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RESEARCH ARTICLE

SIMULTANEOUS INTRUSION AND RETRACTION OF MAXILLARY ANTERIOR TEETH WITH ORTHODONTIC MINI IMPLANTS -A CLINICAL STUDY

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ABSTRACT

Introduction: Simultaneous intrusion and retraction results in correction of proclination of incisors, reduction in overjetand overbite with closure of space. This can be achieved by either orthodontic mini-implants. ***Aims and Objectives:*** To assess the skeletal, dental, soft tissue changes and amount of anchor loss during simultaneous intrusion and retraction with orthodontic mini-implants. ***Materials and Methods:*** Total 20 subjects were selected from the patients visiting department of orthodontics. Simultaneous intrusion and retraction was carried out using mini-implants. Two lateral cephalograms were taken one, at the beginning of the treatment (T1) and other at the completion of the retraction and intrusion (T2). ***Results*:** There was significant amount of intrusion and retraction with mini-implant. ***Conclusion:*** The mini-implants showed significant amount of retraction and intrusion of upper incisors, minimal extrusion of molars, minimal change in FMA and minimal amount of anchor loss.

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INTRODUCTION

Extraction closure is a particularly interesting aspect of orthod ontic treatment.[1] Space closure can be achieved either by en-masse retraction of anterior teeth or by individual canine retraction followed by retraction of incisors.[2] However in cases with increased inclination of incisors and increased overbite we need to intrude and retract the incisors simultaneously. Orthodontic tooth movement is result of appropriate forces applied to the teeth, while the reactive forces could result in reciprocal tooth movement which is likely to compromise the treatment outcomes. From past few years, temporary anchorage devices have been used in orthodontic treatment to reinforce anchorage, among which orthodontic mini-implant was most widely used. Mini implants have various advantages as they are cost effective, can be placed and removed easily, are small in size and thus can be used in most of the sites and thus are the most popular for absolute anchorage .[4] Intrusion and retraction of anterior teeth can be achieved with minimal side effects by using mini implants as anchorage.[5] Though in literature, various studies have been done on simultaneous intrusion and retraction but there are limited clinical studies to assess simultaneous intrusion and retraction by using mini implants.

Thus, the aim of the present study was to assess the treatment effects on the skeletal, dental, soft tissues and amount of anchor loss by using mini implants.

MATERIALS AND METHODS

The present study was done in the Department of Orthodontics and Dentofacial Orthopaedics.20 patients who wanted to receive dental treatment in the orthodontics department were incorporated in the study. Informed consent was taken from the patient, parent or guardian. This study received ethical approval from the Institutional research ethical committee.
The following inclusion and exclusion criteria:-

INCLUSION CRITERIA

- Angle's Class I or Class II Div. 1 malocclusion with orthognathic maxilla.
- Age of the patient 13years or more.
- Overjet/overbite of greater than 4mm.
- Extraction of first premolars.
- Except for the third molars no other teeth should be congenitally missing.

EXCLUSION CRITERIA

- Patient with trauma or craniofacial anomalies.

- Missing or impacted teeth in the anterior segment.
- Cleft lip and cleft palate patient.
- Subjects with severe anterior discrepancies.

Methodology: All patients were treated with MBT system (0.022"X0.028"). After the extraction of first premolars, TPA was given to reinforce the anchorage. Initial leveling and alignment were done and 0.019"X0.025" stainless steel arch wire were placed. To ensure that the wires were passive, they were left in place for at least 4 weeks before starting retraction and intrusion mechanics in both the groups.

MINI IMPLANT PLACEMENT

Fabrication of wire guide[6]: A wire guide was made from a rectangular wire segment of 0.019x 0.025 inch stainless steel. Three helices of 2–3 mm diameter were made as they were helpful in area determination. The wire guide was soldered onto the arch wire between the first molar and the second premolar on the buccal side using standard soldering procedure. A radiovisiograph was taken to confirm the correct position of the helices for the mini implant insertion.

