

Comparison of Skeletodental Changes Occurring during Deep Overbite Correction with Mini-Implant Anchorage System and the Utility Arches Reinforced by a Transpalatal Arch

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ABSTRACT

Deep overbite has potentially detrimental effects on mandibular and temporomandibular joint function and periodontal health as well as esthetics. Incisor intrusion can be achieved with various treatment modalities. The most commonly used is the utility arch technique. In mini-implant anchorage system, forces can be applied to produce tooth movement in any direction without detrimental reciprocal forces and does not depend on patient cooperation. Very few studies give a direct comparison between the effects of different types of incisor intrusion mechanics.

The aims and objectives of the study were to determine the amount of true incisor intrusion and torque change of the incisors and the molar extrusion attained with mini-implants and utility arch during a 6-month observation period. Fourteen patients with deep bite were selected for the study and were divided equally into the two groups which were treated with utility arch, reinforced with transpalatal arch and mini-implants. Mini-implants were found to be superior as compared to utility arch for intrusion of incisors and there was minimal change of incisor inclination with microimplants. The difference in the extrusion seen is not statistically significant.

Keywords: Deep bite, Intrusion, Utility arch, Micro-implants, TAD.

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INTRODUCTION

Deep overbite correction is often a major component of orthodontic treatment. Nonsurgical treatment alternatives include molar extrusion, incisor intrusion or a combination of both.¹

Incisor intrusion is indication for the management of deep bite combined with a gummy smile of varying degrees. More specifically, in cases where bite opening with orthodontic eruption of posterior teeth using biteplates or cervical headgear is contraindicated or unsuccessful, deep bite correction may only be achieved with incisor intrusion.² Patients with increased overjet and lower facial height, and at the same time displaying gummy smile and incisor exposure at lip rest, as in Class II

div 1 malocclusion, are perfect candidates for intrusion in order to improve esthetics.³ Since, it has been suggested that attractive smiles have zero gingival exposure, whereas gingival exposure of more than 2 mm results in significant esthetic compromise,⁴ hence deep bite correction with orthodontic eruption of posterior teeth does not contribute toward esthetic improvement. The outcome of orthodontic eruption is not stable, especially in adult patients with a small mandibular plane angle and strong masticatory system as shown clinically by the presence of strong masseter muscles and a rectangular face, due to the increased vertical component of the biting force that affects the stability of posterior eruption.⁵

In general, orthodontic intrusion in periodontal patients is a contradictory issue. Many authors dispute the benefits of such an approach and claim that it has negative effects on the periodontium,⁶ whereas others support the view that orthodontic treatment inhibits the progression of osseous loss.⁷ More recent studies concluded that a combination of periodontal treatment and orthodontic intrusion may improve periodontal status, given that the mechanics used and oral hygiene are carefully controlled.⁸ More specifically, the use of light orthodontic force is recommended because as the bone loss progresses, periodontal support is reduced and the same force now induces greater stress on the periodontal ligament as compared to a tooth with normal tissue support.⁹

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In mini-implant anchorage system, forces can be applied to produce tooth movement in any direction without detrimental reciprocal forces and do not depend on patient cooperation. Therefore, orthodontic treatment with miniscrew skeletal anchorage system has become increasingly popular. Very few studies give a direct comparison between the effects of different types of incisor intrusion mechanics. This study was performed to analyze the skeletodental changes occurring during deep overbite correction with mini-implant anchorage system, and the utility arches reinforced by a transpalatal arch.

AIMS AND OBJECTIVES

1. To determine the amount of true incisor intrusion attained with mini-implants and utility arch during a 6-month observation period.
2. To determine the change in inclination or torque of the incisors with both types of intrusion mechanics.
3. To determine the amount of molar extrusion.

METHODOLOGY

The sample of this study consisted of 14 patients with deep overbite and with increased upper incisor/anterior gingival display. An informed consent was taken, seven patients were treated with mini-implants in the interradicular bone in maxillary arch, and seven patients were treated with utility arches reinforced by a transpalatal arch.

The inclusion criteria were:

1. Patients with deep overbite and increased incisor/anterior gingival display.
2. No active growth left according to cervical vertebrae analysis.¹⁰

The exclusion criteria were:

1. Patients with active periodontal disease.
2. Severe craniofacial disorders, cleft lip and palate or extensive prosthetic appliances.
3. Medically compromised cases.

The sample patients were treated using PEA appliance with 0.022" slot Roth prescription. After the initial alignment of the incisors with 0.016" NiTi wire (approximately 2 months); mini-implants were placed in the first group and utility arches were placed in the second group of patients.

The first group of patients were treated with mini-implants of the self tapping variety (Leone implants 8 mm in length and 2 mm in diameter) (Fig. 1).

