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Comparison of Intrusive Effects of Mini screws and Burrstone Intrusive Arch: A Radiographic Study

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ABSTRACT

Aim: This prospective study was done to compare the effects of incisor intrusion obtained with the aid of miniscrews and burstone intrusive arch.

Materials and Methods: Twenty- patients with deep bite of at least 4 mm were divided to 2 groups. In group1, 10 patients (6 males, 4 females; mean age group of 14-20 years) in the postpubertal growth period were treated by using burstone intrusive arches and in group 2, 10 patients (6 male, 4 female; age group of 14-20 years) were treated using miniscrews. Lateral cephalometric head films were taken at the beginning of treatment and after intrusion for the evaluation of the treatment changes. Statistical analyses of the data were performed with a significance level of $p<0.001$.

Results: The changes in the center of resistance of the incisors were 4.3 mm ($P <0.001$) for group 1; and 4.3 mm ($P<0.001$) for group 2.The mean change in the angle of upper incisor to palatal plane was 10.9^0; $p<0.001$. The change in distance from upper molar to VR (mm) is 4.2 mm $p <0.001$. The change in Upper 1^{st} molar to SN plane angle in burstone intrusive arch was 4.9^0 (83.70± 2.264 to 78.80± 2.448) $p <0.001$. And in mini implant, the change in upper incisor to palatal plane angle is 1^0 (71.40± 1.43 to 72.40 ± 1.506) $p > 0.001$ which is statistically not significant. The maxillary molar showed no movement in the miniscrew group and molar moved distally at an average of 4.9^0 in intrusive arch group.

Conclusions: Both the mini implant and the utility arches are equally effective in intrusion of upper incisors. Mini implant gives true intrusion. Vertical height of molars does not change much with Mini implant while molar extrusion can be seen with intrusive arch.

Keywords: Bone screws, Dental arch, Tooth intrusion.

INTRODUCTION

Deep overbite is one of the most common malocclusions seen in children as well as adults[1]. Deep overbites can be corrected by four types of tooth movements[2] namely extrusion of posterior teeth – most common and easiest, although not always the best method to correct deep overbites, flaring of anterior teeth – only in patients with lingually tipped incisors, intrusion of incisors[3,4] – the best method to correct overbites in

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children as well as adults, surgical – in adult patients, orthognathic surgery in combination with Orthodontics is often the treatment of choice either because of severity of problem or reluctance of patient to undergo lengthy treatment.

Intrusion arches act either by extrusion of posterior teeth or inhibition and genuine intrusion of anterior teeth. This decision is based in part on where the clinician desires to place the occlusal plane, the amount of mandibular growth anticipated, and the vertical dimension desired at the end of treatment. Untreated deep bite can cause increased anterior crowding, maxillary dental flaring, periodontal problems, and temporomandibular joint problems and can interfere with lateral and anterior mandibular movements[5-7]. Mini-screw implants used as fixed anchorage devices give orthodontists increased potential for favorable treatment outcomes and many treatment options and most importantly, they help to increase patient compliance during treatment. Mini-screw implants are especially well suited for intruding teeth because they make it possible to apply light continuous forces of known magnitudes. Also, better control of the forces could diminish apical root resorption often associated with intrusive movements[8-11]. Hence, titanium miniplates and dental implants have also been successfully used for tooth intrusion[12-17].

Therefore, this prospective study was aimed at comparing two maxillary intrusion systems involving mini-implants and burstone intrusive arches used as intraoral intrusion systems. The treatment efficiency of these 2 intrusion systems with different anchorage zones during maxillary incisor intrusion was evaluated. The initial and final records in this study included case sheet, clinical examination, intraoral and extraoral photographs, lateral cephalograms, and panoramic radiographs. The skeletodental changes occurring during deep overbite correction with mini implant and the burstone intrusive arch were also analyzed.

MATERIALS AND METHODS

The sample of this study consisted of 20 patients with deep overbite and with average or low growth pattern in the age group of 14-20 yrs. An informed consent was taken, and 10 patients were treated with burstone intrusive arches and 10 patients were treated with mini implant to bring about the intrusion of upper incisors.