Method of mini implant placement: The height of the mini implant was kept around 8-10 mm from the gingival margin between first molar and second premolar. After selection of implant location, height of mini-implant insertion site was measured using William's periodontal probe. After the administration of local anaesthesia, the wire guide was inserted between the first molar and the second premolar on the buccal side. The self-drilling mini implant was inserted through the helix of the wire guide between second premolar and first molar. Mini implant of 1.5 mm diameter and 8mm length was initially inserted perpendicular to the buccal surface, then was inserted at 45^0 to the long axis of the proximal tooth to increase the contact area between implant and cortical bone. Clockwise rotation of the mini implant using a manual driver was performed.[7]After the confirmation of accurate implant position, the wire guide was disengaged and then the mini implant was completely inserted. J hooks were soldered distal to the lateral incisor on 0.019"x 0.025" stainless steel archwire. The height of J-hook was kept less than that of mini-implants, so that both horizontal as well as vertical force vector were applied. An elastomeric module with ligature wire of 0.009 inch was tied between the J hook and to the head of the mini implant. Lateral cephalograms were taken for all the patients, before the start of treatment (T1) and at the end of the intrusion and retraction process (T2). All measurements on the lateral cephalogram were done twice by the same examiner to minimize the error of measurements as shown in Table I.

RESULTS

The results were obtained after statistically analyzing the data using SPSS (Version 21) software. Student's paired t-test was used to compare pre and post treatment measurements. The comparison of pre and post treatment mean values of the parameters are shown in Table II. The comparison of measurements of treatment changes among both the groups is shown in Table IV.

DISCUSSION

The simultaneous intrusion and retraction of anterior teeth can be achieved by orthodontic mini-implants.

The main aim of the treatment is to achieve the desired tooth movement while keeping in consideration the side effects, mini implants have come into use. The present study was done to assess the skeletal, dental and soft tissue changes and amount of anchor loss in the treatment outcomes by using orthodontic mini implants. The present study showed statistically significant ($p<0.05$) decrease in mean values of SNA,ANB, A-PTV as shown in Table II. There was a significant decrease in Group I because retraction of incisors with bodily movement is known to produce more bone remodeling as the force is passing near the centre of resistance of anterior teeth. These results were in accordance with the study done by Hariprashad A *et al* (2020)[3]and Verma P *et al* (2020)[8]. Further, on comparing the pre-treatment and post-treatment mean values of SNB,L1-NB,IMPA and Facial angle , decrease in the mean values were found to be statistically insignificant ($p>0.05$) as shown inTable II. There was no significant change in the mean values because in the present study we have placed implants only in the maxillary arch and retraction in mandibular arch was done using sliding mechanics.. So the treatment effects were observed only in the maxillary arch.These results were in accordance to the study done by Lee A *et al* (2011)[9] and Agnani S *et al* (2020)[10]**.**

Further, on comparing the pre-treatment and post-treatment mean values of SN-OP, FMA,Y-axis, Ar-Go-Me, GoGn-SN, ANS-Me and U6-PP , statistically insignificant difference ($p>0.05$) was found as shown in Table II. The insignificant change was due to no effect on the molar as the force application was through the mini-implants.These results were in accordance to the study done by Hariprashad A *et al* (2020)[3] and Agnani S *et al* (2020)[10]. Moreover, on comparing the pre-treatment and post-treatment mean values of U1-PTV, U1-NA(linear and angular),U1-SN,U1-L1 and Overjet in Group I and Group II, statistically significant difference ($p>0.05$) was found as shown in Table II.This decrease in the valueswas more because of closure of extraction space entirely by the retraction of anterior segment asanchorage was taken from mini implants. These results were in accordance with the study done by Hariprashad A *et al* (2020)[3],Agnani S *et al* (2020)[10] and Li F *et al* (2011)[11]. Further, on comparing the pre-treatment and post-treatment mean values of U1-PP, overbite, statistically significant difference ($p>0.05$) was found as shown in Table II.The significant decrease were found as intrusive force vector was applied in both the groups. But in Group I, the decrease was comparatively more because intrusive force was applied with the mini-implants which passes near the centre of resistance of anterior teeth.These results were in accordance to the study done by Verma P *et al* (2020)[8] and Kaushik A *et al* (2016)[12].

