



COMPARISON OF APICAL ROOT RESORPTION IN PATIENTS WITH MAXILLARY ANTERIOR INTRUSION USING TWO AND SINGLE MICRO IMPLANT PLACEMENT

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ABSTRACT

Introduction: Orthodontic treatment with mini implant skeletal anchorage system has become increasingly popular in the recent times and very few literature compare effects of different types of incisor intrusion mechanics and apical resorption associated with it. In this study we compare apical root resorption in orthodontic patients with maxillary anterior intrusion using one mini implant and two mini implant placement in patients with gingival smile.

Aim: To compare the amount of root resorption during anterior intrusion using one implant and two implants in patients with gingival smile

Objectives:

- To evaluate the amount of root resorption during anterior intrusion using single mini implant.
- To evaluate the amount of root resorption during anterior intrusion using two mini implants.
- To compare the amount of root resorption during anterior intrusion using single implant and two implants.

Method

- The sample size included 14 patients which were further divide into two Groups . The Group A consist of 7 patients and Group B consist of 7 patients.
- For both Group A and Group B conventional orthodontic mechanics were employed using 3M UNITEK MBT 0.022inch slot brackets .
- For both the Groups initial levelling and aligning was performed by using 0.016 inch NiTi arch wire followed with 17 x 25 NiTi and 19 x 25 NiTi and then to 19 x 25 stainless steel wire.
- 0.019 x 0.025-inch stainless steel arch wire was placed for intrusion of upper anteriors with the help of mini implants by placing single implant in Group A below the anterior nasal spine and in Group B mini implants were placed bilaterally between lateral incisor and canine.
- Before placement of mini implants pre-treatment study models, photographs and RVG (T0) were taken. RVG was taken using the paralleling technique for standardization of the angulation, paralleling technique is accomplished by placing the receptor parallel to the long axis of the tooth .
- In Group A mini implant was place on the Anterior nasal spine (ANS) and were attached from the mini implant to the arch wire with the help of E-chain with 90 gms force and was checked using the Correx tension gauge.
- In Group B mini implants were placed between distal to lateral incisors, ie, between upper lateral incisors an canine on both side of the dentition and are attached to the arch wire with the help of E-chain, similarly the forces given is checked using Correx tension gauge.
- After 6 months of intrusion post treatment (T1) study models, photographs and RVG was taken.
- The amount of root resorption was analysed by the help of VixWin Platinum – KaVo version 3.5 software by comparing the pre treatment and post treatment length of both central incisor and lateral incisor lengths from the incisal edge of the tooth to the tip of the apex. The differences were noted for evaluating amount of apical root resorption that has occurred.

Results: The results from the RVG study showed intrusion was highly significant in patients with deep bite and gingival smile. Linear measurements used for the study were subjected to statistical analysis using the Wilcoxon signed rank test to check the treatment changes. Initial and the post treatment root resorption was calculated with the help of RVG and the results showed intra Group values were statistically significant and inter Group results were non-significant.

Conclusion: The present study showed root resorption is over 1 mm, being positively related to the amount of intrusion with no significant differences between cases treated with one or two mini implants ; it ceases at the end of active treatment. Stability is satisfactory when using either one or two mini screws.

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INTRODUCTION

Deep bite is one of the most difficult malocclusions to treat. The treatment is further complicated because of the potential negative effects it can have on the teeth and surrounding periodontal tissues. Nonsurgical treatment strategies are focused on either intrusion of anterior teeth or extrusion of posterior teeth, or both. The choice depends on various factors such as incisor display at rest and smile, inter occlusal space and vertical dimension.¹

Intrusion of anterior teeth is often the most preferred way of deep bite correction, especially in patients with deep bite and excessive gingival display resulting in gingival smile. Absolute intrusion of the maxillary incisors is required rather than extrusion of molars. Maxillary incisor intrusion should be achieved with minimum side effects and cooperation of the patient. Some methods of Deep bite correction include the use of high pull headgear, Burstone's intrusion arch, and J-pull headgear etc. However, intruding the incisors requires complex arch wire bending adjustments to prevent undesirable side effects such as extrusion and flaring of posterior teeth.²

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In Orthodontics, External Apical root resorption is seen as a biological response to an orthodontic force. Massler and Malone¹ (1954) stated that root resorption occurs in 100 per cent of orthodontic patients. Apical root resorption observed mid or post treatment is occasionally of passing interest to the clinician and usually of little importance as it is rare to encounter truly severe resorption that threatens the longevity of the tooth or forces a halt to treatment.

The fact is, however, that orthodontic tooth movement does directly cause irreversible resorption of the root. Recently, there has been more interest in using mini implant as a source of absolute anchorage devices.

