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Comparative Evaluation of two Different Intrusion Methods in Three Plane of Space: An Invivo Study

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ABSTRACT

Background: Nonsurgical correction of deep bite involves either extrusion of posterior teeth, the intrusion of incisors, or a combination of both. The introduction of skeletal anchorage device with mini-implant provides near-absolute anchorage without producing any untoward effects on the anchor unit. Connecticut Intrusion Arch (CIA) provided an efficient system of intruding anterior segment without producing any adverse effects on anchor teeth.

Material and Methods: The study comprised of 30 patients of Class I and Class II div 1 malocclusion randomly distributed into two groups. Group A was treated using the CIA while Group B treated with orthodontic mini-implants. Lateral cephalograms were taken pre-intrusion and post-intrusion at the end of six months.

Results: On Comparison of Group A to Group B, radiographically, it was found that intrusion was achieved in both the Groups but Group B (1.59±0.86) shows a slightly higher amount of intrusion as compared to Group A (0.93±0.35) which was statistically significant. The unwanted side effects such as protrusion of maxillary incisors were seen in both Group A and Group B as shown by Cephalometric analysis. Group A exhibited a slightly higher protrusion (0.29±1.11) as compared to Group B (0.18±1.06), but it was statistically non-significant with P value of 0.844 Overbite reduction was seen in both the Groups but was statistically non-significant.

Conclusion: Intrusion of maxillary anterior dentition for correction of a deep bite can be better achieved with a single implant placed in between two maxillary incisors.

Keywords: CIA, Mini- implant, Intrusion, Lateral cephalogram, Protrusion.

INTRODUCTION

In adults, the skeletal discrepancy can be compensated by dentoalveolar orthodontic methods with fixed appliance[1]. Maxillary incisor intrusion was preferred treatment in nongrowing patients with anterior deep bites caused by overeruption of the maxillary incisors[2] because it maintains the vertical dimensions of the patient.Connecticut Intrusion Arch is a multifunctional wire that is performed from nickel titanium[2]. It provides light, continuous forces and thus was an efficient system of intruding anterior segment without producing any adverse effects on anchor teeth.[3] They have high memory and low load-deflection rates, creating small increments of deactivation over time and thus reducing the number of reactivation appointments.[1] A pure

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intrusion arch requires point contact at the incisors. Insertion of the wire into the incisor brackets, tend to flare the incisors, which may or may not be desirable. When archwire was activated, a single force system results, consisting of vertical force in the anterior region and a moment in posterior region[4]. The introduction of skeletal anchorage device with mini-implant provides near-absolute anchorage without producing any untoward effects on anchor unit[5]. True intrusion can be achieved with simple mechanics via miniscrew with only minimal protrusion of anterior teeth.

The aim of this prospective study is to compare the 2 maxillary intrusion systems involving Connecticut intrusion arches and mini-implants used as intraoral intrusion systems. The treatment efficiency of these 2 intrusion systems during maxillary incisor intrusion was evaluated.1

AIMS AND OBJECTIVES

The aims and objectives of the study are as follows:

1) To evaluate and compare the change in the vertical skeletal and dental dimensions using two different methods of intrusion.

2) To evaluate and compare the incisor position using two different methods of intrusion.

3) To evaluate and compare overbite and overjet using two different methods of intrusion.

MATERIAL AND METHODS

The present clinical study was done on untreated Orthodontic patients, selected from the subjects who visited to the OPD of Department of Orthodontics and Dentofacial Orthopaedics, Seema Dental College &Hospital, Rishikesh and from the camps conducted in the local population. Patients advised for fixed mechanotherapy requiring incisor intrusion were selected for the purpose of the study. A total of 30 subjects were selected and divided into two groups based upon the methods used for Intrusion. Subjects for each Group were chosen randomly.

Group A: CIA Wire Group - 15 Subjects who were treated with CIA wire (0.017x 0.025 Niti) ligated to the anterior segment at the lateral incisors and between the central incisors with the segmented stable base archwire.

