagyeshwar Malhotra, 2021, Comparative Evaluation of Root Resorption in Correction of Class II Malocclusion, *International Healthcare Research Journal*, 4(11), OR7–OR13. <https://doi.org/10.26440/ihrj/0411.02393>.
20. Singla, Anu & Batra, Puneet & Sonar, Saurabh, 2019, Effect of class ii treatment with hybrid fixed functional appliance on foot length and root volume - A prospective study using CBCT, *International Journal of Scientific Research*, 8, 28-31.
21. Nasiopoulos, A. T., Athanasiou, A. E., Papadopoulos, M. A., Kolokithas, G., & Ioannidou, I., 2006, Premolar Root Changes Following Treatment with the Banded Herbst Appliance, *Journal of Orofacial Orthopedics / Fortschritte Der Kieferorthopädie*, 67(4), 261–271. <https://doi.org/10.1007/s00056-006-0607-8>.