Further, on comparing the pre-treatment and post-treatment mean values of U6-SN,U6-PTV, statistically insignificant difference ($p>0.05$) was found as shown in Table II. Insignificant changewas due to the fact that maxillary first molar remained stable and upright throughout the retraction phase using the mini implants, as force was not applied on molar. These results were in accordance to the study done by Upadhyay M *et al* (2008)[13] and Agnani S et al(2020)[10]. Further, on comparing the pre-treatment and post-treatment mean values of Ls-E line and Nasolabial angle there was statistically significant difference ($p>0.05$) found as shown in Table II. The retraction of incisors and upper lip was more so the increase in the mean values were also more asposition of the upper lip which follows the incisors.

Table I. Dental, skeletal and soft tissue measurements used in the study

A.SKELETAL MEASUREMENTS [Figure 3 (A)]		
1.	SNA (°)	Angle formed between sella- nasion plane and the line joining nasion to point A
2.	SNB (°)	Angle formed between sella- nasion plane and the line joining nasion to point B
3.	ANB (°)	Angle formed between the line joining nasion to point A and the line joining nasion to point B.
4.	GoGn-SN (°)	Angle formed between the line joining gonion to gnathion and the sella-nasion plane.
5.	SN-OP angle(°)	Angle formed between sella-nasion plane to occlusal plane
6.	FMA(°)	Angle formed between frankfort horizontal plane and tangent to lower border of mandible
7.	Y axis(°)	Angle formed by line joining Sella-nasion plane and sella to gnathion.
8.	Ar-Go-Me(°)	Angle formed by line joining articulare to gonion and gonion to menton.
9.	A-PTV (mm)	Linear distance from point A to pterygoid vertical plane.
10.	ANS to Me(mm)	Linear distance from anterior nasal spine to menton.
B.DENTAL LINEAR MEASUREMENTS [Figure 3 (B)]		
1.	U1-PTV(mm)	Linear distance from the labial surface of upper incisor to pterygoid vertical plane
2.	U6-PTV(mm)	Linear distance from the mid point of the crown of upper molar to pterygoid vertical plane.
3.	U1- PP(mm)	Linear distance from the incisal edge of upper incisor to palatal plane
4.	U6-PP(mm)	Linear distance from mesial cusp of upper molar to palatal plane
5.	U1-NA(mm)	Linear distance between most anterior labial surface of upper central incisor to N-A line.
6.	LI-NB(mm)	Linear distance between most anterior labial surface of lower central incisor to N-B line.
7.	OVERJET	Linear distance between upper and lower incisors with reference to the upper occlusal plane
8.	OVERBITE	Vertical overlap of the upper and lower incisors.
C.DENTAL ANGULAR MEASUREMENTS [Figure 3 (B)]		
1.	U1-SN(°)	Angle formed between the long axis of upper incisor to sella-nasion plane
2.	U1- NA(°)	Angle formed between the long axis of upper incisor to N-A line
3.	U6-SN(°)	Angle formed between the mid point of crown of upper molar to sella-nasion plane
4.	U1-L1(°)	Angle formed between the long axis of upper incisor to the long axis of lower incisor.
5.	IMPA(°)	Angle formed between the long axis of lower incisors to mandibular plane.
D.SOFT TISSUE MEASUREMENTS [Figure 3 (A)]		
1.	Ls-E line(mm)	Linear distance from the labralesuperius toEsthetic line.
2.	FACIAL ANGLE(°)	Angle formed between FH plane and line joining soft tissue nasion to soft tissue pogonion.
3.	NASOLABIAL ANGLE(°)	Angle formed between the tangent to the base of nose & tangent to the upper lip.