Group B: Implant Group - 15 Subjects who were treated with a single Implant placed between two central incisors. Lateral cephalograms were obtained and evaluated for overjet, overbite, U1 to PP (Linear and angular) , U1 to SN (Linear and Angular) Cephalometric investigation was done to assess whether the intrusion was required in the anterior maxillary segment. IOPAs of maxillary anterior dentition were obtained to assess the root formation and periapical region for periodontal status. Pre-treatment frontal photographs (normal and on smiling) were obtained to compare them with the post-treatment photographs to evaluate the changes in incisal and gingival exposure, overbite and overjet .

Inclusion criteria:

1) Permanent dentition with Complete root formation

2) No history of orthodontic treatment

3) Angles Class I &II Malocclusion with deep overbite

4) Subjects with increased incisal and gingival exposure

5) Subjects with a short upper lip

Exclusion criteria:

1) Teeth with incomplete apexification

2) History of Trauma

3) History of root canal treatment

4) Previous orthodontic treatment

METHODOLOGY

Selected subjects were started with fixed mechanotherapy using M.B.T prescription with a slot size of .022".Levelling and alignment were achieved with .016" NiTi till .017"X.025" NiTi. Extraction was done depending upon the requirement of the case. Rigid .017 X.025 S.S wire was placed in the upper arch .Pre Intrusion records were taken before insertion of implants(Dentos) and CIA Wire(rabbit force).

CIA wire placement:

For CIA wire (0.017x0.025 Niti) placement stable segmental base archwire was placed. CIA wire was ligated to the anterior segment at the lateral incisors and between the central incisors. If no incisor flaring is required CIA wire tied to the anterior segment only at lateral incisors and Cinch-backs distal to molars maintain anteroposterior incisor positions. When a Class I molar relationship was already present, the use of posterior wire segments or a transpalatal bar is recommended to minimize tip back and 3rd-order molar side effects2

Implant placement:

For implant (1.2 X6 mm, Absoanchor, Dentos, Korea) implant was placed at the junction of attached and free gingiva. IOPA radiograph was recorded to assess the bone in between the root of adjacent teeth for the placement of the implant, in case of insufficient space between the roots to place the implants root uprighting is performed either by changing the axial inclination of bracket or by artistic positioning bands in the archwire before placing the implant.

Force application and force measurement:

Before application of intrusive force segmental ligation from lateral to lateral was done using .009" SS ligature wire in the figure of '8'. Intrusive force of 40- 60gm was applied using force module ligated between implant to the archwire. For CIA wire, wire was ligated in anterior segment gingivally with the help of SS ligature wire on the base archwire.Force was measured using Dountrix gauge. Force modules were replaced at every 6-week interval.

Intrusion measurement:Radiographic reading of pre intrusion and post intrusion was evaluated.Force module was replaced every 6thweek to maintain the intrusive forces until the desired intrusion was achieved.

Method Error

To assess intra-observer error, the sample was selected randomly and re-examined 1 week after the initial examination by the same observer to eliminate the grading errors as recommended by Intraclass Correlation test. For interclass correlations sample was revisited by a different observer

Statistical Methods

The data obtained were subjected to statistical analysis.Student's unpaired t-test was performed for statistical comparison on mean values and associate interferences. An interclass Correlation test was performed to evaluate the interclass and intraclass observation errors.