Aim and Objectives

Aim

- To compare the amount of apical root resorption during anterior intrusion with one implant and two implants.

Objectives

- To evaluate the amount of root resorption during anterior intrusion using single mini implant.
- To evaluate the amount of root resorption during anterior intrusion using two mini implants.
- To compare the amount of root resorption during anterior intrusion using single implant and two implants.

MATERIALS AND METHOD

Materials

Clinical Study

Patients between the age 18 to 28 years reported to the Department Of Orthodontics and Dentofacial Orthopaedics, Yenepoya Dental College, Mangalore for treatment of malocclusion and requiring intrusion of anterior teeth accordingly are selected for the case.

Inclusion Criteria

- Patients with overbite more than 3mm.
- Gingival display more than 4 mm at smiling.
- Patient in the age Group of 18-28 years.

Exclusion Criteria

- Patients with cleft lip and palate.
- Medically compromised patients.
- Patients with active periodontitis.
- Uncooperative patient.
- Long term use of antibiotic, cyclosporine, anti-inflammatory drugs etc

All patients were explained about the treatment procedure before the commencement of the treatment and patient information sheet was given. Patients consent was taken prior to the placement of mini implant.

Patients Records

After patient selection, routine records such as detailed case history, pre-treatment study models, photographs, lateral cephalograms, orthopantomograms, and intra oral periapical radiographs of all patients were acquired.

Armamentarium

1. MBTVersatile + bracket prescription (3M Unitek)
2. Orthodontic mini implant (1.4mm x 8 mm)
3. Implant driver
4. 0.019x 0.025- inch SS wire
5. Closed coil spring/ E-Chain
6. Study models
7. Correx tension gauge
8. Topical anaesthetic spray
9. Chlorhexidine mouth wash



Implant Driver



MBT Bracket Kit



Bonding Materials



Light Cure Unit



Correx Tension Gauge



E - Chain



Titanium Mini Implant



Pre Intrusion – Group A



Post Intrusion – Group A



Pre Intrusion – Group B



Post Intrusion – Group B

METHODOLOGY

- After obtaining ethical clearance for study, from Yenepoya University Ethical committee (YEC 2), the study was initiated.
- The sample size included 14 patients which were further divide into two Groups. The Group A consist of 7 patients and Group B consist of 7 patients.
- For both Group A and Group B conventional orthodontic mechanics were employed using MBT 0.022inch slot brackets.
- For both the Groups initial levelling and aligning was performed by using 0.016 inch NiTi arch wire followed with 0.017 x 0.025 NiTi and 0.019 x 0.025 NiTi and then to 0.019 x 0.025 stainless steel wire.
- 0.019 x 0.025 inch stainless steel arch wire was placed for intrusionof upper anteriors with the help of mini implants by placing single implant in Group A below the anterior nasal spine and in Group Bmini implants

were placed bilaterally between lateral incisor and canine bilaterally.

- Mini implant of dimension 1.4 x 8 mm was selected and pre-treatment study models, photographs and RVG (T0) were taken before the implant placement. RVG was taken using the paralleling technique for standardization of the angulation, paralleling technique is accomplished by placing the receptor parallel to the long axis of the tooth .
- In Group A mini implant was placed on the Anterior nasal spine (ANS) and was attached from the mini implant to the arch wire with the help of E-chain with 90 gms force and was measured using the Correx tension gauge.
- In Group B mini implants were placed between distal to lateral incisors, ie, between upper lateral incisors an canine on both side of the dentition and are attached to the arch wire with the help of E-chain, similarly the forces given is measured using Correx tension gauge.
- After 6 months of intrusion (T1) study models, photographs and RVG was taken.
- The amount of root resorption was analysed with the help of VixWin Platinum – KaVo version 3.5 software by comparing the pre treatment and post treatment length of both central incisor and lateral incisor lengths from the incisal edge of the tooth to the tip of the apex. The differences were noted for evaluating amount of apical root resorption that has occurred.

Immediate Loading

- Mini implants were immediately loaded with E-chain for intrusion.
- Each mini implant were loaded with a force of 90 grams and the force was checked with a Correx tension gauge.

Collection of Data

- Before intrusion mechanics was initiated, records were taken in the form of radiographs: Lateral Cephalogram, OPG, and IOPA.
- Same method was used at the end of 6 months to measure the amount of intrusion.

Measurement of Root Resorption

- Amount of root resorption was analysed with the help of VixWin platinum – KaVo version 3.5 software* .
- It was done by comparing the pre-treatment and post treatment length of both central incisor and lateral incisor lengths from the incisal edge of the tooth to the tip of the apex.
- The difference was noted for understanding the amount of apical root resorption that had occurred.

