

# A Clinical Evaluation of Effect of Positional Change of Mini Implant on Intrusion of Maxillary Incisors - A Randomized Clinical Trial

Dr Gauri Agrawal,<sup>1</sup> Dr Suchita Daokar<sup>2</sup>

<sup>1</sup>Consultant Orthodontist, Bhopal, Madhya Pradesh, India, <sup>2</sup>Prof. Dept of Orthodontics, CSMSS Dental College, Aurangabad, Maharashtra, India

Correspondence: Dr Suchita Daoka; Email: suchitadaokar@gmail.com

## ABSTRACT

**Introduction:** A true maxillary intrusion is always a challenge for orthodontists. There are number of methods of incisor intrusion. Mini Implant assisted incisor intrusion is gaining popularity in recent years. We conducted this research to evaluate and compare the effect of different implant positioning on amount and rate of intrusion, axial and labiolingual inclination of incisors, amount of external apical root resorption of incisors.

**Materials & Method:** A prospective, double-blind, randomized clinical study was designed consisting of 30 adult orthodontic patients, aged 25 and above. The subjects were divided into two groups (Group A-15 patients where mini-implant was placed between two maxillary central incisors below ANS, Group B -15 patients where mini-implant was placed distal to maxillary lateral incisor). Amount of intrusion and change in axial inclination was measured on OPG, labiolingual inclination was measured on Lateral cephalogram, IOPA was taken to observe EARR.

The intragroup comparison of pre treatment and post treatment changes were done using Wil-coxon signed rank test, where as the intergroup comparison between Group A and Group B were compared using Mann Whitney U test.

**Result:** Statistically significant 3D changes of both central and lateral incisors were seen when continuous intrusion forces were applied from implant placed distal to lateral incisors. Whereas true intrusion with minimal (non significant) axial and labiolingual inclination changes were seen with forces applied through implant placed in the midline. 80 grams of light continuous forces brought about rapid tooth movement with no side effects such as tissue irritation and EARR.

**Conclusion:** Mini implant placed below ANS leads to true en-mass intrusion of four maxillary incisors while intrusion carried out with implant placed distal to lateral incisors bilaterally have 3D changes on all four maxillary incisors.

**Keywords:** Deep bite, Intrusion, Mini implant.

## INTRODUCTION

In adults and patients with vertical growth tendencies, true incisor intrusion is the treatment of choice for deep bite correction.<sup>1</sup> There are several methods of correcting deep bite by incisor intrusion: Utility arch by Rickets, Burstone intrusion arch, Connecticut intrusion arch(CIA), and J-hook headgear (J-HG), utility arch combined with high pull headgear.<sup>2</sup> To pre-vent complex wire bending and taxing of anchor tooth, TAD's have been introduced in ortho-dontic as an anchor unit.<sup>3-13</sup> Since its inception, various implant placement sites were used by dif-ferent investigators to perform intrusion of maxillary anterior.<sup>14-18</sup> In 1983, Creekmore and Eklund used vitallium screws placed in the anterior nasal spine region to intrude maxillary inci-sors upto 6mm.<sup>14</sup> Ravindra Kumar Jain, Sridhar Prem Kumar attempted intrusion of maxillary incisors by placement of mini-implant between lateral incisor and canine.<sup>18</sup> However comparison of

effects of various implant position sites on the incisors have not been reported till date. Hence, this study was undertaken to compare the effect on positional changes in implant sites on intrusion of maxillary incisor in all the 3 planes of space along with its rate of intrusion and ex-ternal apical root resorption (EARR).

## MATERIALS AND METHOD

### STUDY DESIGN

The study was designed to be double blinded and randomized consisting of thirty healthy pa-tients who were supposed to undergo fixed orthodontic treatment. The patients were selected from the outpatient Department of orthodontics and Dento-facial orthopaedics of our college using simple random sampling techniques. The CONSORT statement was used as a guide for this study.<sup>19</sup> New patients fulfilling the set inclusion criteria were selected by a staff member who was not involved in the study. There is no funding to be declared.

## ETHICAL APPROVAL AND INFORMED CONSENT

Ethical approval of this prospective clinical study was obtained from the local ethics committee of our institute and University vide letter no MUHS/PG/E2/2376/2015 dated 11/06/2015. The purpose and method of the study was explained to the patients in detail. A written consent was procured from each subject before commencement of the study.