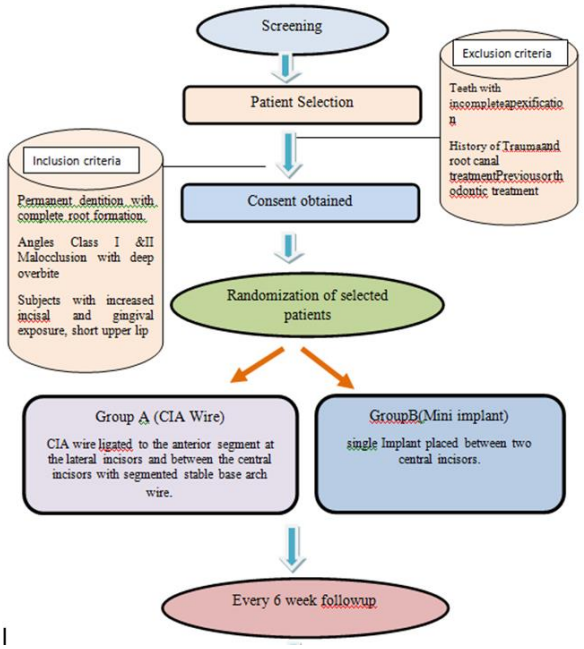

Fig 1: Study Design.

Fig 2: Dentos Implant with driver and topical LA

Fig 3: CIA Wires.

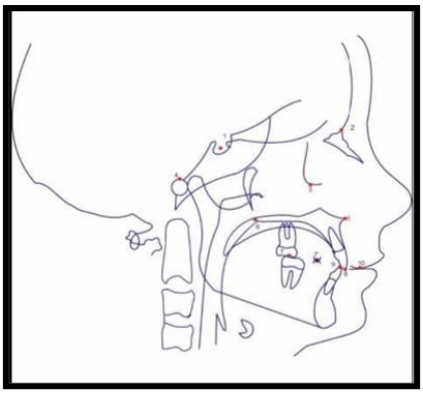

Fig 4: LANDMARKS-: Sella(S)-The midpoint of the Hypophyseal fossa, Nasion (N)-The most anterior point on Nasofrontal suture in the median plane, Orbitale(Or)- Lowermost point of the orbit in the radiograph,Porion (Po)- The superior point of the external auditory meatus,ANS-Tip of bony anterior nasal spine , in the median plane, PNS-The constructed point, the intersection of a continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose, 7"-Intercuspation of molar and premolar,U1-Incisal edge of upper incisor,L1-incisal edge of lower incisor, Stms- most inferior point on StomionSuperius (Stms).

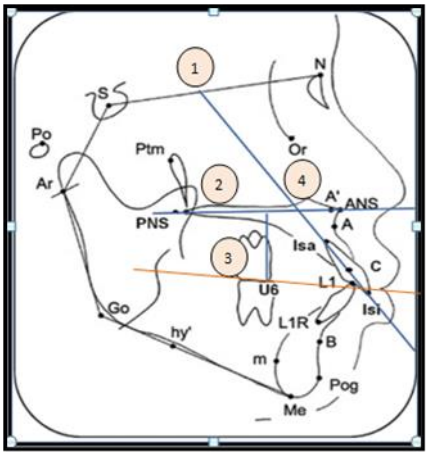

Fig 5: Planes-: 1)SellaNasion plane, 2) PP- Palatal plane, 3) OP- Occlusal Plane, 4)Long axis of upper incisors.

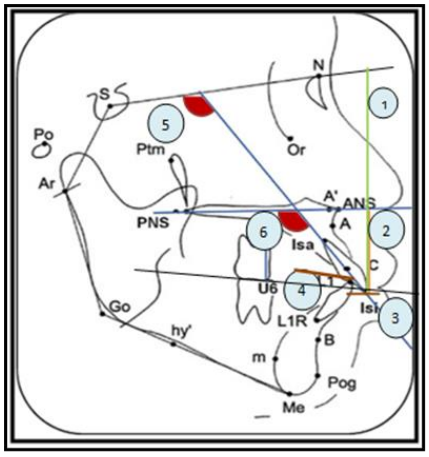

Fig 6: LINEAR AND ANGULAR MEASUREMENTS-:1) U1 to SN, 2)U1 to PP, 3) OVERJET, 4) OVERBITE, 5) U1 to SN, 6) U1 to PP.

Fig 7: CIA wire group.

Fig 8: Mini- Implant group.