Inclusion Criteria: Patients with deep overbite (4mm or more), average or low growth pattern**,** age group – 14-20 yrs.

Exclusion Criteria: Patients with true deep bite**,** no apical root resorption of teeth to be intruded prior to orthodontic treatment**,** no history of trauma to tooth to be intruded.

The initial records included case sheet, clinical examination, intraoral and extraoral photographs, lateral cephalograms (Figure 1) and panoramic radiographs. The orthodontic treatment was performed with a full fixed pre adjusted edgewise appliance (3M). 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 (approximately 3 months).

PROCEDURE

In both groups group the teeth were aligned and leveled with 0.016 nickel-titanium in and 0.016 x0.022-in nickel-titanium segmental wires. After leveling, a 0.017 x 0.025 stainless steel wire was bent to the maxillary anterior segment with small hooks at its distal ends for intrusion. In group 1, 10 patients were treated by using burstone intrusive arch mechanics. An anterior, passive sectional arch from the same wire was fabricated for the stabilization of the incisors[18] and activated to get intrusive force of 70 g. Control appointments were every 4 weeks, and the force levels were checked at every appointment with dynamometer. In group 2, 10 patients in the postpubertal growth period were treated by using bone anchorage with mini implant (Figure 2). The screws were loaded 2 weeks later with medium super-elastic nickel-titanium closed-coil springs, and an intrusion force of 70 g was applied. Control appointments were every 4 weeks, and the force levels were checked at every appointment with dynamometer.

Pre- Intrusion and Post- Intrusion Records

At the beginning of treatment and at the end of intrusion, the following records were taken for each patient.

1. Lateral cephalograms and OPG with the orientation markers

Standard photographs [extraoral and intraoral]

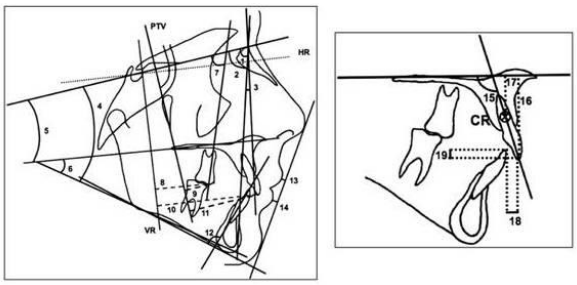

Fig 1: Two conventional lateral cephalometric head films of the patients.

Fig 2: Pre operative and post operative photograph.

Fig 3: No movement in the miniscrew group and molar moved distally average of 4.90 in intrusive arch group.

Evaluation of intrusion and anchorage loss

Standardized lateral cephalograms were taken before the mini implant and intrusive arch placement i.e. at the end of leveling and 5 months later at the end of intrusion. Each cephalogram was traced on 0.003 inch acetate paper with 0.3mm lead pencil. Two conventional lateral cephalometric head films of the patients, one at the beginning of treatment (T1) and the other at the end of intrusion (T2) were obtained. Twenty-one landmarks (Figure 1) were located, and measurements were made on the cephalometric tracings. Two vertical reference planes were constructed for measurement confirmation of the dental movements. The first reference was the pterygoid vertical (PTV) drawn perpendicular to the sella-nasion (SN) plane, and the second was drawn perpendicular to the constructed horizontal plane (7 to the SN plane) from the point of intersection of the anterior wall of sella turcica and the anterior clinoid process (VR). The center of resistance (CR) of the maxillary central incisor was determined for each patient rather than the CR of the anterior segment because of its ease of location and high reproducibility[19]. The CR of the maxillary central incisor was taken as the point located at one-third of the distance of the root length apical to the alveolar crest[20] (Figure 1).

Statistical analysis: One Sample Kolmogorov-Smirnov test results revealed that all the variables followed normal distribution. Therefore to analyze the data parametric analysis is used. To compare the mean values between implant and utility arch groups independent samples t-test was applied. To compare the mean values between T1 and T2 paired samples t-test was used.