Table II. comparison of pretreatment and post treatment mean values of the parameters in mini-implant

PARAMETERS	PRETREATMENT	POSTREATMENT	TEST OF SIGNIFICANCE	
	MEAN±SD	MEAN±SD	t value	p value
SKELETAL				
SNA (º)	81.3±4.16	78.7±4.08	15.9	**0.0001*****
SNB (º)	75.8±3.58	75.2±2.51	1.67	0.519
ANB (º)	5.5±1.96	3.3±1.25	6.73	**0.0001*****
GoGn-SN (°)	28±3.50	28.3±3.53	1.96	0.08
SN-OP angle(°)	16.2±2.0	16.6±1.7	1.81	0.1
FMA(°)	24.2±3.0	24.7±3.1	2.24	0.06
Y axis(°)	64.3±2.98	64.6±3.24	1.96	0.08
Ar-Go-Me(°)	127.1±3.07	127.4±2.95	1.96	0.08
A-PTV (mm)	53.5±1.78	50.8±1.81	12.65	**0.0001*****
ANS to Me(mm)	67.1±1.79	67.4±1.90	1.96	0.08
DENTAL LINEAR				
U1-PTV(mm)	56.2±1.32	52.4±1.35	10.48	**0.0001*****
U6-PTV(mm)	19.3±1.34	19.6±1.43	1.96	0.08
U1- PP(mm)	26.7±1.57	23.5±1.65	8.23	**0.001*****
U6-PP(mm)	18.7±1.49	18.9±1.37	1.5	0.168
U1-NA(mm)	9.0±0.77	5.2±0.18	9.77	**0.001*****
LI-NB(mm)	7±2.11	4.3±0.95	6.28	**0.001*****
OVERJET	6.4±1.84	3.1±0.74	6.98	**0.0001*****
OVERBITE	6.3±1.89	2.8±0.79	8.72	**0.0001*****
DENTAL ANGULAR				
U1-SN(°)	112.4±2.07	100.9±2.33	18.57	**0.0001*****
U1- NA(°)	38.4±3.20	25.4±1.26	15158	**0.0001****
U6-SN(°)	67.6±1.51	67.9±1.29	1.96	0.08
U1-L1(°)	113.1±5.99	129.5±2.68	12.44	**0.0001*****
IMPA(°)	98.5±2.84	90.2±1.75	16.07	**0.0001*****
SOFT TISSUE				
Ls-E line(mm)	3.0±0.84	0.9±0.66	17.5	**0.0001*****
FACIAL ANGLE(°)	89.3±1.77	88.9±1.52	0.88	0.39
NASOLABIAL ANGLE(°)	92.6±3.92	102.9±3.0	1.35	**0.0001*****

p<0.05 * statistically significant; p<0.001** statistically highly significant ;p<0.0001*** statistically very highly significant