RESULTS

The mean U1 - SN (Linear) pre-treatment, post-treatment and difference from pre to post-treatment was compared between Group A (CIA group) and Group B (Implant group) using the

unpaired t-test. The mean difference in U1 - SN (Linear) from pre to post-treatment was significantly more among Group B (Implant group) compared to Group A (CIA group) with a P value of 0.043.The mean U1-PP (Linear) pre-treatment, post-treatment and difference from pre to post-treatment was compared between Group A (CIA group) and Group B (Implant group) using the unpaired t-test. The mean difference in U1-PP (Linear) from pre to post-treatment was significantly more among Group B (Implant group) compared to Group A (CIA group)with P value of 0.049. The mean overjet pre-treatment, post-treatment and difference from pre to post-treatment was compared between Group A (CIA group) and Group B (Implant group) using the unpaired t-test. There was no significant difference mean overjet pre-treatment, post-treatment and difference from pre to post-treatment between Group A (CIA group) and Group B (Implant group).

Table 1: The mean U1 - SN (Linear) pre-treatment, post-treatment and difference from pre to post-treatment.

	Group A (CIA group)		Group B (Implant group)				
U1 - SN (Linear)	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Pre-treatment	76.21	4.69	76.32	5.07	-0.10	-0.044	0.966
Post-treatment	75.29	4.83	74.73	5.02	0.56	0.233	0.818
Difference from pre to post treatment	0.93	0.35	1.59	0.86	-0.66	-2.923	0.043*

Table 2: The mean U1-PP (Linear) pre-treatment, post-treatment and difference from pre to post treatment.

	Group A (CIA group)		Group B (Implant group)				
U1-PP (Linear)	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Pre-treatment	27.64	2.53	27.59	2.21	0.05	0.046	0.964
Post-treatment	26.71	2.91	26.05	2.32	0.67	0.541	0.596
Difference from pre to post treatment	0.93	0.53	1.55	0.79	-0.62	-2.811	0.049*

Table 3: The mean overjet pre-treatment, post-treatment and difference from pre to post-treatment.

	Group A (CIA group)		Group B (Implant group)				
Overjet	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Pre-treatment	5.29	1.50	4.68	1.33	0.61	0.896	0.383
Post-treatment	5.57	0.98	4.86	1.76	0.71	0.966	0.349
Difference from pre to post treatment	-0.29	1.11	-0.18	1.06	-0.11	-0.199	0.844

Table 4: The mean overbite pre-treatment, post-treatment and difference from pre to post-treatment.

	Group A (CIA group)		Group B (Implant group)				
Overbite	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Pre-treatment	5.20	1.16	4.45	1.13	0.75	1.352	0.195
Post-treatment	4.29	1.22	3.36	1.63	0.92	1.281	0.219
Difference from pre to post treatment	0.91	0.32	1.09	0.92	-0.18	-0.487	0.633

Table 5: The mean U1-SN (Angular) pre-treatment, post-treatment and difference from pre to post treatment was compared between Group A (CIA group) and Group B (Implant group) using the unpaired t-test.

	Group A (CIA group)		Group B (Implant group)				
U1- SN (Angular)	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Pre-treatment	108.43	9.00	107.91	6.89	0.52	0.139	0.891
Post-treatment	110.36	10.29	108.91	5.79	1.45	0.385	0.706
Difference from pre to post treatment	1.93	3.81	1.00	2.79	0.93	0.598	0.558

Table 6: The mean U1-PP (Angular) pre-treatment, post-treatment and difference from pre to post treatment was compared between Group A (CIA group) and Group B (Implant group) using the unpaired t-test.