RESULTS

The changes in the center of resistance of the incisors were 4.3 mm ($p < 0.001$) for group 1 and 4.3 mm ($p<0.001$) for group 2.The mean change in upper incisor to palatal plane angle the mean change was 10.9^0; $p<0.001$. The change in distance from upper molar to VR (mm) is 4.2 mm $p < 0.001$ The change in upper 1^{st} molar to SN plane angle in burstone intrusive arch was 4.9^0 (83.70± 2.264 to 78.80± 2.448) $p<0.001$. And in mini implant, the mean change of angle in upper incisor to palatal plane angle was 1^0 (71.40± 1.43 to 72.40 ± 1.506) $p> 0.001$ which was statistically not significant. The maxillary molar showed no movement in the miniscrew group (Figures 3,4,5).

DISCUSSION

The purpose of this study was to quantify overbite correction in such a way as to allow clinically relevant comparisons of two different intervention strategies. An intrusive force that is labial to the center of resistance of the incisors would intrude them but also tip them labially[21]. Labial tipping tends to decrease overbite because it influences the vertical incisal edge position[22-24], and depending on the original inclination of the incisors, it can be

Table 1: Comparison of T1 and T2 Group.

		T1 (mean+sd)	T2 (mean+sd)	P value
1.	SNA^0	81.80±2.440	80.50±2.506	0.010
2.	SNB^0	77.20±1.398	77.70±1.567	0.052
3.	ANB^0	4.60±2.27	3.10±2.18	0.010
4.	GOGNSN^0	29.20±2.044	28.10±2.079	0.012
5.	U1-PP^0	103.40±4.477	114.30±4.739	**<0.001**
6.	U1-PP(mm)	35.90±1.969	32.70±1.829	**<0.001**
7.	CR-PP(mm)	18.20±1.549	15.90±1.524	**<0.001**
8.	U1-PTV(mm)	68.20±1.989	72.00±2.000	**<0.001**
9.	UI-VR(mm)	89.20±3.7	94.10±4.012	**<0.001**
10.	U6-PTV(mm)	26.90±1.729	22.70±2.406	**<0.001**
11.	U6-VR(mm)	46.80±1.687	43.50±2.469	**<0.001**
12.	U6-SN^0	83.70±2.264	78.80±2.448	**<0.001**
13.	IMPA^0	100.70±4.270	101.60±4.812	0.029
14.	Over jet(mm)	6.90±1.595	8.70±0.949	**<0.001**
15.	Overbite(mm)	7.00±1.247	2.70±0.949	**<0.001**
16.	Ls-E-PLANE(mm)	5.50±1.434	5.10±1.449	0.037
17.	Li-E-PLANE(mm)	6.20±1.398	5.70±1.252	0.015

advantageous in deep bite correction[25]. Deep bite patients with at least a 4-mm closure of the maxillary incisors with the lower lip and a gummy smile need to be treated with intrusion of the maxillary incisors[26,27].

Conventional intrusion-arch mechanics frequently cause labial tipping of the incisors, which does not always[28] give favorable treatment outcomes. Counteracting movements in the molars are frequently inevitable. Reinforcement of posterior teeth by using rigid stainless steel arches was recommended to minimize the movement of the posterior anchorage unit by Burstone. Recent studies[29] have shown that with increasing age of patients, it is normal that the upper lip will cover more and more of the maxillary incisors. Correspondingly more of the mandibular incisors will show, associated with the aging process. The explanations for these changes are reduction of tonicity and gravity. The upper lip becomes longer and hides more and more of the maxillary incisors, whereas the drooping of the lower lip will expose gradually more of the mandibular incisors. As a consequence, show of maxillary incisors with relaxed lips signifies youth and beauty[30] whereas display of mandibular incisors is a characteristic of the elderly therefore anterior maxillary intrusion of upper teeth was selected.

Table 2: Comparison of T1 and T2 Group.