Figure 1. Template soldered on archwire forpositioning of mini implant

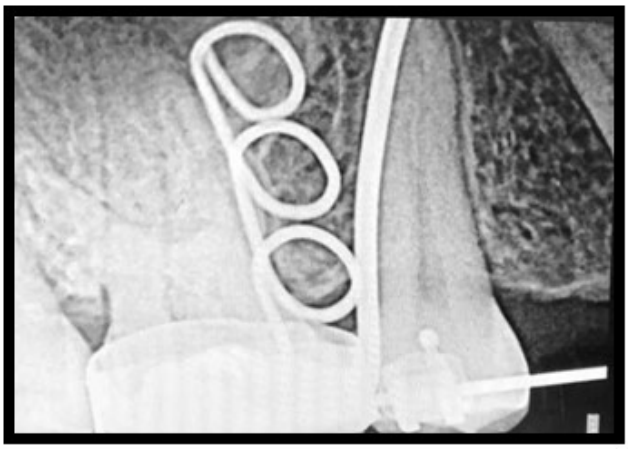

Figure 2(A). Intraoral periapical view of the soldered template

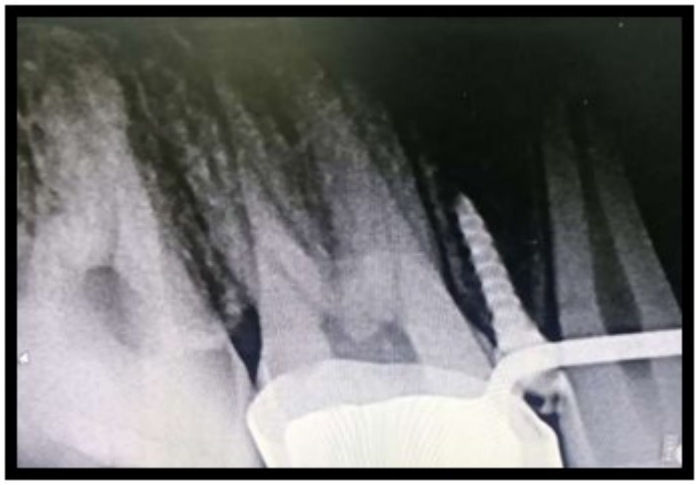

Figure 2(B). Intra oral periapicalview to check mini implant position

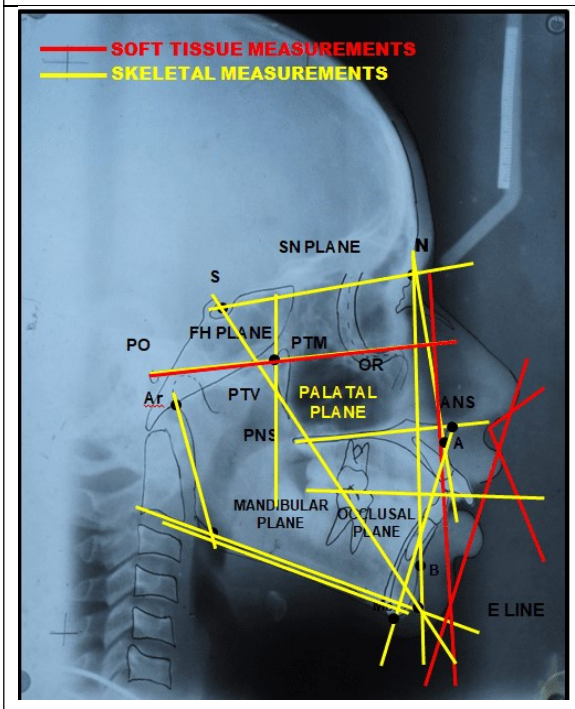

Figure 3(A). Lateral cephalogram showing skeletal and soft tissue parameters

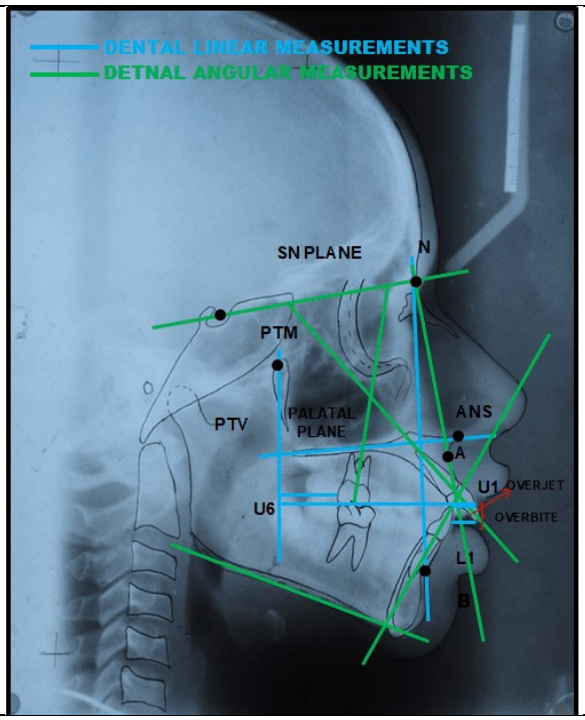

Figure 3(B). Lateral cephalogram showing dental angularand dental linear parameters