	Group A (CIA group)		Group B (Implant group)				
U1-PP (Angular)	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
Pre-treatment	114.83	9.04	115.64	5.77	-0.81	-0.225	0.825
Post-treatment	116.17	11.39	116.64	5.45	-0.47	-0.117	0.909
Difference from pre to post treatment	1.33	4.13	1.00	2.79	0.33	0.199	0.845

DISCUSSION

Correction of deep bite often requires intrusion of anterior teeth. Intrusion requires careful control of force application both in magnitude and direction. The concentration of forces is in a small area around the apex of the incisors thus light forces directed in the long axis of the tooth are preferable. A light force of 15 to 20 gm per tooth is recommended for the intrusion. Thus, a total of 60 g is adequate for the intrusion of four maxillary incisor teeth. Intrusion also causes changes in the pulpal tissue such as vascularization of the odontoblast and pulpal oedema. Use of heavier force will not fasten the intrusion rate; instead it will cause resorption of the apical portion of teeth and in prolonged cases, it leads to pulpal death. For intrusion to happen in the anterior segment, forces should be directed through the centre of resistance of the tooth. Various modalities of intrusion mechanics are used for correction of deep bite. Propagators of different prescriptions of Pre adjusted Edgewise Appliances used various auxiliaries integrated to their appliance system to achieve maximum intrusion of incisor segment. But all these auxiliaries produce unwanted effects in the anchor segment affecting the overall treatment results. Introduction of SAD provided an option to move tooth/teeth without

producing any reciprocal movement in the anchorage unit. Incisor intrusion treatment with micro-implants only affects the maxillary incisor area and position of molars is maintained during intrusion phase. In cases of CIA, molar extrusion is a reciprocal movement that occurs in the posterior anchor segment. The altered occlusion and muscles of mastication might move the extruded posterior teeth back to their original positions causing relapse, until soft tissues and hard tissue equilibrium are obtained.[5] The micro-implants were available in diameters of 1.2– 2.7 mm. In the present study, we used micro-implants of 1.2 mm diameter and 6 mm in length. This was chosen considering the available inter-radicular space between central incisors and the stability required for the intrusion of the maxillary incisors segment. CIA was fabricated from nickel-titanium alloy providing shape memory, spring back, and light continuous force. Its primary mechanism for force delivery is a V bend calibrated to deliver approximately 40–60 g of force.[5] In the present clinical study, Cephalometric evaluation of 30 subjects was undertaken to assess the aetiology of deep overbite so that the appropriate treatment modality can be planned to correct the malocclusion. Lateral Cephalograms were taken and linear and angular parameters were measured. After thorough examination maxillary anterior dental intrusion was planned to correct the deep overbite rather than extrusion of molars. In the present study on comparison of the mean values of U1- SN linear pre and post-treatment in Group A (CIA Group) it was found that the linear distance between the maxillary central incisal edge and Sella-Nasion plane had decreased significantly with a mean difference of 0.93±0.35 with a p-value of <0.001 suggestive of intrusion of the maxillary anterior dentition achieved in Group A as shown in Table no. 3 and Graph no. 1.

On comparison of the mean values of U1- SN linear pre and post-treatment in Group B (Implant Group) it was found that the linear distance between the maxillary central incisal edge and Sella-Nasion plane implant Group had decreased significantly with a mean difference of 1.59±0.86 with a p-value of <0.001 suggestive of intrusion achieved in maxillary anterior dentition in Group B as shown in Table no. 3 and Graph no.1 and Table 9, graph 8. When U1-SN linear of Group A and Group B were compared, it was found that Group B (1.59±0.86) had higher value of intrusion as compared to Group A(0.93±0.35) with the P value of 0.043 which shows the significant difference between both the Groups.

This finding was confirmed by comparison of the mean values of U1- PP linear pre and post-treatment in Group A (CIA Group) it was found that the linear distance between palatal plane & maxillary central incisal edge in Group Ahad decreased significantly from pre to post with a mean difference of 0.93±0.53 and with a p value of 0.004 which shows that significant amount of intrusion was achieved in Group A. On comparison of the mean values of U1- PP linear pre and post-treatment in Group B (Implant Group) it was found that the linear distance between the maxillary central incisal edge and palatal plane in Implant Group had decreased significantly with a mean difference of 1.55±0.79 from pre to post with a p-value of <0.001 suggestive of intrusion achieved in maxillary anterior dentition as shown in Table no. 6 and Graph no.4 and Table 9, graph 8. When U1-PP linear were compared in both Group A& Group B, however, it was found that in Group B intrusion were slightly more(1.55±0.79) as compared to group A(0.93±0.53)with a P-value of 0.049 which shows a statistically significant difference between the two groups as shown in Table no.10 Graph 8. The finding of this study was in support with the survey by ***Senisik and Tukkahraman(2012)*** in which the mean amount of intrusion was 2.20mm in CIA Group and 2.47 mm in implant Group.[1]