		T1 (mean+sd)	T2 (mean+sd)	P value
1.	SNA^0	82.40±1.646	80.20±2.150	0.021
2.	SNB^0	77.60±2.066	76.50±2.421	0.020
3.	ANB^0	4.70±0.949	3.70± 0.824	0.021
4.	GOGNSN^0	28.80±2.098	27.70±2.058	0.010
5.	U1-PP^0	115.20±2.251	117.90±1.969	0.025
6.	U1-PP(mm)	37.90±1.197	34.40±1.174	**<0.001**
7.	CR-PP(mm)	24.40±1.350	20.90±1.664	**<0.001**
8.	U1-PTV(mm)	64.50±1.434	65.20±1.033	0.025
9.	UI-VR(mm)	84.50±1.434	86.50±1.269	0.014
10.	U6-PTV(mm)	18.90±0.994	19.80±0.919	0.014
11.	U6-VR(mm)	38.90±0.994	39.70±0.949	0.014
12.	U6-SN^0	71.40±1.430	73.40±1.506	0.012
13.	IMPA^0	101.60±1.578	99.40±1.838	0.019
14.	Over jet(mm)	7.70±1.567	6.90±1.44	0.0018
15.	Overbite(mm)	6.60±1.265	2.20±1.135	**<0.001**
16.	Ls-E-PLANE(mm)	3.90±0.568	3.70±0.949	0.168
17.	Li-E-PLANE (mm)	4.20±1.033	3.80±0.789	0.037

Liou et al[31] demonstrated that the screws are clinically stable but not absolutely stationary when forces are loaded on them, which, in the case of implants, would be because of the correct osseointegration.

The objectives of the present study were to determine the amount of true incisor intrusion attained with intrusive arches and mini implant, to determine the change in inclination or torque of the incisors with both types of intrusion mechanics and to determine the amount of molar extrusion with both types of intrusion mechanics.

In this study the mean values were compared using paired sample t –test and the mean true incisor intrusion achieved with burstone intrusive arch was 4.3mm (7± 1.2 to 2.70±0.9) p<0.001 which is statistically significant. And true incisor intrusion achieved with mini implant was 4.4mm (6.60 ± 1.2 to 2.2 ± 1.13) p<0.001 which is statistically significant. But the difference in the intrusion achieved by burstone intrusive (2.70 ± 0.9) arch and mini implant (2.20 ± 1.13) is not statistically significant with p value of 0.299. Ohnishi et al[31] obtained 3.5 mm of incisor intrusion relative to the maxillary incisor tip. Kim et al applied a segmental intrusive force between the maxillary central incisors. The incisors were protruded relative to the Frankfort horizontal plane. The amounts of true maxillary incisor intrusion were not given in these articles. However, these results were in accordance with the results of conventional mechanics, and the clinical setup of these studies provided a base for this study. The amounts of true maxillary incisor intrusion were not given in these articles. Also, these results were in accordance with the results of conventional mechanics, and the clinical setup of these studies provided a base for our study.

The maxillary first molars showed no movement in the miniscrew group. Since the intrusive force was given with a tip-back bend in the utility arch, the maxillary first molars were tipped by 4.9^0 distally. Crown movement was minimized by

constraining the arch with a cinchback bend, but mesial root movement was seen. Bioprogressive therapy uses $45^0$of buccal root torque to obtain cortical anchorage. Since incorporating buccal root torque creates the risk of root resorption, it was not applied to the patients in this study. Due to the risk of distal molar tipping, reinforcement of the posterior segment was recommended in intrusion mechanics. DeVincenzo and Winn used a Nance appliance with intrusion arches and minimized the amount of molar movement. In segmented arch mechanics, the posterior anchorage unit was stabilized by using heavy stainless steel arch wires to counteract the movements produced during incisor intrusion And all the other variables included in the study like SNA, SNB, ANB, G_0GN/SN, IMPA, Ls-E-Plane, Li-E-Plane showed no significant variations in both the groups.

CONCLUSION

From the present study, with an aim to analyze the skeleto-dental changes occurring during deep overbite correction with mini implant and the burstone intrusive arch it was concluded that both the mini implant and the utility arches are equally effective in intrusion of upper incisors. Mini implant gives true intrusion. Vertical height of molars does not change much with Mini implant while molar extrusion can be seen with intrusive arch. Intrusive arch cause significant proclination whereas mini implant causes mild proclination of upper incisors. And the other variables like SNA, SNB, ANB, G_0GN/SN, IMPA, Ls-E-Plane, Li-E-Plane show no significant variations in both the group.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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