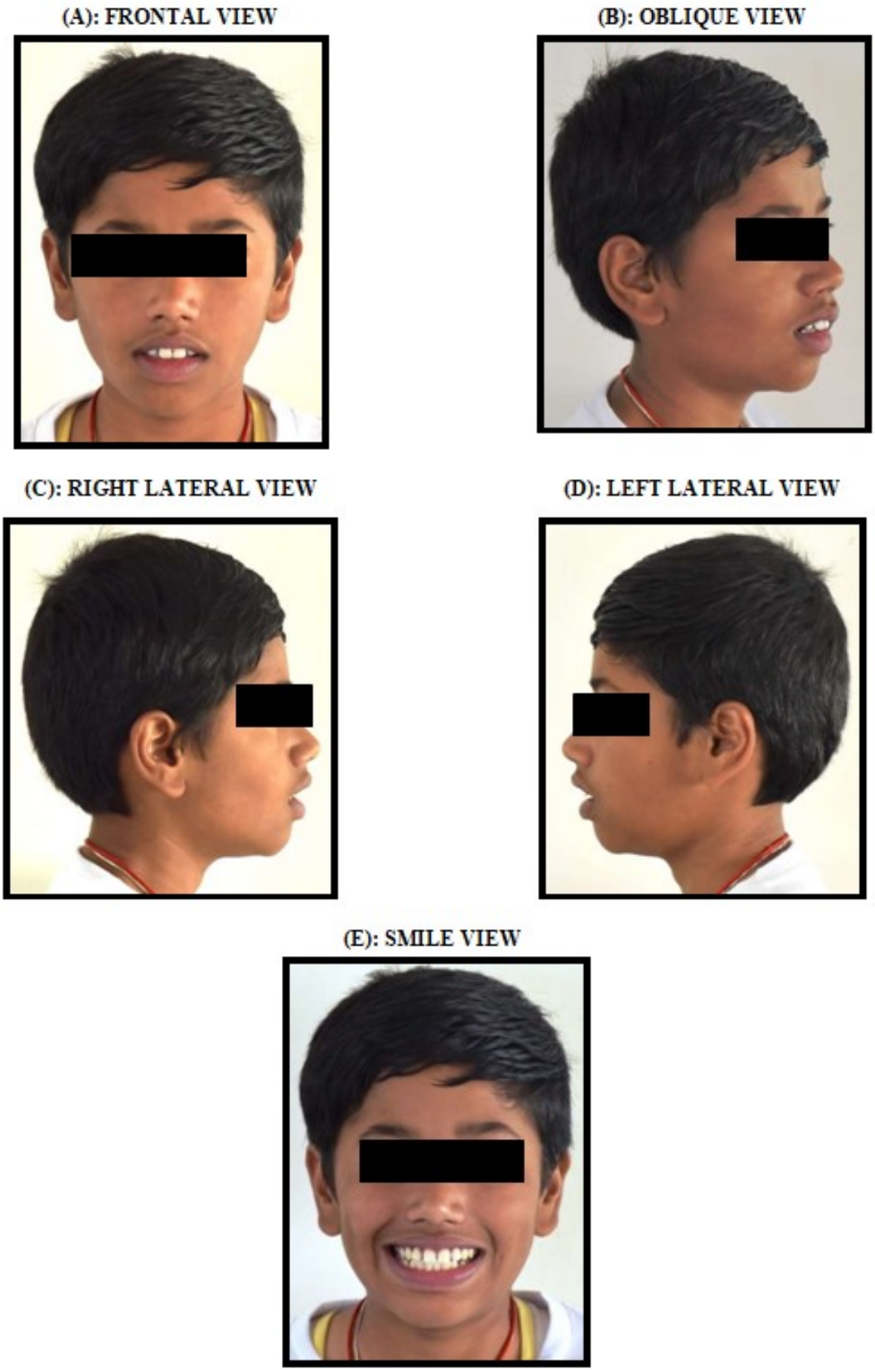

Figure 4. Pre-treatment extra oral photographs of patient treated with mini-implants mechanics