Assessment of Implant Stability

Implant stability was assessed clinically and with IOPA radiographs taken at the end of intrusion to check for movement or tipping of the implant under the orthodontic load.

RESULTS

This study compared the amount of root resorption during anterior intrusion by single implant and two mini implants placement. After 6 months of intrusion, post treatment study

models, photographs and RVG were taken and evaluated. The amount of root resorption was analyzed with VixWin software. Wilcoxon signed rank test was used to compare pre and post treatment changes within Groups. Mann-Whitney U test was used to compare pre and post treatment changes between Groups. P value ≤ 0.05 was considered to be statistically significant.

Table 1 Intragroup Comparison of Group A

	Mean	Standard Error Of Mean	Standard Deviation	Median
RIGHT CI LENGTH – BASELINE(T0)	24.186	0.210	0.558	24.2
RIGHT CI LENGTH - 6 MONTHS(T1)	23.300	0.205	0.544	23.80
RIGHT LI LENGTH – BASELINE(T0)	20.901	0.385	1.019	21.10
RIGHT LI LENGTH - 6 MONTHS(T1)	20.015	0.362	0.959	20.20

	Right CI Length 6 Months - Baseline	Right LI Length 6 Months - Baseline
Z	-2.456 ^b	-2.456 ^b
P value	.014*	.014*

*significant at p≤0.05

Interpretations

Maxillary Right Central Incisor Intrusion

The mean pretreatment right CI Length measurements (24.186 ± 0.558) were compared to the mean post treatment right CI Length measurements (23.3 ± 0.544) using Wilcoxon signed rank test. Upper right central Incisor length at baseline was found to be significantly different from that at 6 months (P Value = **0.014***).

The P value ≤ 0.05 which was considered to be Statistically Significant.

Maxillary Right Lateral Incisor Intrusion

The mean pretreatment right LI length measurements (20.901 ± 1.0198) were compared to the mean post treatment right LI length measurements (20.0157 ± 0.959) using Wilcoxon signed rank test. Upper right lateral incisor length at baseline was found to be significantly different from that at 6 months (P Value = **0.014***). The P value ≤ 0.05 which was considered to be statistically significant.

Table 2 Intragroup Comparison of Group B

	Mean	Standard Error of Mean	Standard Deviation	Median
Right CI Length – Baseline(T0)	23.371	0.453	1.199	23.5
Right CI Length - 6 Months(T1)	22.500	0.433	1.146	22.4
Right LI Length – Baseline(T0)	20.530	0.418	1.106	20.1
Right LI Length - 6 Months (T1)	19.672	0.399	1.058	19.4

*significant at p≤0.05

	Right CI Length 6 Months - Baseline	Right LI Length 6 Months - Baseline
Z	-2.375 ^b	-2.379 ^b
P value	.018*	.017*

Interpretations

Maxillary Right Central Incisor Intrusion

The mean pretreatment right CI length measurements (23.371 ± 1.199) were compared to the mean post treatment right CI length measurements (22.5 ± 1.146) using Wilcoxon signed rank test. Upper right central incisor length at baseline was found to be significantly different from that at 6 months (P Value = 0.018*). The P value ≤ 0.05 which was considered to be statistically significant.

Maxillary Right Lateral Incisor Intrusion

The mean pretreatment right LI length measurements (20.53 ± 1.106) were compared to the mean post treatment right LI length measurements (19.672 ± 1.058) using Wilcoxon signed rank test. Upper right lateral incisor length at baseline was found to be significantly different from that at 6 months (P Value = 0.017*). The P value ≤ 0.05 which was considered to be statistically significant.

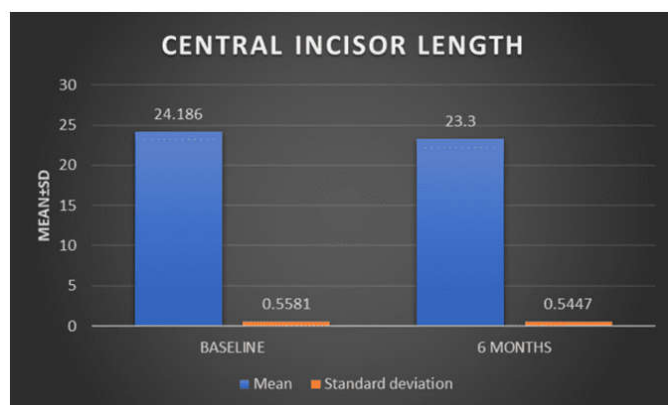
Table 3 Intergroup Comparison of Group A And Group B