The surgical procedure is as follows:¹¹

- A surgical guide was made from a rectangular wire segment to help identify the mini-implant location on the IOPA (Figs 2 and 3)
- Under local anesthesia, a punch cut was given in the region of the labial frenum in between the maxillary central incisors to denude the alveolar bone. The bone corresponding to the guidewire was drilled with a 1.5 mm pilot drill using saline irrigation as far as the length of the mini-implant



Fig. 1: Armamentarium needed for mini-implant placement



Fig. 2: Intraoral guidewire placement

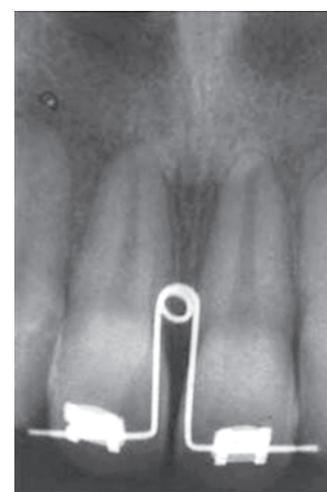


Fig. 3: IOPA to assess the position of the guidewire

- The implant was inserted using a miniature screw driver
- The position of the mini-implant was documented with an IOPA (Fig. 4)
- Postoperative antibiotics and analgesics were given to the patient.

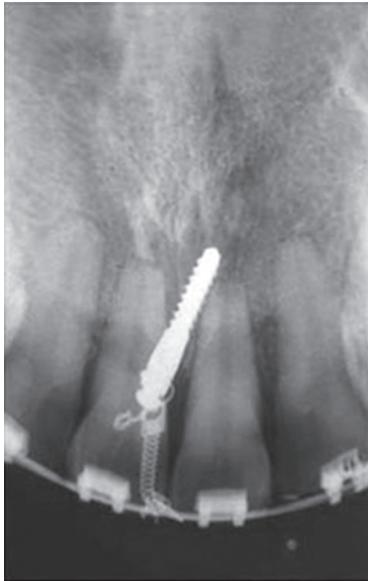
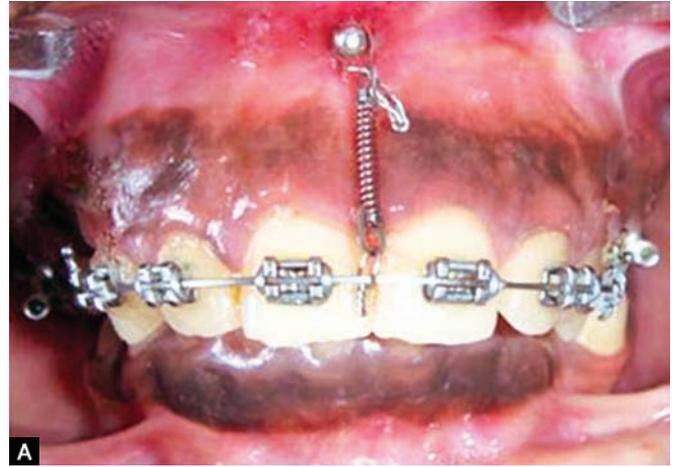


Fig. 4: IOPA after placement of the mini-implant



Figs 6A and B: (A) End of leveling, (B) end of intrusion using mini-implant anchorage



Figs 5A and B: (A) End of leveling, (B) end of intrusion using utility arch mechanics

After a healing period of 2 weeks,¹² the implant was loaded with a NiTi closed coil spring. A force of approximately 50 gm was applied from the spring to a 0.018" A J Wilcock base archwire connecting the four incisors and the first molars. The wire was cinched back on the molars to prevent flaring of the incisors.

The second group of patients was treated with a utility arch as described by Ricketts.¹³ After the initial alignment of the incisors, a utility arch (2×4 appliance) of the 0.016" × 0.022" TMA was fabricated and inserted. It was activated by a tip-back bend to deliver an intrusive force of approximately 50 gm. The wire was cinched back to prevent the flaring of the incisors. The molar anchorage was reinforced by a transpalatal arch.

Standardized lateral cephalograms were taken before the mini-implant and utility arch placement, i.e. at the end of leveling (T1) and at the end of intrusion 4 months later (T2) as seen intraorally in Figures 5A to 6B. Each cephalogram was traced on acetate paper with 0.3 mm lead pencil. Two linear and one angular measurement were selected for cephalometric analysis.

1. *Vertical position of the maxillary incisors:* Perpendicular distance from the midpoint between the incisal edge and the apex of the tooth along the long axis to the palatal plane (PP) was measured.¹
2. *Vertical position of the maxillary first molar:* Perpendicular distance from the mesiobuccal cusp tip of the molar (MB) to the palatal plane (PP) was measured.
3. *Change in the inclination of the maxillary incisors:* Angle between the long axis of the maxillary incisor and the sella-nasion plane (SN plane) was measured.

