

# Influence of Invisalign's Precision Bite Ramp Position on Deep Bite Correction and Root Length

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*2022 Research Aid Awards (RAA)*

***Dr. Fatemah A. A. M. Husain***

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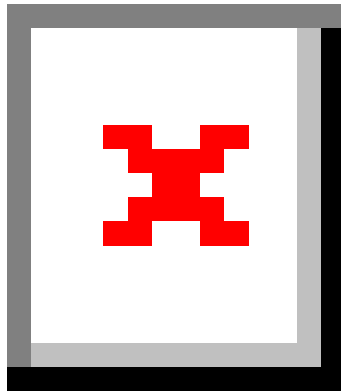
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# FollowUp Form

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## *Award Information*

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*In an attempt to make things a little easier for the reviewer who will read this report, please consider these two questions before this is sent for review:*

- Is this an example of your very best work, in that it provides sufficient explanation and justification, and is something otherwise worthy of publication? (We do publish the Final Report on our website, so this does need to be complete and polished.)*
- Does this Final Report provide the level of detail, etc. that you would expect, if you were the reviewer?*

### **Title of Project:\***

Influence of Invisalign's Precision Bite Ramp Position on Deep Bite Correction and Root Length

### **Award Type**

Research Aid Award (RAA)

## Period of AAOF Support

July 1, 2022 through June 30, 2023

## Institution

University at Buffalo

## Names of principal advisor(s) / mentor(s), co-investigator(s) and consultant(s)

Thikriat Al-Jewair, Stephen Warunek, Ashish Gurav

## Amount of Funding

\$5,000.00

## Abstract

(add specific directions for each type here)

**Introduction:** Deep overbite is a common malocclusion, representing 15 to 20% of the US population. Treating deep bites with aligners has been perceived as more difficult due to the patient's natural biting forces aiding in posterior intrusion. Clear aligner therapy (CAT) is one of the proposed treatment modalities used for deep bite correction. Invisalign, initially introduced the G5 protocol to correct deep bites and recently introduced the G8 protocol for a more predictable deep bite correction. With CAT, there is no wait time necessary to level the curve of Spee with mandibular incisor intrusion. This is in contrast to multi-edgewise fixed appliances, where the clinician typically waits until some initial leveling and aligning is achieved before placing the reverse curve arch wires. Bracket interferences can also cause delays in leveling the curve of Spee with fixed appliances. Studies on the Invisalign G5 protocol showed that it is effective in correcting skeletal deep bite, possibly due to precision bite ramps (equivalent of bite turbos) which allow for dis-occlusion in the posterior teeth resulting in more buccal extrusion than would have otherwise been possible. Yet, precision bite ramp placement varies among clinicians for speech articulation reasons or personal preferences. To our knowledge, there is no established protocol for the placement of precision bite ramps and no available evidence exploring the influence of precision bite ramp position on treatment outcomes. One of the most undesirable side effects of orthodontic treatment is orthodontically induced external apical root resorption (EARR). Multiple factors can be associated with EARR. These include the amount of tooth movement, magnitude and type of force applied to the tooth, and treatment duration. Intrusion in particular has been associated with higher risk of EARR and the type of appliance used can also be a factor. Objective evidence is thus needed to evaluate the true skeletal and dental effects of bite opening mechanics using clear aligners according to precision bite ramp placement and accounting for treatment duration. **Aims:** This study will answer two questions: 1) "Is there a correlation between precision bite ramp position and skeletal deep bite correction in adults?", and 2) "Is there a correlation between precision bite ramp position and root length of anterior teeth when assessed according to treatment duration?". The primary objective of this study is to assess the influence of precision bite ramp position on skeletal deep bite correction and root length in adults. As a secondary objective, the study will evaluate the accuracy of deep bite correction with clear aligners.

**Hypotheses:** We hypothesize that precision bite ramp location does not influence the amount of skeletal deep bite correction achieved and root length of maxillary and mandibular anterior teeth in adults. We also hypothesize that ClinCheck predications will not be an accurate predictor for the final treatment outcome.