	Group - A	Group - B	Mann Whitney U- Test	Z	P Value
• Right Central Incisor	23.30 (0.5447)	22.500 (1.1460)	13.5	-1.409	0.159
• Right Lateral Incisor	20.015 (0.959)	19.672 (1.058)	19.0	-0.703	0.482

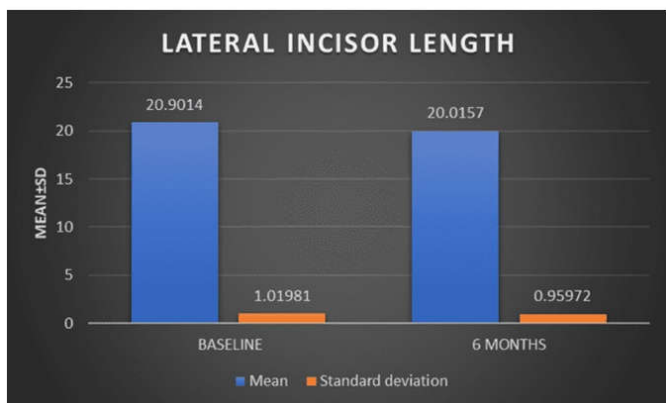
*significant at p≤0.05

Interpretations

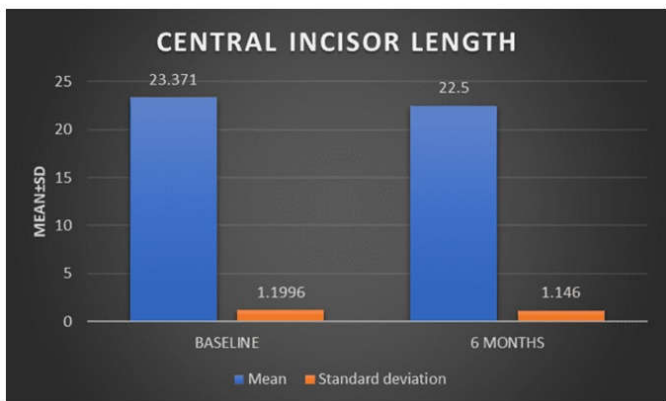
- Mann-Whitney U test was used to compare pre and post treatment changes between Groups - (Intergroup comparison)
- The mean difference between right CI length of Group A and Group B was found to be Statistically Insignificant. (P value = 0.159)
- The mean difference between right LI length of Group A and Group B was found to be Statistically Insignificant. (P value = 0.482)



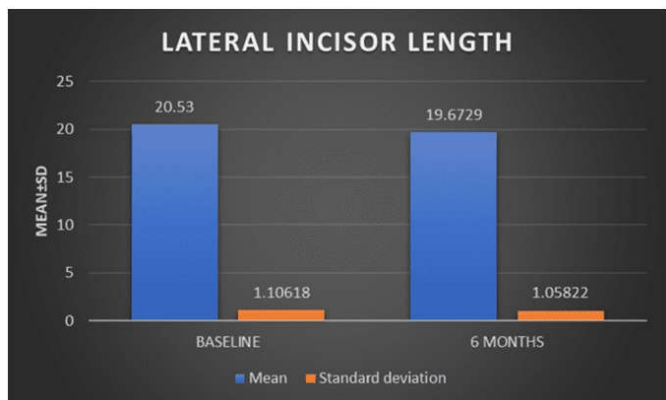
Graph 1: Intragroup Comparison of Mean Ci Length In Group A



Graph 2: Intragroup Comparison of Mean Li Length In Group A.



Graph 3: Intragroup Comparison of Mean Ci Length In Group B



Graph 4 Intragroup Comparison of Mean Li Length In Group B

DISCUSSION

Incisor intrusion assisted by mini implant has gained popularity in recent years, as mini implant reduces the need for complicated mechanics and avoid the side effects of more conventional methods⁹.

Non surgical treatment strategies are focused on either intrusion of anterior teeth or extrusion of posterior teeth, or both. The choice depends on various factors such as incisor display at rest and smile, interocclusal space and vertical dimension.³ Non-surgical treatment approach to correct deep bite and gingival smile is by intruding the maxillary anterior teeth. Intrusion arch wire systems such as a utility arch or an intrusion base arch are frequently used for incisor intrusion^{29,30}.

Intrusion is often the most preferred way of deep bite correction. Especially in patients with deep bite and excessive gingival display resulting in gingival smile, absolute intrusion

of the maxillary incisors is required rather than extrusion of molars. Maxillary incisor intrusion with mini implants was achieved with minimum side effects and more predictable results.