The present study was also supported by a study conducted by ***Prasanna Kumar et al. (2017)*** in which shows that average amount of change in centroid point to PP distance and U1-SN was significantly higher in Group 1(Implant Group)with a mean intrusion of 3.10±0.67 compared to Group 2(CIA Group)with the intrusion of 2.07±0.53 with a P-value of < 0.001. Thus article finally concluded that the amount of intrusion is significantly higher in SAD group.[5]In the present study overbite reduction was seen in both the Groups. In Group A the mean overbite reduction from pre to post was 0.91±0.32 and in Group B was 1.09±0.92 .this suggest that in Group B overbite reduction is more but it was statistically non-significant with a P-value of 0.633 .The present study was in support with the study by ***Polat- Ozsoy et al. (2009)*** conducted on mini-implant and results show that the mean upper

incisor intrusion was 1.92 mm and the mean overbite decrease 2.25 ± 1.73 mm in 4.55 months. Upper incisor angulation resulted in a 1.81± 3.84 degrees change in U1-PP angle and a 1.22 ± 3.64 degrees change in U1-NA angle.[19] In the present study, it was observed that overjet was increased in Group A with a mean value of -0.29±1.11 and also in Group B with the mean value of -0.18±1.06 as shown in Table no. 11 and graph no 9. The mean difference of Group A and Group B was -0.11 with a P-value of 0.844 which was non-significant.This shows that there is a slight increase in proclination of maxillary incisors in both Groups but Group A(0.29±1.11) shows a slightly higher proclination than Group B(-0.18±1.06) but it was non-significant with a P-value of 0.844

This was further proven with the statistical non-significant increase in U1-SN and U1-PP Plane angle in Group A and Group B .In Group A U1-SN angular increased from pre to post with a mean difference of 1.93±3.81 and U1-SN in Group B increased from pre to post with a mean difference of 1.00±2.79 .This shows that Group A has slightly more change in angulation than Group B with a P-value of 0.558 which was considered as non-significant. This result was in support with the study conducted by ***Polat-Ozsoy et al(2011)*** in which miniscrew Group was compared with the utility arche Group and showed that the miniscrew group, the incisors were protruded 0.79± 6 1.4 mm (P .0.05) relative to pterygoid vertical and 3.85± 6 2.4 (P .0.05) relative to the palatal plane and in group 2(utility arch group), the incisors showed 3.91±60.7 mm (P\0.05) of the protrusion relative to pterygoid vertical and 13.55±2.4 (P\0.05) relative to the palatal plane.[23]

CONCLUSION

Comparison of the amount of intrusion in both Groups the results obtained was evaluated and the following points were concluded from the study:-

- Deep overbite correction was achieved by incisor intrusion in both the methods of intrusion.
- There was a significant difference in the amount of intrusion achieved between both the Groups.
- Group B(Implant Group) shows a significantly more amount of intrusion as compared to Group A (CIA Group).
- Both maxillary intrusion system led to protusion of maxillary incisors but Protusion was slightly more in CIA wire Group than Mini Implant Group which was statistically non significant.
- Overbite reduction was seen in both the Groups but Implant Group shows a slightly higher reduction in overbite as compared to CIA Group which was statistically non-significant.

The single mini-implant was an ideal choice of treatment for bite opening by intruding anterior maxillary dentition in in-depth bite cases with increased incisal exposure and it was also better in terms of patient comfort.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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