**Methods:** This is a retrospective comparative study of 150 adults with skeletal deep bites, 120 of which were treated with clear aligners (Invisalign, Align Technology, San Jose, CA), while the remaining 30 were treated with full fixed appliances. Patients treated with Invisalign will be divided into 4 groups (n=30 per group) depending on the presence and location of precision bite ramps. The samples will be compared to 30 skeletal deep-bite patients treated with full fixed appliances, in which mechanics involve using reverse curve of Spee wires in the mandibular arch. Cone Beam Computed Tomography (CBCT) records at two timepoints: T1 (initial records) and T2 (final records after finishing orthodontic treatment) will be used to measure the amount of intrusion, in mm, in mandibular and maxillary incisors, root length (mm), root volume (mm<sup>3</sup>), percentage of root volume loss (%), and treatment outcome accuracy, along with 8 skeletal, 9 dental, and 3 soft tissue variables. All study procedures will be conducted by one investigator.

**Clinical implications:** Finding of this study will have a significant impact on the treatment planning decisions made to correct deep overbite with aligners. The findings will affect the clinician's choice for treatment modality, i.e, CAT vs. Fixed functional appliances. This can be significant when treating patients who present for treatment for the first time with existing risk factors for EARR. The findings may also provide recommendations for precision bite ramp locations when planning the Clincheck to achieve the best treatment outcome.

## *Respond to the following questions:*

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### **Detailed results and inferences:\***

If the work has been published, please attach a pdf of manuscript below by clicking "Upload a file".

**OR**

Use the text box below to describe in detail the results of your study. The intent is to share the knowledge you have generated with the AAOF and orthodontic community specifically and other who may benefit from your study. Table, Figures, Statistical Analysis, and interpretation of results should also be attached by clicking "Upload a file".

Detailed results and inferences Fatemah Husain.pdf

**Title:** Influence of Invisalign's Precision Bite Ramps on Deep Bite Correction and Root Length in Adults

**Introduction:** Deep overbite is a common malocclusion, representing 15 to 20% of the US population.

Treating deep bites with aligners has been perceived as more difficult due to the patient's natural biting force aiding in posterior intrusion. The Invisalign® G5 protocol was found to be effective in correcting skeletal deep bite. However, there's no evidence in the literature that Invisalign® G8 protocol is more effective.

Furthermore, to our knowledge, there is no established protocol for the placement of precision bite ramps and no available research analyzing the influence of precision bite ramp position on treatment outcomes and any resulting root resorption. Objective evidence is thus needed to evaluate the true skeletal and dental effects of bite opening mechanics using Invisalign® according to precision bite ramp utilization and accounting for treatment duration.

**Objectives:** The objectives of this study were to assess the influence of precision bite ramp use on skeletal deep bite correction and root length of maxillary anterior teeth in adults.

**Methods:** This is a retrospective comparative study of 60 adults with skeletal deep bites treated with clear aligners (Invisalign®, Align Technology, San Jose, CA). Patients treated with Invisalign® will be divided into 2 groups, depending on the presence of precision bite ramps. The samples were compared to 26 skeletal deep-bite patients treated with full fixed appliances, in which mechanics involves using reverse curve of Spee wires in the mandibular arch. Cone Beam Computed Tomography (CBCT) records at two timepoints: T1 (initial records) and T2 (final records after finishing orthodontic treatment) were used to measure maxillary anterior teeth root length (mm), root volume (mm<sup>3</sup>) along with 8 skeletal, 9 dental, and 3 soft tissue variables.

**Results:** The mean age of the FFA group was 23.2 ± 6.46 years and for the IBR and INBR groups was 38.20 ± 13.74 years and 39.06 ± 15.62 years, respectively. Significant changes from T-T2 between the three groups

were seen in ANB, lower face %, ODI, and upper incisor proclination. The change in ODI from T1-T2 was 2.65°, 1.5°, 3.55° for the FFA, INBR, and IBR groups, respectively. The overbite reduced in T2 when compared to T1 by 3.1 mm, 3.8 mm, and 3 mm, for the FFA, INBR, and IBR groups respectively. Both changes in ODI and overbite were not statistically significant between groups. Reduction in root length was significantly higher in the FFA group when compared to both INBR and IBR groups ( $p < 0.001$ ). Reduction in root volume change between T1 and T2 was statistically significant between the two Invisalign groups with more reduction in the INBR group. Treatment duration was significantly shorter in the IBR group when compared with the FFA group ( $p = 0.009$ ).

Conclusion: Overbite correction with CAs, with or without bite ramps, is comparable to treatment with fixed appliances. Treatment of deep overbite with CAs resulted in significantly less reduction in root length when compared to fixed appliances. Treatment duration for deep overbite correction was significantly shorter with CAs when compared to fixed appliances.