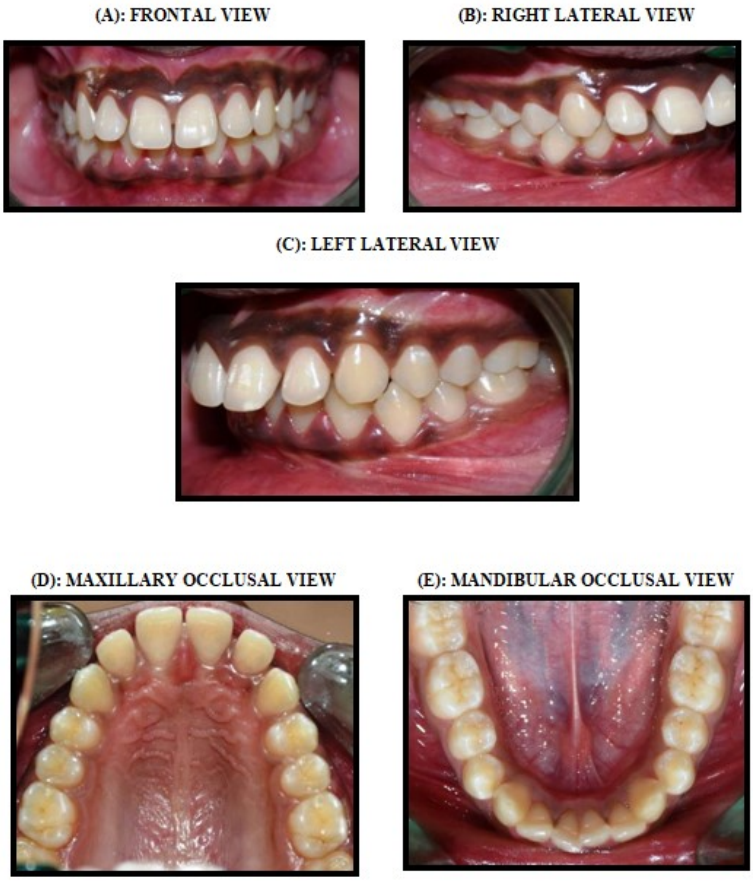

Figure 5. Pre-treatment intra oral photographs of patient treated with mini-implants mechanics

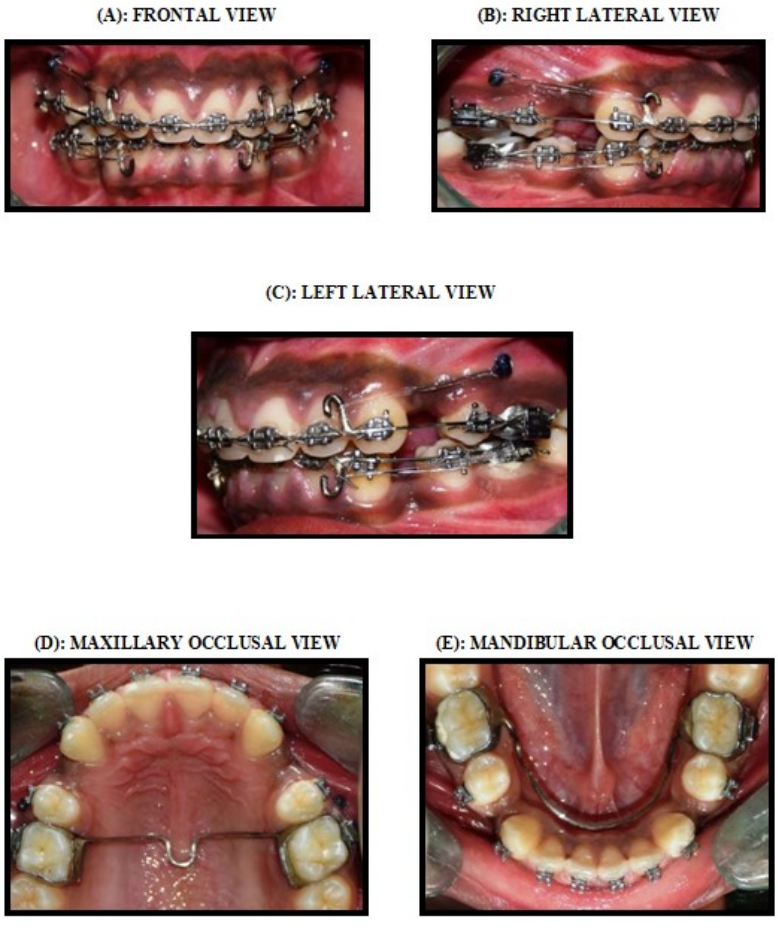

Figure 6. Mid treatment intraoral photographs of patient treated with mini-implant mechanics