Due to the wide variation seen in the collected data, it was decided to use Mann-Whitney test. A ($p < 0.05$) confidence level was considered significant.

RESULTS

Maxillary Incisor Intrusion

The mean incisor intrusion achieved with mini-implants was 3.29 mm with standard deviation of 1.11 (Graph 1) and with utility arches it was 1.29 mm with standard deviation of 0.76, the p-value was 0.009. Therefore, the difference in the intrusion achieved by mini-implants and utility arches is highly significant.

Maxillary Molar Extrusion

The mean molar extrusion seen with mini-implants was 0.29 mm with standard deviation of 0.49, and with utility arches, it was 0.71 mm with standard deviation of 0.76, the p-value was 0.244 (Graph 2). Therefore, the difference in the extrusion seen is not statistically significant.

Change in Incisor Inclination

The mean of the change in incisor inclination is 0.14° with standard deviation of 2.04 and with utility arches it was

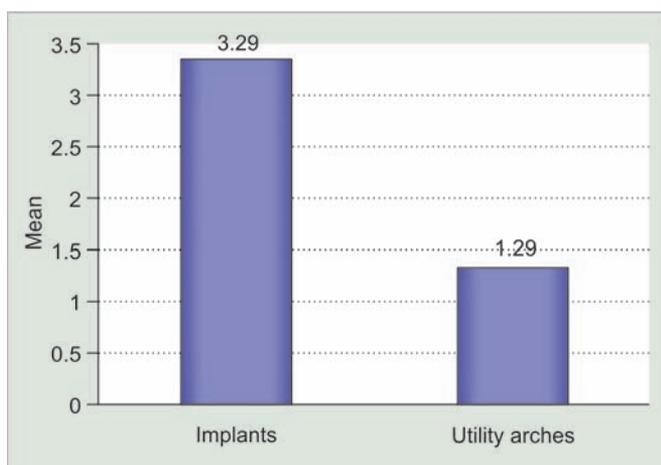
7.86° with standard deviation of 9.14, the p-value was 0.024 (Graph 3). Therefore, the difference seen between the two groups is significant.

DISCUSSION

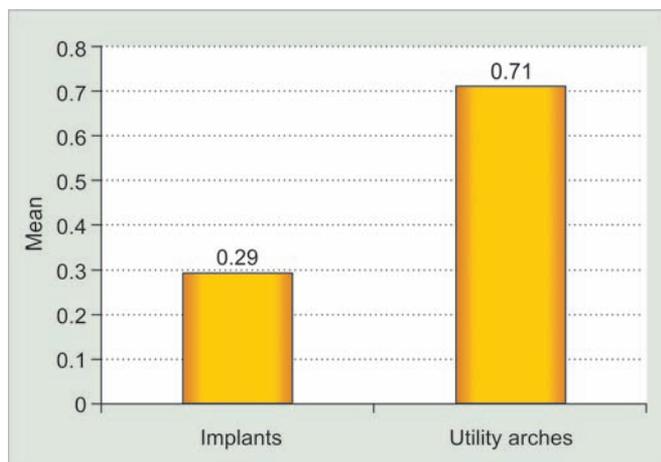
The purpose of this study was to quantify overbite correction, in such a way, as to allow clinically relevant comparisons of two different intervention strategies.

Deep bite case may be due to a reduced lower face height and lack of eruption of the posterior teeth or due to the over eruption of the anterior teeth.⁵ It is widely accepted that correction of deep bite by extrusion of posterior teeth is both more difficult to accomplish and less stable when it is performed on nongrowing patients than when it is attempted on those with appreciable growth remaining.¹⁴⁻¹⁶ Furthermore, if elongating the incisors will create an unesthetic gummy smile, it would be better to intrude the incisors to obtain proper gingival exposure.⁵ Therefore, our evaluation of the patients selected as the sample for our study led us to the conclusion that the deep bite and gummy smile would be improved by maxillary incisor intrusion.