## SAMPLE SIZE CALCULATION

The sample size was determined from a previous study.<sup>17</sup> 15 was the number of volunteers need-ed per group to determine the 3D effect of intrusion force from different point of force applica-tion.

## CLINICAL STUDY PROTOCOL

### PARTICIPANTS

Participants were recruited from patients attending the dept of Orthodontics and Dentofacial Or-thopaedics of our institution. Clinical examination was done on 53 patients. Patients were con-sidered eligible for the study if they met the following inclusion criteria: age 25 or above, with a complete set of permanent dentition with/without third molar, no supernumerary tooth or over-retained deciduous teeth and exhibiting vertical growth pattern with mild to moderate deep bite ( >4mm)

Exclusion criteria were younger patients with horizontal growth pattern and adults with normal / open bite Thirty adult healthy patients were selected for the study.

### RANDOMIZATION

Patients were allocated to the control group or an experimental group with an allocation ratio of 1:1 using a simple randomized controlled trial method. 30 sealed opaque envelopes containing an allocation note (i.e random allocation to either Group A or Group B) were prepared. The enve-lope were placed with the receptionist (not involved in the study). Each subject selected the en-velope as per his/her choice, and the allocation to the study groups was revealed by the patient opening the envelope.

### CLINICAL PROCEDURE

These patients were randomly divided in to two groups -

Group A consisted of 15 patients, where mini-implant was placed between two maxillary central incisors below ANS,

Group B consisted of 15 patients, where mini- implant was placed distal to maxillary lateral inci-sor.

All patients had their maxillary first premolars extracted. OPG, Lateral cephalometric radio-graphs, IOPA, Intra oral and extra oral photograph, at pre treatment and post-treatment just after sufficient intrusion of the maxillary incisors were collected.

### Miniscrew Insertion Protocol:

All miniscrews were inserted by single orthodontist according to the following protocol.

1. Topical anaesthesia with 5% lidocaine gel.
2. Buccal infiltration of 0.3 mL Xylocaine Dental Adrenaline per site (lidocaine hydrochloride 20mg/mL, adrenaline 12.5µg/mL, Dentsply Pharmaceutical)
3. Insertion of mini-screw was done either in between the two central incisors or distal to lateral incisors depending upon the group in the subject belongs. The mini-screws were inserted buccally and interdentially with 30°-40° of angulation.

All the maxillary incisors were bonded and a sectional 0.019"×0.025" SS wire was engaged after initial alignment. The patients were kept under observation for a period of 1 week after the implant placement which were then loaded with very light forces of 80 grams with closed coil spring to achieve the en masse intrusion of four maxillary anterior teeth. In Group A 80 grams force was applied at implant placed below ANS while in Group B 40 grams force was applied at each implant placed bilaterally. Patients were kept on monthly recall visits till the desired intrusion was achieved or the end of 6 months of commencement of intrusion (whichever came early)

### Following investigation method was carried out:

Following methods of investigation was carried out for each subject. All the measure-ments/readings were done by single examiner. The intra examiner reliability for data readings was assessed using Kappa statistics, which was found to be 93%.

1. Evaluation of amount of intrusion, rate of intrusion & axial inclination changes were determined on OPG using Nasal floor as the reference plane. perpendicular vertical distance from the nasal floor to incisal edges were used for evaluating the amount of intrusion where as the inner angle formed

between the nasal floor and the long axis of the tooth was used to evaluate the mesiodistal angular changes.

2. Method to evaluate change in labiolingual inclination of maxillary incisors using Lateral Cephalogram : The inner angle formed between long axis of maxillary incisor with palatal plane
3. Method for determining external apical root resorption: To measure external apical root resorption observation method was used. A 4 grade ordinal scale was used. If no apical root resorption score = 0, if slight blunting of root apex score = 2, if Moderate resorption of root apex beyond blunting and up to one third of root length score =3. If Excessive (severe) resorption of root apex beyond one third of root length score = 4.

#### **Error of the method**

All the measurements/ readings were done by single examiner. The intra examiner reliability for data reading was assessed using Kappa statistics which was found to be 93%.

#### **STATISTICAL ANALYSIS**

Intra group comparison of amount of intrusion, change in axial inclination, change in labiolingual inclination between pre and post treatment value among group A and group B was done using Wilcoxon signed rank test.

Intergroup comparison were statistically analysed using the Mann Whitney U test (intergroup comparison of intrusion & rate of intrusion, change in axial and labiolingual inclination, EARR of central incisor and lateral incisor).