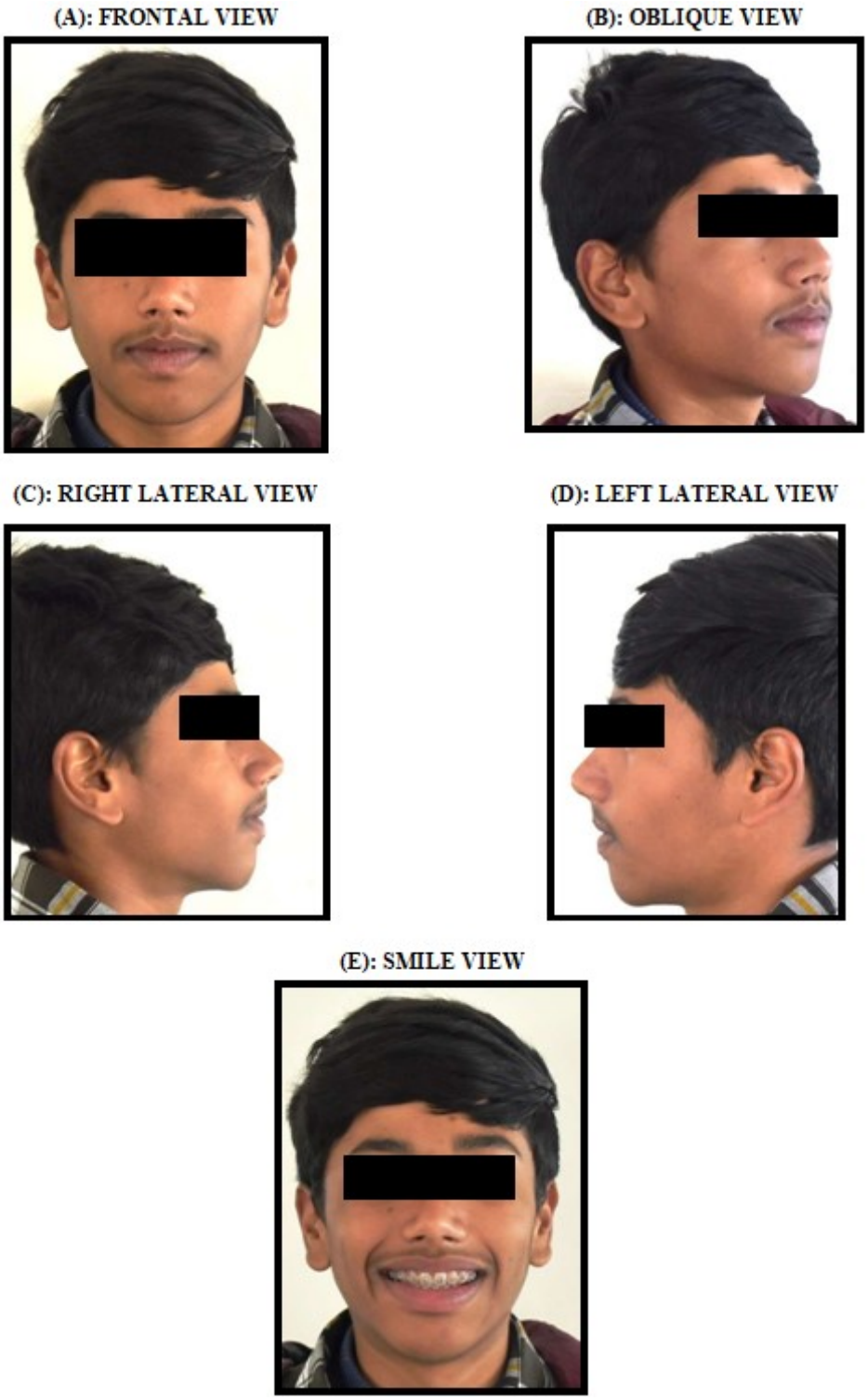

Figure 7. Post-treatment extra oral photographs of patient treated with mini-implant mechanics

These results were in accordance to the study done by Hariprashad A *et al* (2020)[6] and Goel P et al(2014)[14].

CONCLUSION

The conclusions drawn from the study were as follows

The mini-implants showed significant changes in dental, skeletal and soft tissues parameters with significant amount of retraction and intrusion of upper incisors, minimal extrusion of molars, minimal anchor loss, minimal change in FMA, minimal change in lower anterior facial height and maximum improvement in soft tissue profile.

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