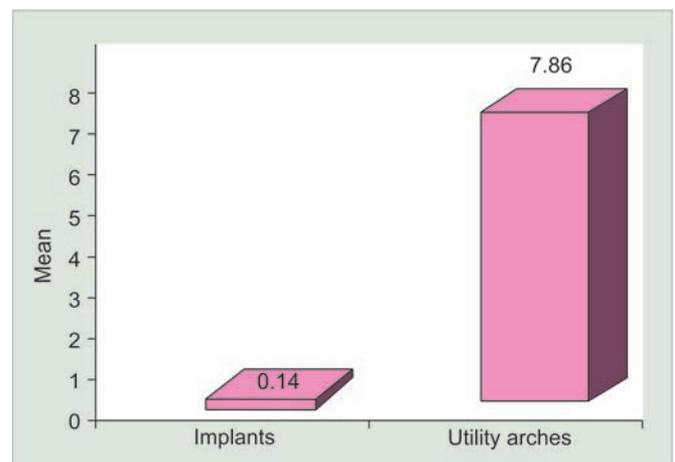
In our study, the mean true incisor intrusion achieved with mini-implants was 3.29 mm and with utility arches it was 1.29 mm. The p-value was 0.009. Therefore, the difference in the intrusion achieved by mini-implants and utility arches was highly significant. According to the meta-analysis conducted by Julia NG et al,¹⁷ true incisor intrusion attained during orthodontic treatment in nongrowing patients by the segmented arch technique was 1.5 mm of incisor intrusion in maxillary arch and 1.9 mm in the mandibular arch. Also, the results of our study are similar to the ones using mini-implants done by Creekmore²⁸ who intruded the maxillary incisors by 6 mm in one year by Kanomi¹¹ in which the mandibular incisors were intruded by 4 mm in 6 months, by Ohnishi et al¹⁸ who intruded maxillary incisors by 3.5 mm, by Kim et al¹⁹ who reported 4 mm of maxillary incisor intrusion in 7 months, and Omur Polat-Ozsoy²⁰ who reported 1.92 mm of upper incisor intrusion in 4.5 months.



Graph 1: Comparison of mean incisor intrusion by implants and utility arches



Graph 2: Comparison of mean molar extrusion by implants and utility arches



Graph 3: Comparison of mean change in incisor inclination by implants and utility arches

Utility arches¹³ used for incisor intrusion creates a force system that tends to elongate the molars.^{5,21} In actively growing patients with a good facial pattern, this is not a major problem. However, in nongrowing patients or those with a poor facial pattern (vertical growers), molar extrusion should be avoided. As a result, the lack of posterior anchorage compromises the ability to intrude the incisors. But, in our study, the mean molar extrusion seen with mini-implants was 0.29 mm and with utility arches it was 0.71 mm. The p-value is 0.244. Therefore, the difference in the extrusion seen was not statistically significant. Reinforcing the molars with a transpalatal arch in the group of patients treated with utility arches prevented the molars from extruding significantly. In the group of patients treated with mini-implants, since the molars were not used as a source of anchorage for the incisor intrusion, the reciprocal forces were not produced at the molars and therefore the side effect, like molar extrusion, was not seen.

The mean change in incisor inclination was 0.14° and with utility arches it was 7.86°. The p-value was 0.024. Therefore, the difference seen between the two groups was significant. The difference may be due to the fact that the point of force application with the utility arches is more labial to the center of resistance whereas in the case of mini-implants the force applied is very close to the center of resistance thus decreasing the moment generated that tends to flare the incisors.

Change in the inclination of incisors can bring about relative intrusion of the teeth. If true incisor intrusion is to be calculated, incisal edge cannot be used as a reference since change in the inclination of the crown will change the position of the incisal edge also. Therefore, incisal edge and the root apex are not good reference points. The incisor centroid, defined as a point on the longitudinal axis of the tooth that is independent of any change in inclination, is the reference point of choice.²³ Different approaches to localize the centroid have been reported.²²⁻²⁴ In our study, we used the midpoint between the incisal edge and the apex of the upper incisor^{1,24} and the palatal plane was used as the reference plane.^{23,24}

None of the implants showed mobility during the course of the treatment. This could be due to the fact that the patients were asked to maintain excellent oral hygiene and clean the region of the implants with chlorhexidine mouthwash to reduce plaque accumulation and thereby control inflammation which is a crucial factor for the clinical success of the mini-implant.²⁵

Mild external root resorption was seen in both groups of patients. Parker and Harris²⁶ found that incisor intrusion and apical displacement with lingual tipping are highly correlated with external root resorption compared to other types of tooth movement. Nanda and Costopoulos²⁷ found that low forces can cause dental intrusion sufficient to correct a deep bite with minimal apical resorption. Therefore, in our study, we used light continuous forces to bring about the desired tooth movement.

From the results of our study, it can be concluded that in order to reduce deep bite and gummy smiles intrusion of incisors followed by periodontal crown lengthening using implants is

more effective than using utility arches. Molar extrusion is not seen with implants or with utility arches that are reinforced by a transpalatal arch. Change in inclination of incisors does not change with mini-implants but significant change in the incisor inclination is seen with the utility arches.

CONCLUSION

From our present study, done with an aim to analyze the skeletodental changes occurring during deep overbite correction with mini-implant anchorage system and the utility arches reinforced by a transpalatal arch, it can be concluded that:

- The mini-implant technique for true incisor intrusion can be considered superior to the use of conventional utility arches.
- Vertical height of molars does not change significantly with implants or utility arches reinforced by a transpalatal arch.
- Inclination of incisors does not change with mini-implants but significant change in the incisor inclination is seen with the utility arches.

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