#### **RESULT**

##### **1) AMOUNT OF INTRUSION**

The pre and post treatment intrusion of central and lateral incisor were compared using Wilcoxon signed rank test, the results were found to be statistically significant for both. in Group A ( $p=0.001$ ,  $p=0.001$ ) in Group B. ( $p=0.001$ ,  $0.001$ ) (Table 1)

When the result of intrusion of central incisor was compared between group A and group B using unpaired t test and Mann Whitney test, the results were found to statistically non significant. ( $p = 0.49$ ,  $p=0.61$ ) respectively. (Table 1) whereas for lateral incisors were found to statistically significant. ( $p = 0.01$ ,  $p= 0.01$ ) respectively. (Table 1)

##### **2) CHANGE IN AXIAL INCLINATION**

When the result of pre and post treatment changes in axial inclination of central incisor and lateral incisor were compared in Group A using Wilcoxon signed rank test the results were statistically non significant ( $p=0.36$ ,  $p=0.19$ ) respectively. (Table 1)

Similarly in Group B the result of lateral incisor were statistically non significant ( $p=0.29$ ) whereas the results of central incisor were statistically significant ( $p=0.004$ ) (Table 1).

Intergroup comparison of mean difference score of axial inclination of central incisor between Group A and Group B and lateral incisor between group A and Group B using Mann Whitney U test were found to be statistically significant ( $p=0.001$ ), ( $p=0.003$ ), (Table 1).

##### **3) CHANGE IN LABIOLINGUAL INCLINATION**

Change's in labiolingual inclination of central incisor in Group A when compared using Wilcoxon signed rank test the results were found to statistically non significant ( $p=0.21$ ). While in group B the result was statistically significant ( $p= 0.03$ ). (Table 1)

Intergroup comparison of changes in labiolingual inclination of central incisor between Group A and Group B using Mann Whitney U test was statistically significant ( $p=0.01$ ). (Table 1)

##### **4) AMOUNT OF EXTERNAL APICAL ROOT RESORPTION (EARR)**

Intragroup comparison of amount of EARR of central incisor and lateral incisor in group A and Group B using Mann Whitney U test the result were statistically non significant ( $p=0.37$ ,  $p=0.27$ ). (Table 1).

When the EARR of central incisor and lateral incisor respectively was compared between group A and group B using Mann Whitney U test, the results were found to statistically non significant ( $p=0.24$ ,  $p=0.46$ ). (Table 1)

##### **5) RATE OF INTRUSION**

In Group A C.I were intruded at the rate of 0.86mm/month and L.I intruded at the rate of 0.73mm/month in 3 months. In Group B C.I intruded at the rate of 0.83mm/month and L.I intruded by 2.8 mms at the rate of 0.93mm/month in 3 months. (Table 1)

Table 1: Pre and post treatment value comparison in Group A and Group B and intergroup comparison

Sr. no.	Parameters	Group A				Group B				Intergroup comparison	
		Pre t/t Mean, S.D	Post t/t Mean, S.D	Mean difference	P value Wilcoxon test	Pre t/t Mean, S.D	Post t/t Mean, S.D	Mean difference	P value Wilcoxon Test	Mean difference Of A & B	Mann Whitney U test
1	Intrusion of C.I	34.96, 2.31	32.43, 2.17	2.53, 0.81	0.001(s)	37.66, 3.35	35.1, 3.44	2.5, 0.46	0.001(s)	0.16	0.61
2	Intrusion of L.I	33.8, 2.56	31.6, 2.46	2.2, 0.79	0.001(s)	36.43, 3.13	33.6, 3.31	2.83, 0.52	0.001(s)	0.63	0.01(s)
3	Axial inclination of C.I	88.13, 5.95	87.13, 6.4	1,1.29	0.36	88.16, 4.96	90.7, 3.38	2.56, 3.72	0.004(s)	7	0.001(s)
4	Axial inclination of L.I	88.55, 7.46	86.46, 7.48	2.08, 3.1	0.19	90.5, 6.32	91.8, 5	1.5, 1.15	0.29	9.43	0.03(s)
5	Labiolingual inclination of C.I	121.6, 13.07	123.96, 11.74	-2.8, 8.36	0.21	116.0, 13.32	108.06, 13.11	7.93, 13.37	0.03(s)	10.73	0.01(s)
6	EARR of C.I			0.71, 0.726				0.43, 0.514			0.24
7	EARR of L.I			0.50, 0.519				0.64, 0.497			0.46
8	Amount of incisal display at rest	1.83, 1.89	0.86, 1.14	0.99, 0.89	0.001(s)	2.26, 2.24	1.16, 1.66	1.1, 0.89	0.001(s)	0.13	0.68
9	Amount of incisal display at smile	5.9, 1.49	4.1, 1.31	1.8, 0.36	0.001(s)	7.1, 1.73	5.03, 1.58	2.06, 0.62	0.001(s)	0.26	0.16