Keywords: Clear aligner therapy, Invisalign, deep bite, root resorption

### Were the original, specific aims of the proposal realized?\*

No. Due to the small sample size in the Invisalign with bite ramps group. It was statistically not possible to study the correlation between the location of the bite ramp and amount of root resorption. Thus, we decided to compare only three groups ( Invisalign with bite ramps regardless of the bite ramp location, Invisalign without bite ramps, and Fixed appliances without bite ramps). Other aims of the studies were realized.

### Were the results published?\*

No

### Have the results of this proposal been presented?\*

No

### To what extent have you used, or how do you intend to use, AAOF funding to further your career?\*

I used the funding provided by AAOF to purchase the software used to analyze data in this research project.

### Accounting: Were there any leftover funds?

\$250.00

## *Not Published*

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Are there plans to publish? If not, why not?\*

Yes

## *Not Presented*

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Are there plans to present? If not, why not?\*

Yes, I intend to present the findings of this research project at NESO Annual Meeting 2023 in Montreal.

## *Internal Review*

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Reviewer comments

Reviewer Status\*

## File Attachment Summary

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### *Applicant File Uploads*

- Detailed results and inferences Fatemah Husain.pdf

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**Introduction:** Deep overbite is a common malocclusion, representing 15 to 20% of the US population. Treating deep bites with aligners has been perceived as more difficult due to the patient's natural biting force aiding in posterior intrusion. The Invisalign® G5 protocol was found to be effective in correcting skeletal deep bite. However, there's no evidence in the literature that Invisalign® G8 protocol is more effective. Furthermore, to our knowledge, there is no established protocol for the placement of precision bite ramps and no available research analyzing the influence of precision bite ramp position on treatment outcomes and any resulting root resorption. Objective evidence is thus needed to evaluate the true skeletal and dental effects of bite opening mechanics using Invisalign® according to precision bite ramp utilization and accounting for treatment duration.

**Objectives:** The objectives of this study were to assess the influence of precision bite ramp use on skeletal deep bite correction and root length of maxillary anterior teeth in adults.

**Methods:** This is a retrospective comparative study of 60 adults with skeletal deep bites treated with clear aligners (Invisalign®, Align Technology, San Jose, CA). Patients treated with Invisalign® will be divided into 2 groups, depending on the presence of precision bite ramps. The samples were compared to 26 skeletal deep-bite patients treated with full fixed appliances, in which mechanics involves using reverse curve of Spee wires in the mandibular arch. Cone Beam Computed Tomography (CBCT) records at two timepoints: T1 (initial records) and T2 (final records after finishing orthodontic treatment) were used to measure maxillary anterior teeth root length (mm), root volume (mm<sup>3</sup>) along with 8 skeletal, 9 dental, and 3 soft tissue variables.

**Results:** The mean age of the FFA group was  $23.2 \pm 6.46$  years and for the IBR and INBR groups was  $38.20 \pm 13.74$  years and  $39.06 \pm 15.62$  years, respectively. Significant changes from T1-T2 between the three groups were seen in ANB, lower face %, ODI, and upper incisor proclination. The change in ODI from T1-T2 was  $2.65^\circ$ ,  $1.5^\circ$ ,  $3.55^\circ$  for the FFA, INBR, and IBR groups, respectively. The overbite reduced in T2 when compared to T1 by 3.1 mm, 3.8 mm, and 3 mm, for the FFA, INBR, and IBR groups respectively. Both changes in ODI and overbite were not statistically significant between groups. Reduction in root length was significantly higher in the FFA group when compared to both INBR and IBR groups ( $p < 0.001$ ). Reduction in root volume change between T1 and T2 was statistically significant between the two Invisalign groups with more reduction in the INBR group. Treatment duration was significantly shorter in the IBR group when compared with the FFA group ( $p = 0.009$ ).

**Conclusion:** Overbite correction with CAs, with or without bite ramps, is comparable to treatment with fixed appliances. Treatment of deep overbite with CAs resulted in significantly less reduction in root length when compared to fixed appliances. Treatment duration for deep overbite correction was significantly shorter with CAs when compared to fixed appliances.

**Keywords:** Clear aligner therapy, Invisalign, deep bite, root resorption