Since not much comparative clinical studies on the effects of mini implants in relation to the incisor area where they are inserted have been published, one of the aims of the present study was to assess the apical root resorption produced by incisor intrusion when using mini implants, and to analyze the differences in root resorption between one and two mini implants located in different areas.

In the single implant group the mean pre treatment right CI length measurements (24.186 ± 0.558) were compared to the mean post treatment right CI length measurements (23.3 ± 0.544) using Wilcoxon signed rank test. Upper right central Incisor length at baseline was found to be significantly different from that at 6 months.

Subsequently the upper lateral incisor measurements was checked and the mean pre treatment right LI length measurements (20.901 ± 1.0198) were compared to the mean post treatment right LI length measurements (20.0157 ± 0.959) using Wilcoxon signed rank test. Upper right lateral incisor length at baseline was found to be significantly different from that at 6 months.

In the double implant group the mean pre treatment right CI length measurements (23.371 ± 1.199) were compared to the mean post treatment right CI length measurements (22.5 ± 1.146) using Wilcoxon signed rank test. Upper right central incisor length at baseline was found to be significantly different from that at 6 months. Subsequently the upper lateral incisor measurements was checked and mean pre treatment right LI length measurements (20.53 ± 1.106) were compared to the mean post treatment right LI length measurements (19.672 ± 1.058) using Wilcoxon signed rank test. Upper right lateral incisor length at baseline was found to be significantly different from that at 6 months.

Inter group comparison between Group A and Group B was carried out using Mann-Whitney U test and was found out that the mean difference between right CI length and right LI length of Group A and Group B was found to be Statistically Insignificant. Also results of our study are similar to the one using mini implants done by Arturo *et al.*, (2020)²³ results showed that overall root resorption was 2.15 ± 0.85 mm with no statistically significant differences between the single and double implant groups.

We can conclude from the study that mini implants can be used for intrusion, and that apical root resorption is related to the treatment duration, not to the number of implants used. McFadden., (1989)⁷ evaluated the relationship between intrusion with low forces (25 g) using utility arches in the bio progressive technique and root shortening. The study concluded that there was no relationship between the root resorption and force that is used for intrusion, but is directly related to the duration of the treatment. Though there are several treatments for incisor intrusion and gingival smile correction, each technique has its own set of benefits and drawbacks.

The limitations of the study was two dimensional method was used to measure root resorption but, as resorption constitutes a volume loss, a three-dimensional quantitative method such as

CBCT would be much more precise. However, the patients did not have CBCTs and taking CBCTs just for the purposes of the study was not considered justifiable.

Summary

This study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, Yenepoya Dental College, Mangalore. The sample size consisted of 14 patients with gingival smile. An informed consent was taken, and the patients were treated in two Groups comprising of 7 in each Group. Group A consist of patients treated with single implant placed 2 mm below the anterior nasal spine and Group B consists of patients having 2 implants placed between maxillary lateral incisor and canine bilaterally.

The sample patients were treated using PEA appliance with 0.022 slot MBT prescription. After the initial alignment of the incisors with 0.016 NiTi wire, mini- implants was placed 2 mm below ANS in Group A and between upper lateral and canine bilaterally in Group B . Patients were treated with mini implants of self-drilling variety (8 mm in length and 1.4 mm in diameter).

Implants were immediately loaded with a force of 90 gms and was applied from the implant to the 0.019 x 0.025 SS wire. The wire was cinched back distal to molars to prevent flaring of the anterior teeth.

RVG using paralleling technique were taken before the mini implant placement i.e. during implant placement (T0) and 6 months after implant placement (T1).

In this study root resorption was calculated by taking RVG by paralleling technique and measuring pre treatment and post treatment length of both central and lateral incisor on the first quadrant and obtaining the difference to know the amount of resorption that has happened, the results showed that there is significant amount of resorption that is occurring during the course of intrusion using single or double mini implants. But when comparing between the groups there is no significant amount of resorption that has occurred. Hence from the study it can be concluded that intrusion can be achieved well with both single and double mini implants with no significant difference in apical root resorption between both the groups.

CONCLUSION

The purpose of this study was to evaluate the apical root resorption using single implant and double implant during gingival smile correction used for a period of six months.

The results of this investigation led to the following conclusions:

- Gingival smile correction was achieved well in both single and double implant Groups.
- There was no difference in apical root resorption between both Groups.

Based on the present results and observations it can be concluded that implants can be success fully used in managing cases with deep bite and gingival smile with no other means of anchor age control required.

Mini implants are safe and very effective for clinical application and well accepted by patients.

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