## DISCUSSION

In adult patients and patients with vertical growth tendencies, true incisor intrusion is the treatment of choice for deep bite correction.<sup>1</sup> The conventional intrusion mechanics needed an extensive wire bending and taxing of the anchorage. Use of Mini-implants as anchorage device brought about a revolution in orthodontic mechanism. Mini-implants are now been used extensively for anchorage purpose. In cases of deep bite, investigators have suggested various mini-implant placement site for true intrusion of maxillary anteriors. This in vivo study was undertaken to study the 3D effects of variation in implant placement sites on maxillary incisors on application of intrusive forces. Patients were divided in 2 groups. Each group consisted of 15 adult patient of age group 15-25 years. In Group A implant was placed between two central incisor and Group B implant was placed distal to lateral incisor bilaterally for en masse intrusion of maxillary incisors.

When pre treatment and post treatment intrusion value of both central and lateral incisor were compared in Group A and Group B the result was found to be statistically significant ( $p=0.001, 0.001$ ) ( $p=0.001, 0.001$ ) respectively. Which indicates that in both the Groups, maxillary central incisor and lateral incisor were sufficient intruded. Intergroup comparison showed that the amount of intrusion of central incisor was statistically insignificant ( $p=0.61$ ) whereas lateral incisors showed statistically significant difference ( $p=0.01$ ) in intrusion levels. (were more intruded in group B). This showed that variation in force application does not have any effect on the amount of intrusion of central incisors, however lateral incisors are affected by the change in point of force application. These results are analogous to Omur Polat - Ozsoy et al<sup>20</sup> study. They found that lateral incisors showed more intrusion when mini-implant was placed distal to laterals bilaterally.

In Group A no change in axial inclination of central and lateral incisor (0.36, 0.19) was found when pre

and post treatment values was compared. In Group B the lateral incisor showed non-significant tipping ( $p= 0.29$ ) but central incisor showed significant distal tipping of crown ( $p= 0.004$ ). Intergroup comparison of axial inclination changes of central incisors in group A & Group B were significant ( $0.001$ ), and lateral incisor ( $0.03$ ). The results followed the law of biomechanics (cue ball effect) as explained by Mulligan.<sup>21</sup>

In group A there was no change in pre and post treatment labiolingual inclination changes of central incisors ( $p= 0.21$ ). In group B central incisor showed lingual crown torque, with significant difference ( $p= 0.03$ ). The intergroup comparison result was statistically significant ( $0.01$ ). Showing that force passed through mini-implant placed in the midline did not lead to any changes in the labiolingual inclination changes, however when force were passed through mini-implant placed distal to lateral incisors, it lead to lingual crown torque. This can be explained by the law of biomechanics (cue ball concept).<sup>21</sup>

On application of 80 grams of continuous intrusive forces the rate of intrusive in both the groups were found to be around 1mm per month, no evidence of external apical root resorption was found in both the groups suggesting that 80 grams of light, continuous intrusive forces produces no deleterious effects on the root surface. The results were in accordance to the study of Liou W.J. E et al<sup>22</sup> who found similar results after application of 50 grams of intrusive forces

## CONCLUSION

Following conclusion can be drawn from our study:

1. Central incisor showed similar amount of intrusion in both the groups. However the amount of intrusion varied for lateral incisor, which showed more intrusion when the force of application passed distal to lateral incisor.
2. Statistically significant 3D changes of both central and lateral incisors were seen when continuous intrusion forces were applied from implant placed distal to lateral incisors. Whereas true intrusion with minimal (non significant) axial and labiolingual inclination changes were seen with forces applied through implant placed in the midline.
3. 80 grams of light continuous forces brought about rapid intrusive movement with no side effects such as tissue irritation and EARR.

Furthermore studies and clinical trials with a larger sample size are recommended to confirm the results of this study.

**OJN**

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